
NAVFAC IGS-16402 (AUGUST 2002)

Preparing Activity: LANTNAVFACENGCOM Based on UFGS-16402N

ITALIAN GUIDE SPECIFICATIONS

Use for ITALIAN projects only

SECTION 16402

INTERIOR DISTRIBUTION SYSTEM

09/02

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

NOTE: This guide specification covers the requirements for the procurement, installation, and testing of electrical wiring systems for construction projects. Telecommunications cabling is covered in Section 16710, "Structured Telecommunications Cabling and Pathway System." These wiring systems primarily involve voltages of 1,000 volts and less and mainly involve interior systems. When voltages greater than 1,000 volts are brought into a facility, Section 16303, "Underground Electrical Work" Section 16360, "Secondary Unit Substations should be consulted and used as required. Requirements for materials and procedures for special or unusual design should be added as necessary to fit specific projects.

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

1. Location of equipment
2. Single-line diagrams elevations, limiting dimensions, and equipment ratings which are not covered in the specifications
3. Remote indicating or control requirements.

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.

ITALIAN ELECTROTECHNICAL COMMITTEE STANDARDS (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 14-8	(1999) Dry type power transformers
CEI 20-13;V1;V2	(1999;01;01) Rubber insulated cables with rated voltages between 1 kV and 30 kV
CEI 20-19/4	(1996) Rubber insulated cables of rated voltages up to and including 450/750V - Part 4: Cords and flexible cables
CEI 20-20/1	(2000) Polyvinyl chloride insulated cables of rated voltages up to and including 450/750V - Part 1: General requirements
CEI 20-22/2;V1	(1999;01) Tests on electric cables under fire conditions - Part 2: Fire propagation
CEI 20-25	(1997) Flat polyvinylchloride sheathed flexible lift cables
CEI 20-29	(1997) Conductors of insulated cables - Guide to the dimensional limits of circular conductors
CEI 20-33	(1998) Joints and terminals for cables with voltage U_0/U not exceeding 600/1000 V a.c. and 750 V d.c.
CEI 20-37/1	(1997) Tests on gases evolved during combustion of electric cables and their compounds - Part 1: Scope and general requirements
CEI 20-38/1	(1997) Fire retardant power cables with low emission of smokes and toxic corrosive gases, rubber insulated - Part 1 - Rated voltage U_0/U not exceeding 0,6/1 kV

CEI 20-39/1	(1999) Mineral insulated cables with a rated voltage not exceeding 750 V - Part 1: Cables
CEI 20-41	(1998) Undercarpet cables - Rated voltages U _o /U: 300/500 V
CEI 23-31	(1997) Trunking metallic systems and related accessories, cable trunking and carrying electrical appliances
CEI 23-32	(1997) Trunking insulating plastic material and related accessories for cable trunking and carrying electrical appliances, for ceiling and wall-mounting
CEI 23-48	(1998) General requirements for enclosures for accessories for household and similar fixed electrical installations
CEI 23-50	(1998) Plugs and socket-outlets for household and similar purposes - Part 1: General requirements
CEI 23-51	(1996) Requirements for the execution, check and tests on switchboards for household and similar fixed electrical installations
CEI 64-8;V1	(1998/01) Electrical installations of buildings
CEI 81-8	(2002) Electrical installations of buildings - Application guide for the selection and installation of the Surge Protective Devices

ITALIAN ELECTOTECHNICAL COMMITTEE TABLES (CEI UNEL)

NOTE: A CEI UNEL is an Italian electrical technical data base describing characteristics, dimensions and sizes of the electrical equipment in compliance with CEI Norms recognized by the Italian Law for the Italian territory.

UNEL 35024/2	(1997) Mineral insulated power cables for rated voltages not exceeding 1000 V a.c./1500 V d.c. - Continuous current capacities for cables laid in air
UNEL 35378	(1999) Fire retardant power cables, HEPR insulated, steel round or flat wire

armoured, PVC sheathed, having reduced emission of corrosive gases during combustion - Multicore cables with rigid conductors - Rated voltages $U_0/U: 0,6/1$ kV

UNEL 35379

(1999) Fire retardant power cables, HEPR insulated, steel tape armoured, PVC sheathed, having reduced emission of corrosive gases during combustion - Multicore cables with rigid conductors, rated voltages $U_0/U: 0.6/1$ kV

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.

UNI EN ISO 1461

(1999) Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods

CEI EN 50005

(1998) Low-voltage switchgear and controlgear for industrial use - Terminal marking and distinctive number - General rules

CEI EN 50086-1

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

CEI EN 50086-2-1

(1996) Conduit systems for electrical installations - Part 2-1: Particular requirements for rigid conduit systems

CEI EN 50086-2-3

(1996) Conduit systems for electrical installations - Part 2-3: Particular requirements for flexible conduit systems

CEI EN 50265-1

(1999) Common test methods for cables under fire conditions - Test for resistance to vertical flame propagation for a single insulated conductor or cable - Part 1: Apparatus

CEI EN 60034-1

(2000) Rotating electrical machines - Part 1: Rating and performance

CEI EN 60079-10	(1996) Electrical apparatus for explosive gas atmospheres - Part 10: Classification of hazardous areas
CEI EN 60079-14	(1998) Electrical apparatus for explosive gas atmospheres - Part 14: Electrical installations in hazardous areas (other than mines)
CEI EN 60269-1	(2000) Low-voltage fuses - Part 1: General requirements
CEI EN 60320-1	(1997) Appliance couplers for household and similar general purposes - Part 1: General requirements
CEI EN 60423	(1996) Conduits for electrical purposes - Outside diameters of conduits for electrical installations and threads for conduits and fittings
CEI EN 60439-1	(1998) Low-voltage switchgear and controlgear assemblies - Part 1: Type-tested and partially type-tested assemblies
CEI EN 60439-2	(1997) Low-voltage switchgear and controlgear assemblies - Part 2: Particular requirements for busbar trunking systems (busways)
CEI EN 60529/A1	(1997/00) Degrees of protection provided by enclosures (IP Code)
CEI EN 60669-1	(2000) Switches for household and similar fixed-electrical installations - Part 1: General requirements
CEI EN 60947-2/A1	(1997/99) Low voltage switchgear and controlgear - Part 2: Circuit breakers
CEI EN 60947-3	(2000) Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units
CEI EN 60947-4-1	(2002) Low voltage switchgear and controlgear - Part 4: Contactors and motor-starters - Section 1: Electromechanical contactors and motor-starters
CEI EN 60998-1	(1997) Connecting devices for low-voltage

circuits for household and similar purposes - Part 1: General requirements

CEI EN 61009-2-1

(1997) Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) - Part 2-1: Applicability of the general rules to RCBO's functionally independent of line voltage

QUALITY MARKS

CE

European Quality Mark

1.2 RELATED REQUIREMENTS

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 asterisk tokens follows a submittal item, it indicates Government approval for that item. Add "G" in asterisk tokens 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. For LANTNAVFACENCOM projects, retain the "G" following each submittal item. Specifier shall edit "G" for other EFD projects.

NOTE: Modify submittals paragraphs to ensure that an appropriate submittal is required for each item in the project.

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

SD-02 Shop Drawings

Busway; G

Cable trays; G

Panelboards; G

Transformers; G

Motor control centers; G

Wireways; G

SD-03 Product Data

Switches; G

Receptacles; G

Circuit breakers; G

Enclosed circuit breakers; G

Transformers; G

Motor controllers; G

Manual motor starters; G

Combination motor controllers; G

SD-06 Test Reports

600-volt wiring test; G

Transformer tests; G

Ground-fault receptacle test; G

Grounding system test; G

SD-07 Certificates

Fuses; G

SD-09 Manufacturer's Field Reports

NOTE: Ensure the following modifications have been made in Section 01330, "Submittal Procedures," paragraph entitled "SD-06 Test Reports": In line 2, change "by the contractor on an actual portion of the work or prototype" to "by the manufacturer on a prototype or an actual portion of the work." In line 1, change "of testing laboratory" to "of the manufacturers test facility or testing laboratory."

Transformer factory tests

[SD-10 Operation and Maintenance Data

NOTE: Delete SD-10 and its subparagraph unless special equipment is added to the section which requires O&M manuals.

Electrical Systems, Data Package 5; G

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data" and as specified herein.

]1.4 QUALITY ASSURANCE

1.4.1 Fuses

Submit coordination data as specified in article entitled, "FUSES" of this section.

[1.5 MAINTENANCE

NOTE: Delete subparagraph unless special equipment is added to the section which requires O&M manuals.

1.5.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

- a. Single line diagram of the "as-built" building electrical system.
- b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).
- c. Manufacturers' operating and maintenance manuals on active electrical equipment.

]PART 2 PRODUCTS

2.1 SOURCE MANUFACTURERS

2.1.1 Rigid Steel Conduit (Zinc-coated)

The following manufacturers provide zinc-coated rigid steel conduit that generally comply with these specifications:

Jannanone Fero Tubi
Via Migliolio 10/12
20090 Segrate (MI)
Tel: 02-26921377
Fax: 02-21355590

Legrand S.p.a.

