SECTION 26 05 19
BUILDINGWIRE AND CABLE

PART 1 – GENERAL

1.03 GENERAL REFERENCE

A. The work of this section is integral with the whole of the contract documents and is not intended to be interpreted outside that context.

B Coordinate the work with all other services affecting the work of this section.

1.03 DESCRIPTION OF WORK

A. This section to include all labours, materials and accessories for the complete performance of all wires and cables system in accordance with the specification and drawings.

1.03 RELATED WORK UNDER OTHER SECTIONS

A. Basic Electrical Materials and Methods

B. Raceway & Boxes

C. Switchboards

D. Distribution Panel Boards

1.04 APPLICABLE STANDARDS REFERRED IN THIS SECTION

A. Cables and wires shall comply with the following standards as appropriate.

1.	BS 6004 IEC 227	:	PVC insulated cables (non-armoured) for Electrical Power and Lighting.
2.	BS 6346	:	PVC insulated cables for Electrical Supply.
3.	BS 6746	:	PVC insulation and sheaths
4.	BS 5467 IEC 502	:	Armoured cables with thermosetting insulation.
5.	BS 6480, 6007	:	Lead Sheathed Cables
6.	BS 5468 IEC 502	:	Cross linked polyethylene Insulation
7.	BS 6500 IEC 227	:	Insulated Flexible Cords.
8.	BS 6207 IEC 245	:	Part-1 Mineral Insulated Cables

9.	BS 6360	:	Copper Conductors for Cables
10.	BS 6234	:	Polyethylene Insulation and Sheath for Cables.
11.	BS 2897	:	Aluminum Strip Armour for Cables
12.	BS 1442	:	Galvanized Mild Steel wire for Armouring Cables.

B. Cable termination shall comply with the following specifications:

1.	BS 4121	:	Mechanical cable glands.
2.	BS 4579	:	Performance of Mechanical and Compression Joints for cables.
3.	BS 6081	:	Termination of M.I.C.C. Cables.
4.	BS 6121	:	Mechanical Cable Glands for Elastomer and Plastic Insulated Cables.

1.05 QUALITY ASSURANCE

1. For cables to be Engineered by the Contractor determine the correct size based on current rating and/or voltage drop, as relevant, after taking into consideration.

   a). Type of Cable and Wire

   b). Ambient Conditions

   c). Method of Installation

   d). The disposition of each cable relative to other cables.

2. Calculate voltage drop and current ratings based on information given in MOE regulations or IEE Regulations, whichever is more stringent.

3. All cables and wires shall be suitable for installation and continuous services in the ambient conditions described in section 16010.

4. Unless otherwise specified, cables and wires of the following specified voltage ratings shall be used as indicated.

a.	600/1000V rated cables:		Main and sub-main distribution panels.
b.	450/750V rated cables:		Final sub-circuit supplies from lighting, socket outlets, etc.
c.	250V rated cables	:	Extra low voltage wiring, communication circuits

where the maximum voltage is 50V.

d. All multicore cables shall be 600/1000V rated.

Refer to relevant sections of the specification for details of cable types.

1.06 SUBMITTALS

A. Shop Drawings and Product Data

1. Submit full technical details of each type of cable or wire proposed with sample.

2. Submit copy of test certificates from the manufacturer or an independent testing authority confirming that cables comply with the specifications.

3. Submit exact route of the cable run and relevant sections in the shop drawings.

1.07 PRODUCTS DELIVERY, STORAGE AND HANDLING

A. Reference Section 16050.

B. Each drum length of cable shall be alloted a distinct and separate reference number. This number shall appear on the test certificates covering the respective length of cable and shall also be clearly marked on the cable drum.

C. The Contractor shall advise the Engineer upon delivery to site of each drum length, quoting the reference number, the test certificates shall be handed to the Engineer for examination and approval.

D. All cables shall be delivered to site with the manufacturers seals, labels or other proof of origin intact. These labels and seals shall not be removed until the cable is required for use and shall be retained for inspection by the Engineer.

E. The Contractor shall be responsible for the off-loading and handling of the cables on site, and shall ensure that cables are delivered to site on drums and properly protected against mechanical damage. Where lengths are cut from cables, the open cable ends shall be sealed.

PARTS - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS FOR ENVIRONMENTAL CONDITIONS

A. The contractor shall be aware of the need to supply and install all wire and cables for this contract which are most suitable for the special environmental conditions prevailing in Kuwait.

