7 CONDUITS AND CONDUIT BOXES

7.1 GENERAL

7.1.1 General Reference

1 The work of this section is integral with the whole of the Project Documentation and is not intended to be interpreted outside that context.

2 Co-ordinate the work with all other services affecting the work of this section.

3 Related Parts and Sections are as follows:

This Section
Part 1..... General Provisions for Electrical Installation
Part 6..... Cables and Small Wiring

7.1.2 References

1 The following references are referred to in this Part:

BS 2782 .....Method of testing plastics

BS 4568 .....Steel conduits and fittings, metric units

BS 4607 .....Non-metallic conduits and fittings for electrical installations rigid PVC conduits and conduit fittings, metric units

EN 50086-1:1994 .....Flexible steel conduits and adapters for the protection of electric cable.

EN 60423 .....IEC 423-A, Conduit diameters and threads for conduit and fittings.

7.1.3 Description

1 This Section to include the supply, installation and commissioning of all conduits works in accordance with the Project Documentation.

2 General:

(a) light and power circuits, fire alarm, telephone, signal, and other low current system wiring shall be drawn in conduits unless otherwise indicated.

(b) conduit system shall generally be concealed and installed as indicated, unless otherwise indicated.

(c) light and power circuits, fire alarm wiring, telephone wiring, signal wiring and low current system wiring shall each be run in separate conduit and wire way.

(d) cable insulated for two different categories of circuit shall be segregated.

(e) irrespective of service, conduit and fitting used shall be:

(i) where embedded: heavy gauge rigid PVC complying to BS 4607, BS 6053 and BS 6099 Part 2, section 2.2.

(ii) where surface mounted, exposed: galvanised steel conduit as per BS 4568

(iii) where installed above false ceilings and in voids: galvanised steel throughout the circuit

(iv) where installed in flame proof and hazardous areas: galvanised steel

(v) from terminal box to machine: flexible steel conduit as per EN 50086-1

7.1.4 Submissions

1 Samples:

(a) cut-away samples of all sizes of conduits, conduit boxes and fittings of each type shall be fixed to a board and submitted to the Engineer.

2 Product Data:

(a) at the time of submitting samples submit manufacturer's details, catalogues and copies of test certificates confirming that offered types comply with the Specification.

3 Shop Drawings:

(a) submit drawings of proposed conduit layout and obtain approval before commencing work.

7.2 PRODUCTS

7.2.1 Rigid PVC Conduit and Fittings

1 Standards:

(a) Conduit and fittings shall comply with BS 4607: Part 1 and CEE Publication 26 or revised/amended/updated standards. In addition, conduit and fittings shall comply with this specification where requirements are more stringent

(b) Conduit diameters shall comply with QGEWC regulations.

2 Physical Properties:

(a) conduit and fittings shall be:

(i) resistant to high temperatures

(ii) non-hygroscopic

(iii) self-extinguishing

(iv) of adequate insulation resistance and electric strength

(v) inert to all liquid normally discharged from residential, commercial and industrial premises

(vi) suitable for installation, storage and transportation at temperature not normally below -5 ° C. or above 85 ° C. and at these temperatures shall not:

- soften or suffer any structural degradation
- show signs of cracking, or deform so that cables cannot be easily drawn in or are likely to be damaged when drawing in, when bent, compressed or exposed to extreme temperature

(vii) of adequate mechanical strength and thermal stability

(viii) suitably and indelibly marked and identified. Markings shall include nominal size and be easily legible

(ix) Smooth inside and outside and free from burrs and sharp edges. Surfaces and corners over which cables may be drawn shall be smooth and well rounded.

3 Sizes of Conduit:

(a) (minimum 20 mm, internal diameter unless otherwise indicated

(b) where size is not indicated: select in accordance with the regulations and as proper to the number and size of conductors.

(c) The minimum conduit wall thickness shall be as per the following:

CONDUIT SIZE (mm)	CONDUIT WALL THICKNESS (mm)
20	1.8
25	1.9
32	2.3
38	2.5
50	3.1

4 Fittings:

(a) conduit entries shall be designed to ensure a watertight joint.

5 Expansion fittings:

(a) type to be approved.