Zona Industriale D5
15047 Spinetta Marengo (AL)
Tel: 0131/245001
Fax: 0131/245688

2.1.2 Rigid Nonmetallic Conduit

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

Dielectrix Italia
Via E. Pavese, 53
29015 Castel San Giovanni (PC)
Tel: 0523-882241

Gewiss S.p.A..
Via Alessandro Volta 1
24069 Cenate Sotto (BG)
Tel: 035-946111
Fax: 035-945222

2.1.3 Flexible Metal Conduit

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

Cortem
Via Ippoliti Nievo 61
00153 Roma
Tel: 06-5803523
Fax: 06-5816348

Legrand S.p.a.
Zona Industriale D5
15047 Spinetta Marengo (AL)
Tel: 0131/245001
Fax: 0131/245688

2.1.4 Liquid-tight Flexible Metal Conduit, Steel

The following manufacturers provide liquid-tight flexible metal steel conduit that generally comply with these specifications:

Cortem
Via Ippoliti Nievo 61
00153 Roma
Tel: 06-5803523
Fax: 06-5816348

Legrand S.p.a.
Zona Industriale D5
15047 Spinetta Marengo (AL)
Tel: 0131/245001
Fax: 0131/245688

2.1.5 Flexible Nonmetallic Conduit

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

Dielectrix Italia
Via E. Pavese, 53
29015 Castel San Giovanni (PC)
Tel: 0523-882241

Legrand S.p.a.
Zona Industriale D5
15047 Spinetta Marengo (AL)
Tel: 0131/245001
Fax: 0131/245688

2.1.6 Fittings for Flexible Metal Conduit

The following manufacturers provide fittings for flexible nonmetallic conduit that generally comply with these specifications:

Cortem
Via Ippoliti Nievo 61
00153 Roma
Tel: 06-5803523
Fax: 06-5816348

Legrand S.p.a.
Zona Industriale D5
15047 Spinetta Marengo (AL)
Tel: 0131/245001
Fax: 0131/245688

2.1.7 Fittings for Rigid Metal Conduit

The following manufacturers provide fittings for rigid metal conduit that generally comply with these specifications:

Cortem
Via Ippoliti Nievo 61
00153 Roma
Tel: 06-5803523
Fax: 06-5816348

Legrand S.p.a.
Zona Industriale D5
15047 Spinetta Marengo (AL)
Tel: 0131/245001
Fax: 0131/245688

2.1.8 Fittings for Flexible Liquid-tight Metal Conduit

The following manufacturers provide fittings for flexible liquid-tight type

metal conduit that generally comply with these specifications:

Cortem
Via Ippoliti Nievo 61
00153 Roma
Tel: 06-5803523
Fax: 06-5816348

Legrand S.p.a.
Zona Industriale D5
15047 Spinetta Marengo (AL)
Tel: 0131/245001
Fax: 0131/245688

2.1.9 Fittings for Rigid Nonmetallic Conduit

The following manufacturers provide fittings for rigid nonmetallic conduit that generally comply with these specifications:

Dielectrix Italia
Via E. Pavese, 53
29015 Castel San Giovanni (PC)
Tel: 0523-882241

Legrand S.p.a.
Zona Industriale D5
15047 Spinetta Marengo (AL)
Tel: 0131/245001
Fax: 0131/245688

2.1.10 Fittings for Flexible Nonmetallic Conduit

The following manufacturers provide fittings for flexible nonmetallic conduit that generally comply with these specifications:

Dielectrix Italia
Via E. Pavese, 53
29015 Castel San Giovanni (PC)
Tel: 0523-882241

Legrand S.p.a.
Zona Industriale D5
15047 Spinetta Marengo (AL)
Tel: 0131/245001
Fax: 0131/245688

2.1.11 Surface Metal Raceway

The following manufacturers provide surface metal raceway that generally comply with these specifications:

Bocchiotti
Piazza Daute 8
16121 Genova

Tel: 010-57131
Fax: 010-565757

BTicino S.p.A.
Via Messina, 38
20154 Milano
WEB Site: www.bticino.it

2.1.12 Surface Nonmetallic Raceway

The following manufacturers provide surface nonmetallic raceway that generally comply with these specifications:

BTicino S.p.A.
Via Messina, 38
20154 Milano
WEB Site: www.bticino.it

Panduit
Via V. Veneto 46
67051 Avezzano (AQ)
Tel: 0863-441777

2.1.13 Busway

The following manufacturers provide feeder and plug-in busways that generally comply with these specifications:

Telemacanique
Via Silvio D'Amico 40
06145 Roma
Tel: 06-549251
Fax: 06-5411863

Zucchini
Via Conicchio 34
25136 Stocchetta (BS)
Tel: 030-2006107
Fax: 030-2009726

2.1.14 Trough-Type Cable Trays

The following manufacturers provide trough-type cable trays that generally comply with these specifications:

Cagnoni & Zambelli
Via S.S. Martino e Severo, 36
45030 Crespino (RO)
Tel: 0425-775177

Legrand S.p.a.
Zona Industriale D5
15047 Spinetta Marengo (AL)
Tel: 0131/245001

Fax: 0131/245688

2.1.15 Ladder-Type Cable Trays

The following manufacturers provide ladder-type cable trays that generally comply with these specifications:

Cagnoni & Zambelli
Via S.S. Martino e Severo, 36
45030 Crespino (RO)
Tel: 0425-775177

Carpaneto Sati
Via Ferrero 10
10090 Via Casaina Vica (TO)
Tel: 011-9590111
Fax: 011-9590200

2.1.16 Channel-Type Cable Trays

The following manufacturers provide channel-type cable trays that generally comply with these specifications:

Cagnoni & Zambelli
Via S.S. Martino e Severo, 36
45030 Crespino (RO)
Tel: 0425-775177

Legrand S.p.a.
Zona Industriale D5
15047 Spinetta Marengo (AL)
Tel: 0131/245001
Fax: 0131/245688

2.1.17 Solid Bottom-Type Cable Trays

The following manufacturers provide solid bottom-type cable trays that generally comply with these specifications:

Cagnoni & Zambelli
Via S.S. Martino e Severo, 36
45030 Crespino (RO)
Tel: 0425-775177

Legrand S.p.a.
Zona Industriale D5
15047 Spinetta Marengo (AL)
Tel: 0131/245001
Fax: 0131/245688

2.1.18 Outlet Boxes and Covers

The following manufacturers provide outlet boxes and covers that generally comply with these specifications:

BTicino S.p.A.
Via Messina, 38
20154 Milano
WEB Site: www.bticino.it

Vimar S.r.l.
Via IV Novembre, 32
36063 Marostica (VI)
Tel. (0424) 488100
WEB Site: www.vimar.it

2.1.19 Floor Outlet Boxes

The following manufacturers provide floor outlet boxes that generally comply with these specifications:

Bocchiotti
Piazza Daute 8
16121 Genova
Tel: 010-57131
Fax: 010-565757

BTicino S.p.A.
Via Messina, 38
20154 Milano
WEB Site: www.bticino.it

2.1.20 Cabinets, Junction Boxes, and Pull Boxes

The following manufacturers provide electrical cabinets, junction boxes, and pull boxes that generally comply with these specifications:

BTicino S.p.A.
Via Messina, 38
20154 Milano
WEB Site: www.bticino.it

Vimar S.r.l.
Via IV Novembre, 32
36063 Marostica (VI)
Tel. (0424) 488100
WEB Site: www.vimar.it

2.1.21 Wires and Cables

The following manufacturers provide electrical conductors, insulation, bonding conductors, service entrance cables, fireproof cables, and cable tray cable that generally comply with these specifications:

Ceat Cavi Industrie
Largo Regio Parco, 9
10100 Torino
Tel: 011-26081

Pirelli Cavi S.p.A.
Viale Sarca, 222
20126 Milano
Tel:02-64422916

2.1.22 Armoured Cable

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

Ceat Cavi Industrie
Largo Regio Parco, 9
10100 Torino
Tel: 011-26081

General Cavi
Via Leonardo Da Vinci 61A
44011 Argenta (FE)
Tel: 0545-988623
Fax: 0545-988613

2.1.23 Mineral-Insulated and Metal-Sheathed Cable

The following manufacturers provide mineral-insulated and metal-sheathed electrical cable that generally comply with these specifications:

Europa Metalli
Via della Repubblica, 257
55052 Fornaci di Barga (LU)
Tel: (0583) 701407

2.1.24 Flat Conductor Cable

The following manufacturers provide flat electrical conductor cable that generally comply with these specifications:

Camuna Cavi
Via General Treboldi 128
25048 Edolo (BS)
Tel: 0364-770077
Fax: 0364-770120

Pirelli Cavi S.p.A.
Viale Sarca, 222
20126 Milano
Tel:02-64422916

2.1.25 Splices and Termination Components

The following manufacturers provide electrical splice and termination components that generally comply with these specifications:

Pirelli Cavi S.p.A.

Viale Sarca, 222
20126 Milano
Tel:02-64422916

NEXANS
via Piagarini 24
00162 Roma
Tel: 06-44235621
Fax: 06-44236338

2.1.26 Device Plates

The following manufacturers provide device plates that generally comply with these specifications:

BTicino S.p.A.
Via Messina, 38
20154 Milano
WEB Site: www.bticino.it

Vimar S.r.l.
Via IV Novembre, 32
36063 Marostica (VI)
Tel. (0424) 488100
WEB Site: www.vimar.it

2.1.27 Toggle Switches

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

BTicino S.p.A.
Via Messina, 38
20154 Milano
WEB Site: www.bticino.it

Vimar S.r.l.
Via IV Novembre, 32
36063 Marostica (VI)
Tel. (0424) 488100
WEB Site: www.vimar.it

2.1.28 Disconnect Switches

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

GE Power Controls Italia S.p.A.
Via Tortona, 27
20144 Milano
Tel: 02-4242.1
Fax: 02-42.42.502

Gewiss S.p.A..