B. All conductors shall have good fatigue resistance and not subject to breaks due to nicks or cuts when terminating.

C. All power cables to be laid underground inside the Refinery premises by the Contractor shall be PVC insulated; lead covered, steel wire Armoured, Overall PVC sheathed copper conductor cable.

D. All multi core, electrical control and annunciation cables to be laid under ground inside the

Refinery premises by the Contractor shall be PVC insulated, lead covered, steel wire Armoured; Overall PVC sheathed copper conductor cable.

2.02 CABLES

A. General

1. Conductors shall be high conductivity copper, to BS 6360 unless otherwise indicate.

2. Copper conductors shall be stranded for Section 4 sq.mm and over.

3. Signal control cables shall have solid conductors.

4. Flexible cords shall have fine stranded conductors.

5. Conductors sizes shall be metric. Conductors with cross sectional areas smaller than those specified will not be accepted.

6. Insulation for each conductor shall be colour coded or otherwise identified as required by the Regulations. Colour coding shall be maintained throughout the installation.

7. The current carrying capacity of conductors has been determined in accordance with the specified Regulations, the specified type of insulation and the expected conditions of installation.

8. All cables shall be, as far as practicable, of one manufacturer only. All cables shall comply with the relevant IEC/BS.

B. PVC Insulated, Single Wire Armoured and PVC Oversheathed (PVC/SWA/PVC) Cable.

1. Multicore PVC/SWA/PVC cable: 600/1000V grade, to BS 6346.

2. Conductor: Annealed high conductivity copper, stranded, shaped and laid in an approved manner.

3. Armour: single layer of galvanized steel wires for multicore cables and aluminum wire or tape for single core cables.

4. Insulation: colour coded to BS 6746C.

5. PVC for sheath and insulation : to BS 6746

C. PVC Insulated PVC Sheathed (PVC/PVC) Cable

1. To BS 6346,600/1000V Grade.

2. Conductor: annealed high conductivity copper, stranded, shaped and laid in an approved manner.

3. Insulation: Colour coded to BS 6746C.

4. PVC for sheath and insulation: to BS 6746.

D. PVC Insulated Wires

1. Single core cables shall be to BS 6004, rated 450/750V, with high conductivity copper conductors and PVC compound insulation. Colour coding shall be:

Red	:	Phase 1
Yellow	:	Phase 1
Blue	:	Phase 3
Black	:	Neutral
Green/Yellow or Green	:	Earth

2. Wires shall be continuous from outlet to outlet and no splice shall be made except within outlet and junction boxes. A separate neutral wire shall be provided for each circuit wires shall be left sufficiently long enough to permit making final connections.

E. Heat Resistant Cable

Tinned copper conductors insulated with silicone base rubber compound

F. Flexible Cable

1. To BS 6004, rated in accordance with manufacturer's tables.

2. Flexible cables subject to excessive heat shall be insulated with silicone base rubber compound with an overall varnished glass fibre braiding.

G. XLPE Cable

1. To BS 5468, 1000V grade.

2. Conductors: plain annealed copper to BS 6360.

3. Cables shall comprise plain copper, stranded circular conductors insulated with an adequate thickness of:

   a. Low density polythene: melt index 0.3 (polythene), or

   b. Extruded cross linked polythene (XLPE); or

   c. Extruded ethylene propylene rubber (EPR).

4. Conductors shall be laid up together and warmed circular with suitable performed fillers and warnings, bound with polythene terephthalate (PTP) tape and covered with an extruded PVC sheath minimum 1.4mm thick.

5. Multicore cables shall have steel wire or tape armouring extruded sheath of black PVC, PCP or CSP.
6. Single core cables shall have aluminum wire or tape armouring.

7. Outer sheath or single and multicore shall be at least 2.5mm thick.

8. Design electrical stress at any point in the insulation shall not exceed:

   a. For polythene and XLPE: 3 KV per mm.

b. For EPR: 4 KV per mm.

9. Conductor screen: non-metallic comprising either:

a. Semi-conducting tape; or

b. A layer of extruded semi-conducting material.

10. The electro-static screen over insulation shall comprise a nonmetallic layer of semi-conducting material applied over the insulation and in direct contact with it, followed by a layer of copper tape applied helically over the semi-conducting layer to ensure close contact throughout.

11. Prevent void formation in insulation by:

a. Polythene and XLPE: careful control of its passage through the temperature graded water baths:

b. EPR: careful control of the vulcanizing and cooling processes.

H. Fire Rated Cable

- To BS 7671/IEE wiring regulations.
- Conductor: Plain annealed copper stranded conductor for flexibility.
- Insulation high performance damage resistance.
- Scream: Aluminium/polyster tape screen in contact with full size tinned annealed copper stranded circuit protective conductor.
- Sheath: Robust thermoplastic sheath.

