

## SECTION 26 05 19

### LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

#### PART 1- GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Building wires and cables rated 1000 V and less.
  - 2. Connectors, splices, and terminations rated 1000 V and less.

##### 1.3 REFERENCE CODES AND STANDARDS

- A. GB/T 14135: Compression type terminal lugs and ferrules with copper or aluminum for power cable connection.
- B. GB/T 12706.1(IEC 60502): Power cables with extruded insulation and their accessories for rated voltages From 1kV(Um=1.2kV) up to 35kV(Um=40.5kV)- Part1: Cables for rated voltage of 1kV(Um=1.2kV) and 3kV(Um=3.6kV)
- C. GB/T 5023(IEC 60227): Polyvinyl chloride insulated cables of rated voltages up to and including 450/750V.
- D. GB/T 19666: Flame retardant and fire resistant wires and cables.
- E. GA306: Flame retardant and fire resistive cables—Classification and requirement for flame retardant and fire resistive characteristics of plastic insulated cables
- F. GB/T 13033 (IEC60702): Mineral insulated cables and their terminations with a rated voltage not exceeding 750V.
- G. GB/T3956 (IEC 60228): Conductors of insulated cables
- H. GB/T 19216 (IEC60331): Test for electric cable under fire conditions-circuit integrity.
- I. GB 12666: Test method on electric wires or cables under fire condition.
- J. GB 11033: Basic technical requirements for power cable accessories with rated voltages up to 26/35KV
- K. GB/T 18380 (IEC60332): Test on electric and optical fiber cables under fire conditions
- L. GB 50217: Code for design of cables of electric engineering.
- M. GB 50054 : Code for design of low voltage electrical installation
- N. JGJ16: Code for electrical design of civil buildings
- O. GB/T 17650 (IEC60754): Test on gases evolved during combustion of material from cables.
- P. GB/T 17651 (IEC61034): Measurement of smoke density of cables burning under defined condition
- Q. GB2681 : Cables color in electric switchgear

- R. GB50303 : Code of acceptance of construction quality of electrical installation in building
- S. GB50168: Electrical installation- code for cable installation and acceptance.
- T. Technical specification for mineral insulated cable laying

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Field quality-control test reports.

**1.6 QUALITY ASSURANCE**

- A. China Compulsory Certification (CCC).

**1.7 PROJECT CONDITIONS**

- A. Wire and cable routing where shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
- B. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.
- C. Where wire and cable routing is not shown, power cables shall maintain separation from data conductors as specified in GB 50168 Standard.

**PART 2- PRODUCTS**

**2.1 CONDUCTORS AND CABLES**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Far East Cable Company., Ltd --Far East Cable
  2. Baosheng Science & Technology Innovation Inc.--Baosheng Cable
  3. Qing Dao Han Lan
  4. Or approved equivalent.
- B. Copper Conductors: Comply with GB/T 3956.
- C. Conductor Insulation: Comply with GB/T 12706.1.
- D. Multiconductor Cable: Comply with GB/T 12706.1.
- E. The color of the cable and conductor is as follows:

Voltage	PHASE	Label	208/120V(China )	380/220V(China )	480/277V(China )	IEC/Most Europe
Conductor color	A	L1	Black	Yellow	Brown	N/A
	B	L2	Red	Green	Orange	N/A
	C	L3	Purple	Red	Yellow	N/A
	EARTHED/ N	N	Light/Blue	Light/Blue	Light/Blue	N/A
	EG/PE	PG	Green/Yellow	Green/Yellow	Green/Yellow	N/A

## 2.2 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Far East Cable Company., Ltd --Far East Cable
  - 2. Baosheng Science & Technology Innovation Inc.--Baosheng Cable
  - 3. Prysmian Cable Co., Ltd.
  - 4. Qingdao Hanlan
  - 5. JiangNan
  - 6. Or approved equivalent.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- C. Spring wire connectors: Corrosion-resistant, live-action spring in insulated shell, rated 105°C.
- D. Connectors and lugs: Circumferential compression (non-indenter) type.