Via Alessandro Volta 1
24069 Cenate Sotto (BG)
Tel: 035-946111
Fax: 035-945222

2.1.29 Receptacles and GFI Receptacles

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

BTicino S.p.A.
Via Messina, 38
20154 Milano
WEB Site: www.bticino.it

Vimar S.r.l.
Via IV Novembre, 32
36063 Marostica (VI)
Tel. (0424) 488100
WEB Site: www.vimar.it

2.1.30 Special Purpose Receptacles

The following manufacturers provide special purpose electrical receptacles that generally comply with these specifications:

Gewiss S.p.A..
Via Alessandro Volta 1
24069 Cenate Sotto (BG)
Tel: 035-946111
Fax: 035-945222

Palazzoli S.p.A.
Via F. Palazzoli, 31
25128 Brescia, Italy
Tel: 39-030-2015.1
Fax: 39-030-2015.217

2.1.31 Plugs

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

BTicino S.p.A.
Via Messina, 38
20154 Milano
WEB Site: www.bticino.it

Vimar S.r.l.
Via IV Novembre, 32
36063 Marostica (VI)
Tel. (0424) 488100
WEB Site: www.vimar.it

2.1.32 Panelboards

The following manufacturers provide panelboards and panelboard buses that generally comply with these specifications:

BTicino S.p.A.
Via Messina, 38
20154 Milano
WEB Site: www.bticino.it

Merlin Gerin
Via Silvio D'Amico 40
00145 Roma
Tel: 06-549251
Fax: 06-5411863

2.1.33 Circuit Breakers

The following manufacturers provide circuit breakers that generally comply with these specifications:

BTicino S.p.A.
Via Messina, 38
20154 Milano
WEB Site: www.bticino.it

Merlin Gerin
Via Silvio D'Amico 40
00145 Roma
Tel: 06-549251
Fax: 06-5411863

2.1.34 Circuit Breakers with GFI

The following manufacturers provide GFI type circuit breakers that generally comply with these specifications:

Merlin Gerin
Via Silvio D'Amico 40
00145 Roma
Tel: 06-549251
Fax: 06-5411863

2.1.35 Fusible Switches for Panelboards

The following manufacturers provide fusible switches for panelboards that generally comply with these specifications:

Legrand S.p.a.
Zona Industriale D5
15047 Spinetta Marengo (AL)
Tel: 0131/245001
Fax: 0131/245688

Schneider Electric S.p.A.
20041 Agrate (MI) Italia
Tel: 39-6558111
Fax: 39-6056900

2.1.36 Motor Circuit Protectors

The following manufacturers provide electric motor circuit protectors that generally comply with these specifications:

ABB S.p.A Milano
20137 Piazzale Lodi, 3
Tel. (39) 025797 2330
Web site: www.abb.it

Merlin Gerin
Via Silvio D'Amico 40
00145 Roma
Tel: 06-549251
Fax: 06-5411863

2.1.37 Fuses

The following manufacturers provide fuses that generally comply with these specifications:

Legrand S.p.a.
Zona Industriale D5
15047 Spinetta Marengo (AL)
Tel: 0131/245001
Fax: 0131/245688

2.1.38 Transformers

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

Ideomat Italia
Via L. Perosi 218
41100 (MO)
Tel: 059-373017
Fax: 059-373014

Trafomec S.p.A.
Taverville Di Panicale - Via Piexaiola
Z1 06068 Perugia, Italy
Tel: 39-075-835371
Fax: 39-075-8355835

2.1.39 Motors

The following manufacturers provide electric motors that generally comply with these specifications:

ABB S.p.A Milano
20137 Piazzale Lodi, 3
Tel. (39) 025797 2330
Web site: www.abb.it

Siemens
Wittelsbacherplatz 2
D-80333 Munich
Federal Republic of Germany
Tel: 49-89-63600
Web site: www.siemens.com
www.siemens.it

2.1.40 Motor Controllers

The following manufacturers provide electric motor controllers that generally comply with these specifications:

GE Power Controls Italia S.p.A.
Via Tortona, 27
20144 Milano
Tel: 02-4242.1
Fax: 02-42.42.502

Telemacénique
Via Silvio D'Amico 40
06145 Roma
Tel: 06-549251
Fax: 06-5411863

2.1.41 Multiple-Speed Motor Controllers

The following manufacturers provide multiple-speed electric motor controllers that generally comply with these specifications:

GE Power Controls Italia S.p.A.
Via Tortona, 27
20144 Milano
Tel: 02-4242.1
Fax: 02-42.42.502

Telemacénique
Via Silvio D'Amico 40
06145 Roma
Tel: 06-549251
Fax: 06-5411863

2.1.42 Reversible Motor Controllers

The following manufacturers provide reversible motor controllers that generally comply with these specifications:

GE Power Controls Italia S.p.A.
Via Tortona, 27

20144 Milano
Tel: 02-4242.1
Fax: 02-42.42.502

Telemacénique
Via Silvio D'Amico 40
06145 Roma
Tel: 06-549251
Fax: 06-5411863

2.1.43 Pushbutton Stations

The following manufacturers provide pushbutton stations that generally comply with these specifications:

GE Power Controls Italia S.p.A.
Via Tortona, 27
20144 Milano
Tel: 02-4242.1
Fax: 02-42.42.502

Siemens S.p.A.
Viale Piero e Alberto Pirelli, 10
20126 Milano - CAP 17154 - 20170 Milano
Tel: 02-66761
Fax: 02-66763416

2.1.44 Pilot and Indicating Lights

The following manufacturers provide pilot and indicating lights that generally comply with these specifications:

GE Power Controls Italia S.p.A.
Via Tortona, 27
20144 Milano
Tel: 02-4242.1
Fax: 02-42.42.502

Siemens S.p.A.
Viale Piero e Alberto Pirelli, 10
20126 Milano - CAP 17154 - 20170 Milano
Tel: 02-66761
Fax: 02-66763416

2.1.45 Reduced-voltage Controllers

The following manufacturers provide reduced-voltage electrical controllers that generally comply with these specifications:

Telemacénique
Via Silvio D'Amico 40
06145 Roma
Tel: 06-549251
Fax: 06-5411863

2.1.46 Manual Motor Starters

The following manufacturers provide manual motor starters (motor rated switches) that generally comply with these specifications:

GE Power Controls Italia S.p.A.
Via Tortona, 27
20144 Milano
Tel: 02-4242.1
Fax: 02-42.42.502

Schneider Electric S.p.A.
20041 Agrate (MI) Italia
Tel: 39-6558111
Fax: 39-6056900

2.1.47 Motor Control Centers

The following manufacturers provide electric motor control centers and bus systems that generally comply with these specifications:

BTicino S.p.A.
Via Messina, 38
20154 Milano
WEB Site: www.bticino.it

Magrini Galileo
Via Silvio D'Amico 40
00145 Roma
Tel: 06-549251
Fax: 06-5411863

2.1.48 Combination Motor Controllers

The following manufacturers provide combination electric motor controllers that generally comply with these specifications:

Telemacénique
Via Silvio D'Amico 40
06145 Roma
Tel: 06-549251
Fax: 06-5411863

2.1.49 Terminal Cabinets

The following manufacturers provide terminal cabinets that generally comply with these specifications:

Quante Trucco S.p.A.
Via della Liberazione, 1
20068 Peschiera Borromeo (MI) Italy
Tel: 39-02-553621
Fax: 39-02-55306967/55362265

Schneider Electric S.p.A.
20041 Agrate (MI) Italia
Tel: 39-6558111
Fax: 39-6056900

2.1.50 Grounding and Bonding Equipment

The following manufacturers provide grounding and bonding equipment that generally comply with these specifications:

Furse
Via Ippolito Nievo 61
00159 Roma
Tel: 06-5803523
Fax: 06-5816348

Gruppo Carpaneto Sati
via Ferro 10
10090 Cascilia Vica - Rivoli (TO)
Tel: 011-9590111
Fax: 011-9590200

2.1.51 Hazardous Locations

The following manufacturers provide electrical equipment for hazardous locations that generally comply with these specifications:

Cortem
Via Ippoliti Nievo 61
00153 Roma
Tel: 06-5803523
Fax: 06-5816348

Italsmea S.p.A.
via Per Cernusco, 15
20060 Bussero (MI) - Italy
Tel: 39-02-9500151
Fax: 39-02-95039102

2.1.52 Transient Voltage Surge Suppressors

The following manufacturers provide transient voltage surge suppressors that generally comply with these specifications:

Merlin Gerin
Via Silvio D'Amico 40
00145 Roma
Tel: 06-549251
Fax: 06-5411863

Gruppo Carpaneto Sati
via Ferro 10
10090 Cascilia Vica - Rivoli (TO)

Tel: 011-9590111
Fax: 011-9590200

2.2 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of CEI, where CEI standards are established for those items, and requirements of CEI 64-8;V1 and shall be CE listed.

2.3 CONDUIT AND FITTINGS

CEI EN 50086-1. Shall conform to the following:

2.3.1 Rigid Metallic Conduit

2.3.1.1 Rigid Steel Conduit (Zinc-Coated)

CEI EN 50086-2-1, Heavy Duty Type [H].