2.03 SUNDRIES

A. Joints

1. For conductors up to 16 sq. mm barrel type connectors with pinching screws, the whole shielded in porcelain or hard resistant materials are not permitted.

2. For conductors exceeding 16 sq.mm : to be made with bakelite shrouds.

B. Jointing Boxes

1. For internal use intermediate joints are necessary on MICC mains cable: to be suitably sized galvanized malleable iron adaptable box with glands and fixed base mechanical clamping connectors of approved design. For external use the jointing box shall be enclosed in a second galvanized box with glands.

2. For use on plastics and elastometer insulated cables: type recommended by cable manufacturers having an inner box with provision for making a watertight seal into inner sheaths of cables, on an outer cast iron box with provision for making a watertight seal to cable outer sheaths, clamping cable armour and bending the armour across the joint.

C. Compression Glands

1. For terminating plastic or synthetic cables to switchgear and other equipment: to BS 6121 and to approval.

D. Termination Boxes

1. For terminating paper insulated cable suitable cast iron or welded steel termination box, with:

    a. Cast or pressed brass coned wiping glands:

    b. Substantial armour clamps;

    c. Compound filling point;

    d. Air vent for enclosed boxes.

E. Cable Terminations

1. For plastics or synthetic rubber insulated cable: suitable brass compression glands, unless otherwise recommended by cable manufacturer. Glands for armoured or screened cables shall have suitable clamps therefore.

2. External compression glands shall have close fitting PVC shrouds.

3. Earthing for armouring and metallic sheaths: suitable brass or copper clamps, and copper strip conductor of selection not less than MOE Regulations requirements and not less than 2.5 sq.mm.

F. Cable Sockets

1. To be correct size for type of cable.

2. To be sweating type, or an approved crimping type used with an approved crimping tool.

3. Sweating sockets for conductors 70 sq.mm and over: machined cast brass.

G. Fire Barriers

1. To be purpose made, comprising a rigid fixed frame with adjustable seals and a suitable clamping device.

2. In fire compartment separation walls and floors; to be same standard of fire resistance as wall or floor.

H. Cable Covers

1. To BS 2484.

2. Concrete covers exceeding 300mm wide shall be reinforced.

I. Pipe Ducts

1. To be PVC or asbestos cement, as indicated.

J. Solder

1. An alloy of lead and tin to BS 219 grade F or H, unless otherwise recommended by cable manufacturer.

K. Cable Sealing Compounds

1. To be:

   a. To BS 1858 and

   b. Approved by cable manufacturer.

2. To be tropical grade in location where normal ambient temperature is likely to exceed 30°C.

3. To be an oil-resisting compound where the difference in level between cable ends exceeds 6m.

L. Cleats

1. To be cast aluminum, gunmetal or brass of approved type.

PART 3 - EXECUTION

3.01 INSTALLATION GENERALLY

A. Installation Cables Generally

1. Pull cable into position by hand, where possible using an adequate number of operatives suitably positioned along cable length.

2. Obtain approval of pulling cables by winch or similar appliance.

3. When pulling by winch or the like, fit a suitable tension gauge into the haulage line between winch and cable. Pulling tension shall not exceed the limit recommended by the cable manufacturer.

4. Do not allow cable to twist or rotate about its longitudinal axis.

5. Lay 3-phase groups of single core cables in trefoil formation. If this is not possible obtain instructions.

6. Install cables to allow any one cable to be subsequently removed without disturbing the remainder.

B. Bending Radius

1. Keep as large as possible and do not allow cable to bend to a radius less than that specified in IEE Regulations or relevant BS.

C. Underground Cables

1. Lay in pipe ducts, or direct in the ground, as indicated

2. Obtain approval of trenches before laying cable.

3. Do not lay cables direct into ground if a corrosive agent is present.

4. Run cables at least 30mm clear of other services, whether the later run parallel or transversely to cable trench.

5. Run cables below intersecting piped services, unless the cable would be at a depth exceeding 2m, in which case seek instructions.

6. Cables shall not cross in trenches.

7. Protect cables with a continuous layer interlocking concrete or earthenware covers.

8. Width of covers:

   a. For single cables: 100mm (minimum) greater than cable diameter.

   b. For multiple cables: 100mm (minimum) greater than cable aggregates of cable diameters.