## 2.3 CABLE FOR GENERAL WIRING WITH MINERAL INSULATION

- A. MI (mineral insulated) cables shall have copper conductors and copper sheath and shall comply with GB/T 13033 (IEC 60702). Unless otherwise specified, cables shall be heavy duty (750V) class and unless otherwise specified shall be sheathed with an LSF material colored orange for general power circuits and red for fire alarm and emergency lighting circuits. Plastic coated fixings and terminal shrouds shall be the same color as the cable sheath.
- B. Where specified MI cables shall have twisted conductors. The frequency of twist shall be at least 20 per meter. The sheath shall have suitable markings to differentiate the cable from untwisted conductor cables.
- C. All grades of cable, terminations, fixings, accessories and all special tools used shall be made by the same manufacturer as the cable itself.
- D. Unsheathed cables shall not be buried in concrete or plaster or installed on galvanized cable tray unless specifically shown on the Drawings.
- E. Terminations shall comply with GB/T 13033 (IEC60702), and shall be suitable for the temperature range indicated in the schedules. Unless shown otherwise on the drawings, glands shall be used at all terminations. Sealing pots and glands shall be marked with the appropriate cable reference.
- F. Terminations shall be made strictly in accord with the manufacturer' s recommended procedures, a copy of which shall be made available on request. Installers shall be fully conversant with the recommended procedures.
- G. Glands and seals shall not protrude into plain hole accessory boxes and prevent the fitting of the accessory. In such case glands having an internal thread shall be used and shall be secured to the box with an externally threaded brass bushing.
- H. Terminations of sheathed MI cables shall be protected by the correct size of plastic gland shroud. Any exposed metal sheath remaining after the installation of the cable gland shall be wrapped with tap, as supplied by the cable manufacturer, before fitting the gland shroud.
- I. Conductors at terminations shall be insulated with continuous lengths of sleeving suitable for the temperature rating of the termination. Conductors shall be identified by short lengths of colored sleeving slid over the insulating sleeving or alternatively the insulating sleeving may be self colored. The colors shall be as defined in GB 2681.

- J. Conductors of 6mm<sup>2</sup> or greater cross-sectional areas shall be terminated with compression or cone grip lugs. Conductors of 4mm<sup>2</sup> or less may be terminated with compression lugs or unscrew clamp or pinch screw terminals. Dies and crimping tools shall be suitable for crimping solid conductors
- K. Cable ends shall be sealed immediately after cutting, either by the permanent seal or by being dipped in bituminous compound
- L. Unused cores in multi-core cables shall be bonded to earth
- M. MI cables shall have plastic outer covering when installed under the following conditions:
  - 1. Cables are exposed to weather.
  - 2. Atmosphere is likely to cause corrosion.
  - 3. Cables are laid upon or fixed direct to a concrete or stone surface subject to dampness.
  - 4. Cables are laid upon or fixed to a zinc coated surface, e.g. a galvanized cable tray or corrugated sheeting, subject to dampness
  - 5. Cables are buried direct in the ground
- N. MI cables buried in concrete brick or other building structure, installed in refrigerated space or areas where the temperature is persistently below 0° C shall be without plastic outer covering.
- O. The outer covering shall be of low smoke halogen free, or low smoke zero halogen, i.e. evolving very low content of smoke or corrosive gases during combustion when tested to IEC 754

### PART 3- EXECUTION

#### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
  - 1. Conductor: Copper. Solid for 6mm<sup>2</sup> AWG and smaller; stranded for 10mm<sup>2</sup> and larger.
  - 2. Insulation: For normal cable, the insulation material is cross linked polyethylene insulated(YJY). For MI cable, the insulation material is Magnesia insulation.
- B. Branch Circuits:
  - 1. Conductor: Copper. Solid for 6mm<sup>2</sup> and smaller; stranded for 10mm<sup>2</sup> and larger.
  - 2. Insulation: For YJY or BYJ cable, the insulation material is cross linked polyethylene insulated
  - 3. For BV wire, the insulation material is polyvinyl chloride insulation.
- C. Motors and equipment connections subject to vibration: Copper. 4mm<sup>2</sup> and larger, stranded conductor, single conductor.
- D. Use stranded conductor, single conductor, 2.5mm<sup>2</sup> minimum for control wiring.

#### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Single conductors in raceway.
- B. Exposed Feeders: Single conductors in raceway.
- C. Feeders, Branch Circuits, and Control Wiring Concealed in Ceilings, Walls, Partitions, and Crawlspace: Single conductors in raceway.
- D. Feeders, Branch Circuits, and Control Wiring Concealed in Concrete, below Slabs-on-Grade, and Underground: Single conductors UL rated for wet locations in raceway.

- E. Feeders, Branch Circuits, and Control Wiring Installed below Raised Flooring: Single conductors in raceway.
- F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

### **3.3 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Conceal cables in finished walls, above ceilings, and in floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install all conduits parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- F. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- G. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

### **3.4 FEEDER REQUIREMENTS**

- A. Contractor shall provide lugs, compression fittings, auxiliary wireways, etc., of adequate size for termination of feeder sizes as indicated on drawings. Feeder sizes indicated may be oversized for voltage drop in some cases. Contractor shall coordinate with equipment manufacturer for proper lug sizes.
- B. Extend feeders at full capacity from origin to termination.
- C. Feeders shall be continuous, without splices in so far as, practical. All feeder splices not specifically indicated on drawings must be prior approved by engineer in writing before splicing any cable.
- D. Each conduit raceway shall contain only those conductors constituting a single feeder circuit.
- E. Where multiple raceways are used for a single feeder, each raceway shall contain a conductor of each phase and neutral, if used, and a grounding conductor.
- F. Where feeder conductors are run in parallel, conductors shall be of same length, same material, circular-mil area, insulation type, and terminated in same manner.
- G. Where parallel feeder conductors are run in separate raceways, raceways shall have same physical characteristics.
- H. Feeders shall follow most accessible routes, concealed in construction in finished areas, exposed to the minimum temperature gradient and to minimum temperature fluctuation.
- I. Confine feeders to insulated portions of building, unless otherwise shown.
- J. Trapped runs without facilities for continuous drainage are not acceptable.
- K. Do not draw conductors into conduits until building is enclosed and watertight and until work which may cause cable damage has been completed.
- L. Feeders shall be sized for a maximum voltage drop of 2%.