2.3.2 Rigid Nonmetallic Conduit

NOTE: Provide "Medium Duty Type [M]" conduits in commercial applications and when encased in a wall. Provide "Heavy Duty Type [H]" conduits in industrial applications and when exposed.

CEI EN 50086-1 and CEI EN 50086-2-1, PVC [Medium] [Heavy] Duty Type[M] [H], rigid, in accordance with CEI EN 50086-1.

2.3.3 Flexible Metal Conduit

CEI EN 50086-2-3.

2.3.3.1 Liquid-Tight Flexible Metal Conduit, Steel

CEI EN 50086-2-3.

2.3.4 Flexible Nonmetallic Conduit

CEI EN 50086-2-3.

2.3.5 Fittings for Flexible Metal Conduit

Ferrous fittings shall be cadmium- or zinc-coated in accordance with CEI EN 50086-1 and CEI EN 50086-2-3.

2.3.5.1 Fittings for Rigid Metal Conduit

CEI EN 60423. Threaded-type. Split couplings unacceptable.

[2.3.5.3 Fittings for Use in Hazardous (Classified) Locations

CEI EN 60079-14.

2.3.5.4 Fittings for Flexible Liquid-tight Metal Conduit

CEI EN 50086-2-3.

2.3.6 Fittings for Rigid Nonmetallic Conduit

CEI EN 50086-2-1.

2.3.7 Fittings For Flexible Nonmetallic Conduit

CEI EN 50086-2-3.

2.4 SURFACE RACEWAY

2.4.1 Surface Metal Raceway

CEI 23-31, two-piece painted steel, totally enclosed, snap-cover type. [Provide multiple outlet-type raceway with grounding-type receptacle where indicated. Receptacles shall be as specified herein and shall be spaced minimum of one every [500] [_____] mm.] [Alternate receptacles shall be wired on different circuits.]

2.4.2 Surface Nonmetallic Raceway

NOTE: Designer should coordinate with Design Division regarding the use of this wiring method in the project.

CEI 23-32, nonmetallic totally enclosed, snap-cover type. [Provide multiple outlet-type raceway with grounding-type receptacle where indicated. Receptacles shall be as specified herein and shall be spaced minimum of one every [500] [_____] mm] [Alternate receptacles shall be wired on different circuits.]

2.5 BUSWAY

NOTE: Phase sequence of voltages, orientation, etc., should be indicated on the drawings for existing transformers, switchboards, switchgear, motor control centers, etc.

CEI EN 60439-1 and CEI EN 60439-2. Protection grade [40] [54] [_____] in accordance with CEI EN 60529/A1. Buses shall be copper. Busways shall be rated [_____] volts, [_____] continuous current amperes, three-phase, [three-] [four-]wire, and include integral or internal [50-percent] ground bus. Short circuit rating shall be [[_____] root mean square (rms) symmetrical amperes minimum] [as indicated]. [Busway systems shall be suitable for use indoors.] Enclosures shall be metallic. Hardware shall

be plated or otherwise protected to resist corrosion. Joints shall be one-bolt type with through-bolts, which can be checked for tightness without deenergizing system. Maximum hot spot temperature rise at any point in busway at continuous rated load shall not exceed 55 degrees C above maximum ambient temperature of 40 degrees C in any position. Provide internal barriers to prevent movement of superheated gases. Contractor shall coordinate proper voltage phasing of entire bus duct system, for example where busway interfaces with transformers, switchgear, switchboards, motor control centers, and other system components.

2.5.1 Feeder Busways

Provide [ventilated, except that vertical busways within 1830 mm of floors shall be unventilated,] [unventilated, totally enclosed] low-impedance busway. Bus bars shall be fully insulated from one another, except at stabs. Entire busway system shall be polarized.

2.5.2 Plug-In Busways

Unventilated type. Plug-in units shall be [fusible, handle-operated, switch type, horsepower-rated] [circuit breaker-type] [handle-operated, switch type, equipped with high interrupting-capacity, current-limiting fuses]. Bus bars shall have insulating sleeving entire length, except at joints.

2.6 CABLE TRAYS

NOTE: When using "as indicated" option, insure information required is shown on the drawings.

CEI 23-31 and UNI EN ISO 1461. Cable trays shall form a wireway system, and shall be of nominal [75] [100] [150] mm depth. Cable trays shall be constructed of [steel that has been zinc-coated after fabrication]. Trays shall include splice and end plates, dropouts, [covers] and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius. [Radius of bends shall be [300] [600] [920] [] mm.] [Radius of bends shall be as indicated.]

2.6.1 Trough-Type Cable Trays

[Sized as indicated] [Of nominal [75] [100] [150] [200] [300] [400] [] mm width].

2.6.2 Ladder-Type Cable Trays

[Sized as indicated] [Of nominal [100] [200] [300] [400] [500] [600] mm width with maximum rung spacing of [200] [300] mm].

2.6.3 Channel-Type Cable Trays

[Sized as indicated] [[50] [75] [100] [150] [200] [300] [] mm wide].
Trays shall be one-piece construction having slots spaced not more than 110 mm on centers.

2.6.4 Solid Bottom-Type Cable Trays

[Sized as indicated] [Nominal [100] [150] [200] [300] [400] [] mm width].

2.7 OUTLET BOXES AND COVERS

CEI 23-48, metal or nonmetallic Cadmium- or zinc-coated, if ferrous metal.

[2.7.1 Outlet Boxes in Hazardous (Classified) Locations

CEI EN 60079-14.

]2.7.2 Floor Outlet Boxes

Boxes shall be adjustable and concrete tight. Each outlet shall consist of [nonmetallic] or [cast-metal] body with threaded openings, [or sheet-steel body with knockouts] for conduits, adjustable ring, brass flange ring, and cover plate with [20] [25] [32] [40] [] mm threaded plug. Telephone outlets shall consist of [surface-mounted, horizontal] [flush], aluminum or stainless steel housing with [25 mm bushed side opening] [19 mm top opening]; telephone outlets shall have provisions to accommodate 10-wire telephone terminal block. Receptacle outlets shall consist of [surface-mounted, horizontal] [flush] aluminum or stainless steel housing with duplex-type receptacle as specified herein. Provide gaskets where necessary to ensure watertight installation.

2.8 CABINETS, JUNCTION BOXES, AND PULL BOXES

CEI 23-48. Volume greater than 1640 cu. cm, with protection degree IP as per CEI EN 60529/A1, hot-dip, zinc-coated, if sheet steel.

2.9 WIRES AND CABLES

Wires and cables shall meet applicable requirements of CEI 64-8;V1 for installation and CEI 20-13;V1;V2 and CEI 20-20/1 for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.9.1 Conductors

NOTE: or conductors and smaller diameter, consideration may be given to the use of stranded wires, if suitable terminal devices can be applied which enable proper connection. Also, stranded wires in sizes and smaller diameter may be required for projects involving uninterrupted power supply (UPS) installations.

CEI 20-13;V1;V2 for EPR insulated conductors and CEI 20-20/1 for PVC insulated conductors. EPR insulated conductors 10 sq. mm and larger diameter shall be stranded. Provide Type FG7 for flexible; Type RG7 for rigid. Conductors 6 sq. mm and smaller diameter shall be solid Type UG7, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. PVC insulated conductors shall be flexible Type N07V-K or rigid Type N07V-R for conductors 10 sq. mm and larger. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.9.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.9.1.2 Minimum Conductor Sizes

NOTE: Include bracketed option if 10A circuit breakers are used to protect lighting branch circuits. Delete bracketed option if 16A circuit breakers are used.

Minimum size for branch circuits shall be 2.5 sq. mm [for outlet system and 1.5 sq. mm for lighting system;] for remote-control and signal circuits, 1.5 sq. mm; for low-energy, remote-control and signal circuits, 1.5 sq. mm; and for Class 3 low-energy, remote-control, alarm and signal circuits, 1.5 sq. mm.

2.9.2 Color Coding

NOTE: Coordinate color code with Installation where project is located. Revise this paragraph as necessary. When the Activity does not have a color coding standard or does not indicate a preference, select the unbracketed colors.

Provide for service, feeder, branch, control, and signaling circuit conductors. Color of conductors in different voltage systems shall be as follows:

- a. 400/231 volt and 230/133 volt, three-phase:
 - (1) Phase A - grey [black] [brown]
 - (2) Phase B - black [grey] [brown]

- (3) Phase C - brown [black] [grey]
 - (4) Neutral - light blue
 - (5) Grounding PE - yellow with green stripes
- b. 400/231 Volt and 230/133 Volt wiring systems shall run in separate raceways.
- c. Single Phase color codes:
- (1) Phase - black [grey] [brown]
 - (2) Neutral - light blue
 - (3) Grounding PE - yellow with green stripes

2.9.3 Insulation

NOTE:

Unless specified or indicated otherwise or required by CEI 64-8;V1, power and lighting wires shall be [Type N07V-K conforming to CEI 20-20/1 and CEI 20-22/2;V1] [or] [Type [FG7OR 0.6/1KV] [or] [RG7OR 0.6/1KV] [or] [UG7R 0.6/1KV] conforming to CEI 20-13;V1;V2 and CEI 20-22/2;V1], except that grounding wire may be Type NOV7-K conforming to CEI 20-20/1; remote-control and signal circuits shall be Type NOV7-K, conforming to CEI 20-20/1 and CEI 20-22/2;V1. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.9.4 Bonding Conductors

CEI 64-8;V1 and CEI 20-29, solid insulated copper wire for sizes 10 sq. mm and smaller diameter; stranded insulated copper wire for sizes 16 sq. mm and larger.