9. Draw cable into pipe ducts where they:

   a. Cross roads and paved areas; except under removable tilling finish

   b. Pass through corrosive soils;

   c. Enter buildings.

D. Above Ground Cables

1. Protect exposed cables where they are likely to be damaged.

2. Run cables at least 50mm from each other.

3. Run cables at least 150mm from piped services.

E. Jointing

1. Joints in wires and cables shall be avoided wherever possible. Joints in flexible cables and cords are not permitted. Where joints are unavoidable they shall be permanently accessible and made only in junction boxes.

2. Leave at least 150mm of free conductor at each outlet, switch point and pull box for the making up of joints or the connecting of fixtures and devices, except where conductors are intended to loop without joints through lamp holders, socket outlets and the like.

3. Complete joints and termination in the shortest time without interruption.

4. Do not commence jointing and terminations without approval, except where the work is in a dry, weather-proof places.

5. Do not make joints in wet or dirty conditions.

6. Make outdoor joints under a suitable tent or shelter.

7. Fill joints with compound filling in stages to allow the material to flow. Do not allow compound to cool to the point where re-heating is necessary.

8. Ensure sealing compounds are pouring at the correct temperature check compound level

and top up if necessary, after cooling.

9. Make intermediate joints on plastics and elastomer insulated cables in a joint box. Arrange to have each joint inspected by the Engineer before closing and filling.

10. External joints on MICC cable: fill other box with jointing compound.

11. Joint cable in straight through joints and main cables in tees and other branching joints core to core.

F. Terminations

1. Take cable cores through the termination box directly to equipment terminals, without crosses, unless impracticable and make off with sweated cast brass or hydraulically crimped sockets.

2. Sweet cable core solid 25mm on each side of compound level and over-tape the exposed core insulation with two layers of PVC or other approved tape in appropriate phase colour, half-lapping the tape.

3. Plumb the cable sheath to the brass wiping gland, neatly lay back the armour wires over the gland and fix with an armour clamp effectively bonded to earth.

4. Cut back tape of tape armoured cables neatly below the wiped gland, thoroughly clean, secure with a suitable armour clamp and bond to the body of the terminating box with two soft copper tapes at least 70sq.mm aggregate cross section.

5. Equipment to which cables are connected will have blank, undrilled gland plates. Drill holes necessary for fitting glands.

G. Cable Support

1. Run single core cables used to make up 3 phase circuits in trefoil formation, unless otherwise indicated, and support in cleats.

2. Adjust spacing of cable supports and fixing devices below the specified maximum as necessary to prevent cables sagging and where cables must deviate to pass obstructions.

3. PVC/SWA/PVC cables: run on cable trays as indicated.

4. PVC/PVC cables: run on cable trays.

5. XLPE cables: run on cable trays as indicated

H. Heat Resistant Cables

1. In areas where a constant ambient temperature exceeding 55°C will occur, run all final sub-circuits in heat resistant cable.

2. Make conversion from PVC cable to heat resistant cable with a fixed block connector housed and fixed into a conduit box or equal, except where the conversion of cable types emanate from a switch, ceiling rose or similar fixed connector accessory.

I. Flexible Cables

1. Keep flexible to a minimum

2. Install out of sight.

3. Mechanical retainment shall not depend on electrical connections.

3.02 INSTALLING CABLE IN CABLE TRAYS

A. Generally

1. Install cables on trays in a single layer, unless otherwise specified.

2. Use purpose made straps or saddles to maintain cables in a neat regular disposition.

3. Secure cables with load bearing cleats securely fixed to the tray, where trays do not directly support the cables.

4. Space cleats saddles and straps at maximum centers recommended in MEW Regulations.

B. Direct Buried System

1. When practical, cable trenches shall run through unpaved areas. Where the cable trench passes beneath paved areas, such as in process paved areas, the paving shall be scored to indicate the trench location. Markers indicating cable voltage and cable location shall be provided at points in unpaved areas where the trench changes direction and also at 100-foot intervals. The location of the markers at each point shall be as follows.

Trench Width	Marker Location
Larger than 4 feet	At each edge of trench and between each voltage class
2 feet – 4 feet	At each edge of trench
Less than 2 feet	At one edge of trench with arrow pointing to opposite edge

Where markers projecting above grade level obstruct passages, walkways, etc, flush or tapered markers shall be used.

3.03 TESTS AND INSPECTION

Test shall be performed at the manufacturer's plant in accordance with BS-6004, BS-6346 BS-5468, BS-5467, BS-6746 where applicable for different cables.

The manufacturer shall submit the test report to the purchaser for approval.

END OF SECTION