### 3.5 BRANCH CIRCUIT REQUIREMENTS

- A. Do not use wire smaller than 1.5 mm<sup>2</sup> (unless otherwise noted) for branch circuit wiring, including motor circuits. All 16 amp, 220 volt branch circuit homeruns (to panelboard) serving receptacles, equipment, and lighting shall be 1.5 mm<sup>2</sup> minimum to first outlet or light fixture.
- B. Size home runs for 220V branch circuits based on the overall circuit length to the furthest outlet. The following requirements shall be followed:
  - 1. For other branch circuits, size conductors so that voltage drop does not exceed 3%.
- C. All 220 volt branch circuits shall have a dedicated neutral conductor for each circuit.
- D. The plans show a circuit number for each device or light. This is done for clarity. No more than three 220 volt circuits shall be allowed in a single home run conduits.
- E. Arc Fault Circuit Interrupter circuits shall have dedicated neutrals for each circuit, sharing of neutrals will cause nuisance tripping and is not allowed.
- F. For isolated ground receptacle circuits, provide a dedicated neutral conductor and a dedicated isolated ground conductor for each circuit.
- G. Any branch circuit protected by a RCD circuit breaker shall be provided with a dedicated neutral conductor.

### 3.6 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 150 mm of slack.
- D. Clean conductor surfaces before installing lugs and connectors.
- E. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- F. Use compression connectors for conductor splices and taps, 16mm<sup>2</sup> and larger. Use compression tool designed for the size and type of connector being compressed. Tape uninsulated conductors and connector with electrical tape to 150% of insulation rating of conductor.
- G. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10mm<sup>2</sup> and smaller.
- H. Where oversized conductors are called for (due to voltage drop, etc.) provide/install lugs as required to match conductors, or provide/install splice box, and splice to reduce conductor size to match lug size.

### 3.7 MOTOR AND EQUIPMENT WIRING

- A. Furnish and install motor circuits in accordance with schedules on drawings and code requirements, from source of supply to associated motor starter, and from starter to motor terminal box, including necessary and required intermediate connections.
- B. Conductor and conduit size for motor branch circuits, if shown on drawings, are sized for motor requirement only. Contractor may, at his option, include associated control conductors in same conduit providing the conduit size is adjusted to meet code requirements for percentage of fill.

- C. Motors shall have proper size wire as per applicable codes and nameplate ratings. Verify ratings of motors before installing wiring.
- D. Obtain manufacturer's wiring diagrams of electrical equipment furnished with equipment and do not proceed to wire equipment without this information.
- E. Before installing raceways and pulling wire to any mechanical equipment, verify electrical characteristics with final submittal on equipment to assure proper number and AWG of conductors. (As for multiple speed motors, different motor starter arrangements, etc.).
- F. Make equipment connections with flexible conduit or liquid-tight flexible metallic conduit. Properly ground non-current carrying metal parts of equipment. Where cord connections or receptacles are required, provide type "S" rubber jacketed cord, 1000 volt, heavy duty service of sizes and lengths required, and receptacle as applicable.
- G. Coordinate work with the other trades such that the operation of mechanical equipment will be as described in mechanical specifications.
- H. Unless otherwise indicated on drawings or in specifications, motors shall be furnished, set in place, and connected to driven equipment and prepared for operation as specified in other sections. Provide final connection and proper phase relationship to achieve proper motor rotation.

### **3.8 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### **3.9 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

### **3.10 FIELD QUALITY CONTROL**

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors.
  - 2. Visual and Mechanical Inspection
    - a. Compare cable data with drawing and specifications
    - b. Inspect exposed sections of cables for physical damage and correct connection in accordance with single-line diagram.
    - c. Inspect bolted electrical connections for high resistance. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
    - d. Inspect compression-applied connectors for correct cable match and indentation.
    - e. Inspect for correct contractor identification and phase arrangements.
    - f. Inspect jacket insulation and condition.
  - 3. Electrical Tests
    - a. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be equal to the potential rating of the cable. Test duration shall be one minute.
    - b. Perform continuity tests to insure correct cable connection.
  - 4. Test Reports: Prepare a written report to record the following:

- a. Test procedures used.
  - b. Test results that comply with requirements.
  - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Remove and replace malfunctioning units and retest as specified above.

**END OF SECTION**