[2.9.5 Service Entrance Cables

Service Entrance cables shall be EPR insulated G7 type in accordance to CEI 20-13;V1;V2.

]2.9.6 Fireproof Cables

Fireproof cables shall conform to CEI 20-22/2;V1, CEI 20-37/1, and CEI EN 50265-1.

2.9.6.1 Fireproof Cables with Low Emissions of Corrosive and Toxic Gas

Shall conform to CEI 20-37/1 and CEI 20-38/1.

[2.9.7 Wire and Cable for 400 Hertz (Hz) Circuits

Insulated copper conductors.

]2.9.8 Armored Cable

NOTE: Consult with cognizant electrical design branch manager and obtain written approval before specifying AC cable.

UNEL 35378 and UNEL 35379. Provide Type RG70NR 0.6/1KV for size 6 sq. mm and smaller; Type UG70NR 0.6/1KV for sizes larger than 6 sq. mm.

]2.9.9 Mineral-Insulated (MI), Metal-Sheathed Cable

NOTE: MI cable used for low temperature, high temperature, hazardous locations, life safety, and heating applications. Drawings shall clearly show the MI cable. Surge suppressors should be considered in hazardous locations and where high voltage surges are likely. MI cable is not available in ratings above 600 volts.

CE listed; CEI 64-8;V1 (Para. 521), UNEL 35024/2, and CEI 20-39/1. Sheathing containing asbestos fibers shall not be used.

]2.9.10 Flat Conductor Cable

NOTE: Flat conductor cable is normally used for connection to mobile equipment and motors under carpet, and in flat raceways.

CE listed; CEI 20-19/4, CEI 20-25, CEI 20-41, and CEI EN 50265-1.

]2.9.11 Cable Tray Cable

CE listed; Type G7, FG7, RG7, UG7, or NO7V-K as applicable

]2.10 SPLICES AND TERMINATION COMPONENTS

CEI 20-33 for wire connectors and for insulating tapes. Connectors for 6 sq. mm and smaller diameter wires shall be insulated, pressure-type in accordance with CEI EN 60320-1. Provide solderless terminal lugs on stranded conductors.

2.11 DEVICE PLATES

NOTE: Use last three sentences of paragraph for brig facilities only.

Provide CE listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. For nonmetallic boxes and fittings, other suitable plates may be provided. [Plates on finished walls shall be [urea or phenolic] [nylon or lexan], minimum 0.792 mm wall thickness. Plates shall be same color as receptacle or toggle switch with which they are mounted.] [Plates on finished walls shall be satin finish stainless steel or brushed-finish aluminum, minimum 0.792 mm thick.] Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and CE listed for "wet locations" and shall have protection degree IP in accordance with CEI EN 60529/A1. [Device plates in areas normally accessible to prisoners shall be brown or ivory finish nylon-device plates rated for high abuse. Test device plates for compliance with CEI 23-48 for physical strength. Attach device plates with spanner head bolts.]

2.12 SWITCHES

2.12.1 Toggle Switches

CEI EN 60998-1 and CEI EN 60669-1, totally enclosed with bodies of thermosetting plastic and mounting strap with grounding screw. Handles shall be [brown] [ivory]. Wiring terminals shall be screw-type, side-wired. Switches shall be rated quiet-type ac only, 250 volts, with current rating and number of poles indicated.

2.12.2 Switch with Red Pilot Handle

Provide pilot lights that are integrally constructed as a part of the switch's handle. The pilot light shall be red and shall illuminate whenever the switch is closed or "on". The pilot lighted switch shall be rated [6] [10] [16] amps and 250 volts or as indicated. Provide the circuit's neutral conductor to each switch with a pilot light.

2.12.3 Disconnect Switches

NOTE: Switches requiring frequent operation should be the heavy duty-type and should be so indicated on the drawings.

NOTE: Designer shall know the requirements of the electrical system and the equipment serviced to determine the proper fuse class and type. This note briefly summarizes some of the UL fuse standards and their application.

CEI 64-8;V1 and CEI EN 60947-2/A1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize fuse holders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be kW rated. Provide switches in IP [20] [40] [____], enclosure [as indicated] in accordance with CEI EN 60529/A1.

2.13 RECEPTACLES

NOTE: Designer will select the proper grade for the application. General grade receptacles are suitable for normal use and heavy use.

CEI 23-50 and CEI EN 60998-1, general grade, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of [brown] [ivory] thermosetting plastic supported on a metal mounting strap. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap.

2.13.1 Weatherproof Receptacles

Provide in cast metal box [or PVC box] or [] with gasketed, weatherproof, protection degree of IP 55 (minimum) in accordance with CEI EN 60529/A1, [transparent elastic membrane cover] cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be CE listed for use in "wet locations with plug in use."

2.13.2 Ground-Fault Interrupter Receptacles (GFI)

NOTE: For child care center projects, coordinate project drawings and specifications to include GFI receptacles in bathrooms, kitchens, laundry facilities, exterior locations, and swimming pools.

CEI EN 61009-2-1, for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of CEI EN 61009-2-1 for GFI devices.

[2.13.3 Receptacles in Hazardous (Classified) Locations

CEI EN 60079-14.

]2.13.4 Special Purpose Receptacles

Receptacles serving [____] are special purpose. [Provide in ratings indicated.] [IP [____] configuration in accordance with CEI EN 60529/A1, rated [____] amperes, [____] volts.] [Furnish one matching plug with each receptacle.]

[2.13.5 Plugs

Provide heavy-duty, rubber-covered [three-,] [four-,] [or] [five-]wire cord of required size, install plugs thereon, and attach to equipment. Plugs shall be CE listed with receptacles, complete with grounding blades. Where equipment is not available, turn over plugs and cord assemblies to the Government.

]2.14 PANELBOARDS

NOTE:

CEI EN 60439-1, CEI EN 60529/A1, and CEI 23-51 having a short-circuit current rating as indicated [of 10,000 amperes symmetrical minimum]. Panelboards for use as service disconnecting means shall additionally conform to CEI 64-8;V1. Panelboards shall be circuit breaker-equipped [unless indicated otherwise]. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by CEI norms. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise. Main breaker shall be "separately" mounted ["above"] [or] ["below"] branch breakers. Where "space only" is indicated, make provisions for future installation of breakers. Panelboard locks shall be keyed same. Directories shall indicate load served by each circuit in panelboard. Directories shall also indicate source of service to panelboard (e.g., Panel PA served from Panel MDP). [Provide new directories for existing panels modified by this project as indicated.] Type directories and mount in holder behind transparent protective covering. [Panelboards shall be listed and labeled for their intended use.] Provide panelboards in [IP20] [IP40] [___] assemblies in accordance with CEI EN 60439-1 and CEI EN 60529/A1. Panelboards shall be provided with Form [1] [2] [3] [4] separation by barriers or partitions in accordance with CEI EN 60439-1.

2.14.1 Panelboard Buses

CEI EN 60439-2. Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus in accordance with CEI 64-8;V1 for connecting grounding conductors; bond to steel cabinet.

2.14.2 Circuit Breakers

CEI EN 60947-2/A1, [thermal magnetic-type] [solid state-type] having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be CE listed as suitable for type of conductor

provided.

2.14.2.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.14.2.2 Circuit Breaker With GFI

NOTE: For child care center projects, coordinate project drawings and specifications to include GFI receptacles in bathrooms, kitchens, laundry facilities, exterior locations, and swimming pools.

CEI EN 60947-2/A1. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of [0.01 amperes or greater per requirements of CEI 64-8;V1 GFI devices, for personnel protection,] [and] [GFI for equipment protection.]

2.14.2.3 Circuit Breakers for HVAC Equipment

Circuit breakers for HVAC equipment having motors (group or individual) shall be rated in accordance to the motor power to be served.

NOTE: Use fusible switch as protection for pilot lights and insulating transformers. Use fusible switch for MCC as an alternative to the circuit breakers.

[2.14.3 Fusible Switches for Panelboards

CEI EN 60269-1 and CEI EN 60947-3, hinged door-type. Switches serving as motor disconnect means shall be kilowatt rated.

]2.14.4 400 Hz Panelboard and Breakers

NOTE: Circuit breakers and panelboards normally used in 50/60 Hz systems can be used in 400 Hz systems. In 400 Hz systems, the generator short circuit current is normally 4 times less than the 50/60 Hz systems. The Designer shall increase the magnetic trip of circuit breakers as recommended by the Manufacturer's instructions. Thermal trip does not require increase. Ground fault breakers do not require alteration and can be used in 50/60 Hz or 400 Hz systems.

Panelboards and breakers for use on 400 Hz systems shall be "400 Hz" rated and labeled.

2.15 ENCLOSED CIRCUIT BREAKERS

CEI EN 60947-2/A1. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated. [Provide solid neutral.]

2.16 MOTOR CIRCUIT PROTECTORS (MCP)

Motor circuit protectors; CEI EN 60947-2/A1. MCPs shall consist of an adjustable instantaneous trip circuit breaker in conjunction with a combination motor controller which provides coordinated motor circuit overload and short circuit protection. MCPs shall be rated in accordance with CEI norms.