6 PVC Conduit Boxes:

(a) PVC Conduit Boxes can be used through PVC Conduit raceway system and shall comply with BS 4607

(b) metallic conduit boxes as specified elsewhere in this section can be used alternatively if required for PVC conduit raceway system

(c) all boxes shall be provided with tapped brass inserts for fixing the screws

(d) all boxes for switches, sockets, outlets, etc., shall be rigid PVC or metallic type and their dimensions shall be suitable for fixing the switches, sockets and other accessories.

7.2.2 Rigid Steel Conduit and Fittings

1 Rigid Steel Conduit

(a) all metallic conduits shall comply with BS 4568 and of Class 4 rigid steel screwed type having an interior and exterior zinc coating of uniform quality and appearance throughout all surfaces

(b) conduits shall not be less than 20 mm diameter size, and shall be complete with all necessary threaded fittings, couplings and connecting devices having galvanised equivalent finish

(c) conduits and fittings shall be manufactured specially for electric wiring purposes. When manufactured by a continuous weld process, weld heads both inside and outside the tube shall be completely removed prior to galvanising

(d) all conduits and fittings shall be free from rust or other defects on delivery to the site and shall be properly stored in covered racking so that it is protected from mechanical damage and damage by weather and water whilst stored on the site

(e) all conduits shall be coupled to boxes and trunking wires using brass male bushes. All such bushes shall be hexagon headed, heavy duty long threaded type

(f) all conduit expansion couplings used shall be fabricated from material equal or equivalent to that of the conduit with which the coupling is to be used, having factory installed packing ring and pressure ring to prevent entrance of moisture. All coupling shall be equipped with earthing ring or earthing conductor

(g) all conduit runs shall be fixed using spacer bar pattern saddles giving not less than 3 mm clearance between the conduit and the surface to which it is fixed. Saddles shall have finish to match the conduit and saddle clips shall be secured to the bar by means of brass screws.

2 Metallic Conduit Boxes:

(a) metallic conduit boxes shall be used throughout metallic conduit raceway systems, and shall comply with, or be of demonstrated equivalent quality and performance to BS 4568 requirements. All boxes and covers shall be galvanised, zinc plated or rust-proof finish equivalent to conduit finish

(b) circular and/or rectangular boxes shall be used for pull boxes and terminating boxes, according to size and number of conduits connected to box. Boxes shall be either malleable iron or heavy duty steel construction with welded joints and tapped holes to receive metal threaded cover retaining screws. Self tapping screws will not be permitted

(c) all boxes, other than those to which a fitting or accessory is to be directly mounted shall be fitted with covers screwed to the box by brass screws. Malleable iron covers shall be used with malleable iron boxes and heavy gauge steel covers shall be used with sheet steel boxes

(d) all cover and accessory fixing provisions shall be so positioned that the fixing screws lie completely clear of cable entering the box. All fixing screws shall be of brass all boxes installed in exterior locations, plant rooms, ducts, etc., shall be fitted with approved type gaskets to provide a waterproof seal between box and cover or other items fitted to the box

(e) all boxes provided as junction boxes where cable joints are specified or permitted, shall be provided with fixed terminal blocks. Such boxes shall be of suitable size to contain the terminal block and sufficient cable to allow neat connections to be made. The terminal blocks shall be fixed to the box by brass screws and shall comprise brass conductor connectors, with brass clamping screws enclosed in porcelain or other heat resisting insulation material which will not distort or otherwise have its properties damaged by temperatures below the highest temperature at which the insulation of any cable connected to it is destroyed.

7.2.3 Flexible Conduit and Connections

1 Flexible Conduit:

(a) to EN 50086-1 or updated standard, watertight, PVC sheathed, spiralled stainless steel metal type and UV resistant plastic covered . The conduit shall be terminated at boxes and equipment by means of approved stainless steel or brass/bronze compression glands

(b) to be of the unpacked type for normal atmospheric conditions and non-asbestos packaged for damp situations. Adapters shall be of the solid type rust resistant (Stainless steel/Brass/bronze).

(c) flexible conduit shall be used for the final connection of rigid conduit to the terminal boxes of machines fitted with a means of drive adjustment and/or where vibrations is likely to occur.

(d) flexible conduit for use outdoors shall be weatherproof and certified to be resistant to UV radiation.

2 Flexible Connections:

(a) where connections to electrical machines are to be by multicore glands, the final termination shall be by ring type universal glands and locknuts, and adequate slack cable in the form of a loop or spiral being left to allow for the movement of motors necessitated by belt retensioning, vibration, etc.