2.17 FUSES

NOTE: Designer shall know the requirements of the electrical system and the equipment serviced to determine the proper fuse class and type. This note briefly summarizes fuse standards and their application.

CEI EN 60269-1. Fuses shall be Type [gG] [or] [aM]. Provide complete set of fuses for each fusible [switch] [and] [control center]. Fuses shall be Type [gG] [or] [aM]. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers [or other circuit protective devices] shall be coordinated for proper operation. Submit coordination data for approval. Fuses shall have voltage rating not less than circuit voltage.

2.17.1 Cartridge Fuses, Current Limiting Type

CEI EN 60269-1, Type aM [time delay-type].

2.18 TRANSFORMERS

NOTE: Coordinate the location of dry-type transformers with the mechanical designer to ensure adequate ventilation. This specification does not apply to transformers over 500 kVA, substation transformers, and transformers rated greater than 600 volts; for these types, see Section 16360, "Secondary Unit Substation" Specify 80 C or 115 C transformers when transformer is loaded above 60

percent of nameplate and has continuous duty cycle.

Delete quiet type where noise level does not affect personnel. Relative to noise: the least desirable location for the transformer is in a corner of a room, especially when there is a low ceiling.

CEI 14-8, general purpose, dry-type, self-cooled, [ventilated] [unventilated] [sealed]. Provide transformers in IP [20] [40] [_____] enclosure in accordance with CEI EN 60529/A1. Transformer shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding [150] [115] [80] [] degrees C under full-rated load in maximum ambient of 40 degrees C. [Transformer of 150 degrees C temperature rise shall be capable of carrying continuously 100 percent of nameplate kVA without exceeding insulation rating.] [Transformer of 115 degrees C temperature rise shall be capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.] [Transformer of 80 degrees C temperature rise shall be capable of carrying continuously 130 percent of nameplate kVA without exceeding insulation rating.] [Transformers shall be quiet type with maximum sound level at least 3 decibels less than CEI 14-8 standard level for transformer ratings indicated.]

[2.18.1 Specified Transformer Efficiency

Transformers, indicated and specified with: 400V primary, 80 degrees C or 115 degrees C temperature rise, kVA ratings of 37.5 to 100 for single phase or 30 to 500 for three phase, shall be energy efficient type.

]2.19 MOTORS

NOTE: Motor and motor controller specifications shall be thoroughly coordinated with and cross-referenced in all affected mechanical sections.

CEI EN 60034-1 [except fire pump motors shall be as specified in Section 13920 "Fire Pumps"]; hermetic-type sealed motor compressors shall also comply with CEI EN 60034-1. Provide the size in terms of kW, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 230-volt, 3-phase circuits shall have terminal voltage rating of 250 volts, and those for operation on 380-volt, 3-phase circuits shall have terminal voltage rating of 400 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating. [Provide motors in hazardous locations with classifications as indicated.]

2.19.1 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided.

2.20 MOTOR CONTROLLERS

NOTE: Motor and motor controller specifications shall be thoroughly coordinated with and cross-referenced in all affected mechanical sections. Indicate size of controller on mechanical drawings.

CEI EN 60947-4-1, [except fire pump controllers shall be as specified in Section 13920, "Fire Pumps"]. Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare normally closed auxiliary contact. Magnetic-type motor controllers shall have undervoltage protection in accordance with CEI 64-8;V1 when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. [Selector switch shall have means for locking in any position.] For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, non-fused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position. [Minimum short circuit withstand rating of combination motor controller shall be [_____] rms symmetrical amperes.] [Provide controllers in hazardous locations with classifications as indicated.]

2.20.1 Control Circuits

[Control circuits shall have maximum voltage of 220 [110] [24] [] volts derived from control transformer in same enclosure. Transformers shall be

as indicated. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side. [Provide fuses in each ungrounded primary feeder]. One secondary lead shall be fused; other shall be grounded. Provide for automatic switch over and alarm upon failure of primary control circuit.]

2.20.2 Enclosures for Motor Controllers

NOTE: Indicate type of enclosure on the mechanical drawing to suit the application.

CEI EN 60529/A1.

2.20.3 Multiple-Speed Motor Controllers and Reversible Motor Controllers

Across-the-line-type, electrically and mechanically interlocked. Multiple-speed controllers shall have compelling relays and shall be multiple-button, station-type with pilot lights for each speed.

2.20.4 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.

2.20.5 Pilot and Indicating Lights

Provide transformer, resistor, or diode type.

2.20.6 Terminal Blocks

CEI EN 50005.

[2.20.7 Reduced-Voltage Controllers

NOTE: The designer shall determine, based on the power system characteristics and motor usage, where reduced-voltage controllers shall be specified. Refer to MIL-HDBK-1004/4, "Electrical Utilization Systems," for detailed discussion of these reduced voltage starter types and for guidance in their selection and application.

Provide for polyphase motors [_____] kilowatt and larger. Reduced-voltage starters shall be single-step, closed transition [autotransformer,] [reactor,] [primary resistor-type,] [solid state-type,] or as indicated, and shall have adjustable time interval between application of reduced and full voltages to motors. [Wye-delta reduced voltage starter or part

winding increment starter having adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced-voltage starters for starting of [motor-generator sets,] [centrifugally operated equipment,] [or] [reciprocating compressors provided with automatic unloaders].]

2.21 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

[Single] [Double] [Three] pole designed for [flush] [surface] mounting with overload protection [and pilot lights].

2.21.1 Pilot Lights

Provide yoke-mounted, candelabra-base sockets rated 110 [220] [24] volts and fitted with glass or plastic jewels. Provide clear, 6 watt lamp in each pilot switch. Jewels for use with switches controlling motors shall be green; jewels for other purposes shall be [white] [red] [amber].

2.22 MOTOR CONTROL CENTERS

NOTE: Motor control center should be specified for groups of large motors requiring coordinated control. In other applications, individual controllers or motor control panelboards should be used. Coordinate controller specifications with the mechanical equipment requirements.

CEI EN 60439-1 and CEI EN 60947-4-1. Wiring shall be fireproof in accordance with CEI 20-22/2;V1 IP [20] [31] [40] [54] [65] [___] enclosure in accordance with CEI EN 60529/A1. Provide control centers suitable for operation on [____]-volt, [____]-phase, [____]-wire, [____] Hz system and shall have minimum short-circuit withstand and interrupting rating of [100,000] [65,000] [42,000] [25,000] [____] amperes rms symmetrical. Incoming power feeder shall be [bus duct] [cable] entering at the [top] [bottom] of enclosure and terminating on [terminal lugs] [main protective device]. [Main protective device shall be [molded case circuit breaker] [low-voltage power circuit breaker] [fusible switch] rated at [____] amperes rms symmetrical interrupting capacity.] [Arrange busing so that control center can be expanded from both ends.] Interconnecting wires shall be copper. Terminal blocks shall be plug-in-type so that controllers may be removed without disconnecting individual control wiring. Provide control centers with Form [3] [4a] [4b] separation by barriers and partitions in accordance with CEI EN 60439-1.

2.22.1 Bus Systems

NOTE: Manufacturer's provide short circuit withstand ratings to meet project specifications and to coordinate with upstream over current short circuit interrupting ratings. Include fault current values in brackets to correspond with results of project

fault current calculations. For example, if the fault current calculations show an available short circuit current of 24,500 amps at the MCC bus, and the upstream over current protection is rated at 35 kAIC, then enter 35,000 in the brackets.

Provide the following bus systems. Power bus shall be braced to withstand fault current of [_____] amperes rms symmetrical. Wiring troughs shall be isolated from horizontal and vertical bus bars.

2.22.1.1 Horizontal and Main Buses

NOTE:

Horizontal bus shall have continuous current rating of [600] [800] [1000] [1200] [1600] [2000] amperes. Main bus shall be [copper] [copper, silver-plated] enclosed in isolated compartment at top of each vertical section. Main bus shall be isolated from wire troughs, starters, and other areas.

2.22.1.2 Vertical Bus

NOTE: Copper is standard for bus material. Silver plated copper is available on special request.

Vertical bus shall have continuous current rating of [300] [450] [600] [_____] amperes, and shall be [copper] [copper, silver-plated]. Vertical bus shall be enclosed in flame-retardant, polyester glass "sandwich."

2.22.1.3 Ground Bus

Copper ground bus shall be provided full width of motor control center and shall be equipped with necessary lugs.

[2.22.1.4 Neutral Bus

Insulated neutral bus shall be provided continuous through the motor control center; neutral shall be full rated. Lugs of appropriate capacity shall be provided, as required.

]2.22.2 Motor Disconnecting Devices and Controllers

Shall comply with paragraph entitled "Combination Motor Controllers."

[2.22.3 Combination Motor Controllers

CEI EN 60947-4-1 and other requirements in paragraph entitled, "Motor Controllers." Controller shall employ molded case circuit breaker. [Minimum short circuit withstand rating of combination motor controller

shall be [_____] rms symmetrical amperes [as indicated].] [Circuit breakers for combination controllers shall be [thermal magnetic] [magnetic only].]

2.23 TELEPHONE SYSTEM

NOTE: This paragraph applies only if provision is made for telephone system by others. If a complete system is provided by contract, refer to Section 16710, "Structured Telecommunications Cabling and Pathway System," and Section 16721, "Telephone Distribution Systems, Outside Plant." Where Section 16710 is provided, delete paragraphs entitled, "Outlet Boxes for Telephone System", "Cover Plates", "Conduit Sizing", "Backboards", and "Terminal Cabinets".

Provide system of telephone wire-supporting structures, including: conduits with pull wires [and] [wireways,] [cable trays,] terminal boxes, outlet and junction boxes, other accessories for telephone outlets, and [telephone cabinets] [wire closets] [backboards]. [Additional requirements are in Section 16710, "Structured Telecommunications Cabling and Pathway System."]

2.23.1 Outlet Boxes for Telephone System

NOTE: When using "as indicated" option, insure informations required are shown on the drawings.

Standard type, 90 mm square by 45 mm deep. Mount flush in finished walls at height [indicated] [specified for outlet receptacles]. [Outlet boxes for wall-mounted telephones shall be 90 by 90 [] by 45 [] mm deep; mounted at height[1525 mm above finished floor] [as indicated].] [Outlet boxes for handicapped telephone station shall be 90 by 90 [] by 45 [] mm deep and mounted at height[1200 mm above finished floor] [as indicated].]

2.23.2 Cover Plates

[Blank cover] [Modular telephone type] with same finish specified for receptacle and switch cover plates.

2.23.3 Conduit Sizing

NOTE: For guidelines on conduit sizing, see MIL-HDBK-1004/4. Telephone raceway requirements should be coordinated with the entity providing the telephone wires and cable.

Conduit for single outlets shall be minimum of 21 mm and for multiple outlets minimum of 25 mm. Size conduits for telephone risers to telephone

cabinets, junction boxes, distribution centers, and telephone service, as indicated.

2.23.4 Backboards

NOTE: When using "as indicated" option, ensure information required is shown on the drawings.

Interior grade plywood, 20 mm thick, [1200 by 2400 mm minimum] [size as indicated] [_____]. Paint with gray fire resistant paint.

2.23.5 Terminal Cabinets

NOTE: For guidelines on sizing cabinets, see MIL-HDBK-1004/4, Table 6 entitled, "Cabinet Sizes For Telephone Systems" Coordinate with entity providing telephone service.

UNI EN ISO 1461. Construct of zinc-coated sheet steel. Cabinets shall be constructed with interior dimensions not less than those indicated. Trim shall be fitted with hinged door and flush catch. Doors shall provide maximum-size openings to the box interiors. Boxes shall be provided with 16 mm backboard having a two-coat insulating varnish finish. Match trim, hardware, doors, and finishes to lighting panelboards.

2.23.6 Receptacles for Telephone Service

NOTE: When using "as indicated" option, ensure that information required is shown on the drawings.

Provide receptacle[s], [[230 volts, 16 amperes, single phase, 50 Hz] [_____]], adjacent to telephone [backboards] [cabinets] [_____], served from panelboard circuit [as indicated].

2.24 GROUNDING AND BONDING EQUIPMENT

CEI 64-8;V1. Ground rods shall be copper-clad steel, with minimum diameter of 20 mm and minimum length of 3000 mm.

[2.25 HAZARDOUS LOCATIONS

NOTE: Indicate very clearly the limits of all hazardous locations.

Electrical materials, equipment, and devices for installation in hazardous locations, shall be as defined by CEI EN 60079-10 and CEI EN 60079-14, for

particular "Zone," "Source of Release," and "Ventilation Degree" of hazardous locations involved. Boundaries and classifications of hazardous locations shall be as indicated.

2.26 NAMEPLATES

Provide as specified in Section 16050, "Basic Electrical Materials and Methods."

2.27 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with Section 07840, "Firestopping."

2.28 WIREWAYS

NOTE: In Italy, wireways are the same as cable trays.

CEI 23-31. Material shall be steel [epoxy painted] [galvanized] 0.8 mm thick for heights and depths up to 150 by 150 mm, and 1.9 mm thick for heights and depths up to 305 by 305 mm. Provide in length [indicated] [required for the application] with screw-cover IP [20] [40] [] enclosure per in accordance with CEI EN 60529/A1.

2.29 TRANSIENT VOLTAGE SURGE SUPPRESSORS

NOTE: Consider TVSS devices at panelboards serving security equipment and associated mission essential electronics and communications hardware. Requirements shall be included in the Base Electronics System Engineering Plan.

Provide Transient Voltage Surge Suppression (TVSS) devices which comply with CEI 81-8.

2.30 SOURCE QUALITY CONTROL

2.30.1 Transformer Factory Tests

Submittal shall include routine transformer test results on each transformer and also contain the results of "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of CEI 64-8;V1 and

to requirements specified herein.

[3.1.1 Underground Service

**NOTE: When using this paragraph, designer insert
additional details describing the specific project.**

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

]3.1.2 Hazardous Locations

Work in hazardous locations, as defined by CEI EN 60079-10, shall be performed in strict accordance with CEI EN 60079-14 for particular "Zone," "Source of Release," and "Ventilation Degree" of hazardous locations involved. Provide conduit and cable seals where required by CEI EN 60079-14 and CEI 64-8;V1. Conduit shall have tapered threads.

]3.1.3 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

3.1.3.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by CEI 64-8;V1, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph entitled "Nameplates." Use lettering of at least 6.35 mm in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by CEI 64-8;V1.

3.1.4 Wiring Methods

Provide insulated conductors installed in rigid steel conduit or rigid nonmetallic conduit, except where specifically indicated or specified otherwise or required by CEI 64-8;V1 and CEI EN 60079-14 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated yellow/green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size shall be 16 mm in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 150 mm. Conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors shall be fire-stopped in accordance with Section 07840, "Firestopping".

[3.1.4.1 Nonmetallic Conduit

a. Restrictions applicable to PVC

- (1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.
- (2) Do not use in hazardous (classified) areas.
- (3) Do not use in fire pump rooms.
- (4) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.
- (5) Do not use in hospitals for emergency circuits.
- (6) Do not use Medium Type M in industrial areas or where exposed.

3.1.4.2 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph entitled "Flexible Connections."

3.1.4.2 Service Entrance Conduit, Overhead

Rigid steel from service entrance to service entrance fitting or weatherhead outside building.

3.1.4.3 Service Entrance Conduit, Underground

NOTE:

PVC, Heavy Duty Type [H] galvanized rigid steel. Underground portion shall be encased in minimum of 75 mm of concrete and shall be installed minimum 460 mm below slab or grade.

3.1.4.4 Underground Conduit Other Than Service Entrance

Rigid steel or PVC in accordance with CEI EN 50086-2-1. Convert nonmetallic conduit, to steel conduit before rising through floor slab.

3.1.4.5 Conduit in Floor Slabs

NOTE: Do not specify metal conduit in concrete that contains coral aggregate or is made with salt or brackish water. This type of concrete is rarely allowed.

PVC, rigid type, unless indicated otherwise.

[3.1.4.6 Conduit Interior to Buildings for 400 Hz Circuits

Nonmetallic. Where 400-Hz circuit runs underground or through concrete, conduit shall be PVC rigid, heavy duty Type [H] in accordance with CEI EN 50086-1 and CEI EN 50086-2-1.

]3.1.4.7 Conduit for Circuits Rated Greater Than 600 Volts

Rigid metal conduit.

[3.1.4.8 Armored Cable

Install in accordance with CEI 64-8;V1.

]3.1.4.9 Flat Conductor Cable

Install in accordance with CEI 64-8;V1.

]3.1.5 Conduit Installation

NOTE: Where exposed conduit is installed and subject to vandalism or misuse, such as in toilet or locker rooms, do not allow perpendicular or right angle to ceiling structural members. Provide details on drawings to identify special treatments or offsets as needed.

Do not install exposed conduit systems in inmate housing areas and other areas normally accessible to inmates unless such installations are specifically indicated. Where exposed conduit is indicated, conduits shall be rigid metallic type and outlet boxes shall be cast metal-type with threaded hubs. Install conduits flat against wall; offsets or "kicks" shall be permitted only to enter outlet box. Support conduits on mm maximum centers and within mm of each outlet box using two-hole conduit straps attached to surface with nonremovable break off security type bolts.

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 150 mm away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. [Run conduits [in crawl space] [under floor slab] as if exposed.]

3.1.5.1 Conduit Installed Under Floor Slabs

NOTE: Designer shall closely coordinate with the design of building floor slab and soil conditions and evaluate the acceptability of conduit being installed directly beneath the floor slab. Consideration shall be given to support conduit in case of soil settlement problems and vapor barrier penetrations. Provide details on the drawings to clarify specification.

Conduit run under floor slab shall be located a minimum of [300] [_____] mm below the vapor barrier. Seal around conduits at penetrations through vapor barrier.

3.1.5.2 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.

3.1.5.3 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 40 mm in reinforced concrete beams or to depth of more than 20 mm in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems shall be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. [Support exposed risers in wire shafts of multistory buildings by U-clamp hangers at each floor level and at 3000 mm maximum intervals.] Where conduit crosses building expansion joints, provide suitable [watertight] expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means.

3.1.5.4 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes,

fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.5.5 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 890-N tensile strength. Leave minimum 900 mm of slack at each end of pull wire.

3.1.5.6 Telephone and Signal System Conduits

Refer to Section 16710, "Structured Telecommunications Cabling and Pathway System."