7.3 INSTALLATION

7.3.1 Preparation

1 Sets and Bends:

(a) conduits up to 32 mm diameter; form on site with an approved bending machine using proper formers, guides, springs, etc., taking care not to deform conduit

(b) conduits over 32 mm diameter : use coupling fittings.

7.3.2 Installation of Conduit

1 General

(a) run conduit in square, symmetrical lines, parallel to or at right angles to walls and in accordance with the accepted practice

(b) conduit system shall be mechanically continuous and watertight after installation. All conduit system shall be arranged wherever possible to be self draining

(c) conduit runs between draw-in positions shall conform to QGEWC Regulations regarding no. of bends and lengths of straight run

(d) installation shall permit easy drawing in of cables

(e) keep conduits at least 100 mm from pipes and other non-electrical services

(f) where conduit runs are to be concealed in the structure or are to pass through floor slabs, the Contractor shall be responsible for marking the accurate positions of all chases and holes on site. The Contractor shall arrange the conduit routing to make maximum use of any preformed conduit holes and slots provided in structural beams. Conduit installation on shear walls shall be kept to a minimum. All routings necessary on shear walls shall be agreed with the Engineer before work is put in hand

(g) install conduits so as not to interfere with ceiling inserts, lights or ventilation outlets.

(h) install conduit in accordance with NECA "Standard of Installation." or other national standards or Codes of Practice to the approval of QGEWC.

(i) install nonmetallic conduit in accordance with manufacturer's instructions.

(j) arrange supports to prevent misalignment during wiring installation.

(k) support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

(l) group related conduits; support using conduit rack. Construct rack using steel channel ; provide space on each for 25 percent additional conduits.

(m) fasten conduit supports to building structure and surfaces under provisions of Section "Supporting Devices"

(n) do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports

(o) do not attach conduit to ceiling support wires.

(p) arrange conduit to maintain headroom and present neat appearance.

(q) route conduit parallel and perpendicular to walls.

(r) route conduit installed above accessible ceilings parallel and perpendicular to walls.

(s) route conduit in and under slab from point-to-point.

(t) maintain adequate clearance between conduit and piping.

(u) cut conduit square using saw or pipecutter; de-burr cut ends.

(v) bring conduit to shoulder of fittings; fasten securely.

(w) join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

(x) use conduit hubs or sealing locknuts to fasten conduit to boxes and fittings.

(y) install no more than equivalent of two 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate and factory elbows for bends in metal conduit larger than 2-inch (50-mm) size.

(z) avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

(aa) provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic , control and expansion joints.

(bb) provide suitable pull string in each empty conduit except sleeves and nipples.

(cc) use suitable caps to protect installed conduit against entrance of dirt and moisture.

(dd) provide supports for fittings independently of any false ceiling for sunk and concealed conduit systems.

(ee) size conduits, draw-in boxes and junction boxes in accordance with regulations.

(ff) swab whole of the conduit system to remove any loose matter or dirt before cables are pulled in.

(gg) where conduits connect to switch boxes draw-in boxes and the like the conduits must have a machined faced socket screwed on to the end which when tightened is flush with the outside of the box. The conduit is then to be secured to the apparatus by means of a hexagon smooth bore brass bush screwed from the inside of the apparatus into the conduit socket in order to make a sound and tight mechanical joint.

(hh) all horizontal runs shall be supported at no more than 900 mm. Vertical runs shall be supported at no more than 1200 mm. Where directional changes occur support shall be provided at no more than 150 mm either side of the bend.

(ii) hot bending shall be carried out on all non-metallic conduits. A bending spring of the correct size shall be used in all cases. The heat source shall be provided by a hot air torch. When the conduit is in a pliable state it shall be bent around a suitable former and held in position until the conduit has set. No other method will be approved.

(jj) couplers, slip type bends and spouted fittings shall be made using semi permanent mastic sealing compounds. Expansion couplers shall be used in surface installations where straight runs exceed 8 meters.

(kk) standard junction or adaptable boxes shall be provided at all junctions and at sharp changes of direction in addition to any special positions where they are required on Site. Inspection couplers may be used in long runs to facilitate drawing in cables.