[3.1.5.7 Conduit Installed in Concrete Floor Slabs

NOTE: When this option is included, (such as in BEQ's and similar projects with precast planks and topping slabs), indicate specific locations and provide installation details on the electrical drawings. Electrical designer shall closely coordinate this information with the designer of the slab to ensure that slab thickness, conduit placement/separation, and reinforcement spacing is sufficient to meet requirements of this paragraph.

Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. [Do not stack conduits.] [Do not stack conduits more than two diameters high with minimum vertical separation of [_____] mm.] Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends shall not be visible above finish slab. Increase slab thickness as necessary to provide minimum 25 mm cover over conduit. Where embedded conduits cross building and/or expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings shall allow horizontal and vertical movement of raceway. Conduit larger than 25 mm trade size shall be parallel with or at right angles to main reinforcement; when at right angles to reinforcement, conduit shall be close to one of supports of slab. [Where nonmetallic conduit is used, raceway shall be converted to plastic coated rigid steel before rising above floor, unless specifically indicated.]

]3.1.5.8 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by CEI norms, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by CEI norms.

3.1.5.9 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 150 mm above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.5.10 Flexible Connections

NOTE:

Provide flexible steel conduit between 900 and 1800 mm in length for recessed and semirecessed lighting fixtures[; for equipment subject to vibration, noise transmission, or movement; and for motors]. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 16 mm diameter. Provide liquid tight flexible [nonmetallic] conduit in wet and damp locations [and in fire pump rooms] for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.6 Busway Installation

Installation shall comply at minimum with CEI 64-8;V1. Install busways parallel with or at right angles to ceilings, walls, and structural members. Support busways at 1525 mm maximum intervals, and brace to prevent lateral movement. Hinges provided on risers shall be fixed type; spring-type are unacceptable. Provide flanges where busway makes penetrations through walls and floors, and seal to maintain smoke and fire ratings. Provide waterproof curb where busway riser passes through floor. Seal gaps with fire-rated foam and calk. Provide expansion joints, but only where bus duct crosses building expansion joints.

3.1.7 Cable Tray Installation

[Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Support [as indicated] [at maximum [1800] [_____] mm] intervals. [Contact surfaces of aluminum connections shall be coated with an antioxidant compound prior to assembly.] Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Provide 16 sq. mm insulated copper wire throughout cable tray system, and bond to each section. Conductors that run through smoke and fire partitions shall be installed in 100 mm rigid steel conduits with grounding bushing, extending 300 mm beyond each side of partitions. Seal conduit on both ends to maintain smoke and fire ratings of partitions.]

3.1.8 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, [when

surface mounted on interior walls exposed up to 2135 mm above floors and walkways,] [or when installed in hazardous areas] and when specifically indicated. Boxes in other locations shall be sheet steel, and nonmetallic boxes may be used with nonmetallic conduit system. Each box shall have volume required by CEI norms for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 100 mm square, or round, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports, or make adequate provisions for distributing load over ceiling support members in an approved manner. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. [Threaded studs driven in by powder charge and provided with lock washers and nuts [or nail-type nylon anchors] may be used in lieu of wood screws, expansion shields, or machine screws.] In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 610 mm from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.8.1 Boxes

Boxes for use with raceway systems shall be minimum 45 mm deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 90 mm square, except that 120 by 95 mm boxes may be used where only one raceway enters outlet. Telephone outlets shall be minimum of 90 mm square by 45 mm deep [, except for [wall mounted telephones] [and] [outlet boxes for handicap telephone stations]].

3.1.8.2 Pull Boxes

Construct of at least minimum size required by CEI 64-8;V1 [of code-gauge aluminum or galvanized sheet steel,] [and] [compatible with nonmetallic raceway systems,] except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.9 Mounting Heights

Mount panelboards, [enclosed] circuit breakers, [motor controller] and disconnecting switches so height of operating handle at its highest position is maximum 2000 mm above floor. Mount lighting switches [1200 mm

above finished floor], receptacles [300 mm above finished floor], [and other devices] [as indicated]. Measure mounting heights of wiring devices and outlets to center of device or outlet.

[3.1.10 Mineral Insulated (MI), Metal Sheathed Cable Installation

NOTE: MI cable used for low temperature, high temperature, hazardous locations, life safety, and heating applications. Drawings shall clearly show the MI cable. Surge suppressors should be considered in hazardous locations and where high voltage surges are likely. MI cable is not available in ratings above .

Mineral-insulated, metal-sheathed cable system, may be used in lieu of exposed conduit and wiring. Conductor sizes shall be not less than those indicated for the conduit installation. Cables shall be fastened within 300 mm of each turn or offset and at 800 mm maximum intervals. Make cable terminations in accordance with CEI 20-39/1 and cable manufacturer's recommendations. Single-conductor cables of a circuit, having capacities of more than 50 amperes, shall terminate in a single box or cabinet opening. Individual conductors in all outlets and cabinets shall be color-coded.

]3.1.11 Conductor Identification

NOTE: Reference the section providing details of identifying control circuit wiring.

Provide conductor identification within each enclosure where tap, splice, or termination is made. The color coding shall be by factory-applied, color-impregnated insulation. For conductors 25 sq. mm and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with [Section 15901, "Space Temperature Control Systems."] [Section [____], ["_____"]] [Section 15910, "Direct Digital Control Systems][manufacturer's recommendations].

3.1.12 Splices

Make splices in accessible locations in accordance with CEI 64-8;V1. Make splices in conductors 6 sq. mm and smaller diameter with insulated, pressure-type connector. Make splices in conductors 10 sq. mm and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.13 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not

permitted. Install plates with alignment tolerance of 0.60 mm. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.14 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07840, "Firestopping."

3.1.15 Grounding and Bonding

In accordance with CEI 64-8;V1. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telephone system grounds, and neutral conductor of wiring systems. [Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make equipotential connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with CEI 64-8;V1. Do not use water piping system grounding plates.] [Make ground connection to driven ground rods on exterior of building.] [Interconnect all grounding media in or on the structure to provide a common ground potential. This shall include lightning protection, electrical service, telephone system grounds, as well as underground metallic piping systems. Interconnection to the gas line shall be made on the customer's side of the meter. Use main size lightning conductors for interconnecting these grounding systems to the lightning protection system.]Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.15.1 Resistance

NOTE: If difficulties are encountered in obtaining the proper resistance, the Contracting Officer will make a decision on the number of ground rods to be used, based on local conditions and on the type and size of electrical installation in the project.

Maximum resistance-to-ground of grounding system shall not exceed [_____] ohms in accordance with CEI 64-8;V1, under dry conditions. Where resistance obtained exceeds [_____] ohms, contact Contracting Officer for further instructions.

3.1.15.2 Telephone Service

NOTE: Include this paragraph when telephone service is provided in job and specified in this section and other sections. Choose the second bracketed options

where lightning protection system is provided in the job and specified in other sections.

Provide main telephone service equipment ground consisting of separate ground wire, [16 sq. mm][the same size as the Class I lightning protection system main conductor or 16 sq. mm, whichever is larger], in conduit between equipment backboard and readily accessible grounding connection. Equipment end of ground wire shall consist of coiled length at least twice as long as terminal cabinet or backboard height.

3.1.16 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.17 Elevator

NOTE: To achieve a complete specification, the electrical designer shall ensure that the controls for HVAC, fire alarm system, elevators, cranes, and special systems are definitely and properly covered by the other sections of the project specification. Should controls appear in this section of the project specification, this paragraph shall be modified accordingly. The drawings shall indicate required equipment connections. Elevator paragraph shall be coordinated with Section 14210, "Electric Traction Elevators" and Section 14240, "Hydraulic Elevators."

Provide circuit to line terminals of elevator controller, and disconnect switch on line side of controller, outlet for control power, outlet receptacle and work light at mid-height of elevator shaft, and work light and outlet receptacle in elevator pit. Provide two separate circuits: one for the elevator power system and one for the elevator lights.

[3.1.18 Government-Furnished Equipment

Contractor [shall rough-in for Government-furnished equipment] [shall make connections to Government-furnished equipment] to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

]3.1.19 Repair of Existing Work

Repair of existing work[, demolition, and modification of existing

electrical distribution systems] shall be performed as follows:

3.1.19.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.1.19.2 Existing Concealed Wiring to be Removed

Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

[3.1.19.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment shall include equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, and fittings, [back to equipment's power source] as indicated.

]3.1.19.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Existing circuits of equipment shall remain energized. Circuits which are to remain but were disturbed during demolition shall have circuits wiring and power restored back to original condition.

]3.2 FIELD QUALITY CONTROL

NOTE: Provide any additional test requirements for equipment requiring running tests or tests that shall be coordinated with mechanical equipment.

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer [5] [_____] working days notice prior to [each] [_____] test[s]. All tests shall be conducted in accordance with CEI 64-8;V1.

3.2.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.2.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring 10 sq. mm and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum

resistance shall be in accordance with CEI 64-8;V1.

3.2.3 Transformer Tests

Perform the standard, not optional, tests in accordance with the Inspection and Test Procedures for transformers, dry type, air-cooled, 600 volt and below; as specified in CEI 14-8. Measure primary and secondary voltages for proper tap settings. Tests need not be performed by a recognized independent testing firm or independent electrical consulting firm.

3.2.4 Ground-Fault Interrupter Receptacle Test

**NOTE: If "line" and load leads are reversed "test"
will trip downstream loads but not trip the
receptacle.**

Test ground- fault interrupter receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed. Perform additional tests in accordance with CEI 64-8;V1.

3.2.5 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

-- End of Section --