(ll) particular care must be taken to ensure that no water is allowed to enter conduit at any time and all conduits shall be arranged with adequate ventilation and drainage where necessary as directed by the Engineer. Inaccessible junction boxes will not be allowed.

(mm) only continuous lengths of buried conduit shall be installed between boxes, no joint boxes being allowed in the floor screeds. Conduits crossing expansion joints shall be fitted with couplings of approved manufacture.

(nn) the ends of conduits laid or set in formwork prior to concreting shall be temporarily sealed off with a coupler and a plug.

(oo) fixing to surfaces of walls shall be by means of spacer bar saddles securely fixed by screws. Where conduits are concealed or laid in structural floors they shall be held in position with substantial fixings of make and pattern to be approved by the Engineer.

(pp) adaptable boxes shall be manufactured from PVC as previously detailed for conduit boxes and sized to provide sufficient space factor.

(qq) weatherproof boxes and accessories shall be used outdoors where agreed on Site by the Engineer or where indicated in this Specification or on the Drawings.

(rr) conduit shall be installed such as to permit complete rewiring without the need to remove false ceiling or carry out builders work.

(ss) no single conduit serving phase socket outlets lighting points and switches shall contain more than one phase.

(tt) wiring shall be carried out on the looping-in system and no joints other than at looping-in points will be allowed.

(uu) where the conduit system terminates at any equipment requiring a non-rigid connection a flexible conduit shall be installed of the PVC or PVC sheathed metallic type fully watertight with purpose made connection adapters.

(vv) each flexible connection shall include not less than 400mm length of flexible conduit and a separate earth conductor shall be run within the conduit connected to the earth terminals in the equipment and the fixed conduit run. The flexible conduit shall not be used as an earth continuity conductor.

2 Runs in Reinforced Concrete:

(a) obtain approval for placing PVC conduits before pouring concrete

(b) run conduits in concrete slabs parallel to main reinforcing steel

(c) additional openings in finished slabs, where approved, shall be made by drilling, not by breaking

(d) conduit boxes shall not be nailed to shuttering boards.

3 Horizontal or Cross Runs:

(a) (to be avoided in partitions and side walls.

4 Surface Mounted Conduit (including conduit installed above false ceiling):

(a) fix with distance spacing saddles to allow conduits to be taken directly into accessories without bends or sets.

5 Concealed Conduit:

(a) fix securely to prevent movement before casting of concrete and screeds, application of plaster and the like

(b) spacing of clips shall be not greater than as follows:

	Conduit size	Spacing
(i)	up to 25 mm	600 mm
(ii)	32-38 mm	900 mm
(iii)	50 mm	1000 mm

(c) Supports for exposed conduit shall be fixed at each side of bends.

6 Expansion Fittings:

(a) fix in conduit wherever it crosses as expansion joint in the structure to which it is fixed.

7 Terminations:

(a) make with a flanged coupling, lead washer and hexagonal male brass bush, where conduit runs terminate in cable trunking, distribution boards or any sheet metal structure.

8 Conduit Boxes:

(a) fix at all outlet points.

7.3.3 Installation of Flexible Conduit

1 All conduits must be secured to outlet boxes, junction boxes or cabinets by placing locknuts on outside of box and locknuts and bushings on the inside of box.

2 Conduits connecting recessed fixtures and their adjacent junction boxes must be flexible metallic conduit 20 mm minimum size and shall be of sufficient length to permit dropping of the fixture below the ceiling and to gain access to the junction box.

3 Conduit to motors shall be terminated in the conduit fittings on the motors, the final connection being made with liquid tight flexible conduit and suitable liquid tight connectors.

4 A green insulated 4 mm^2 (minimum) tinned copper earth connection shall be made between the solid conduit or cable sheath and the equipment, the copper cable being run inside the flexible conduit. Couplings fitted to removable covers or non-metallic equipment etc., shall be bonded to the earthing terminal of the equipment etc. Where changes to flexible conduits occur, a watertight outlet box with threaded entries shall be inserted and the earth connection made to an internal terminal. The cover screws shall not be used for earthing connections.

7.3.4 Cleaning

1 The conduit outlets when installed and before wiring shall be temporarily closed by means of well fitting wooden plugs, and immediately before cables are drawn in, conduit systems shall be thoroughly swabbed out until they are dry and clean

END OF PART