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NEW ADDITION



MINISTRY OF ELECTRICITY & WATER

MEW/S-1

**GENERAL SPECIFICATION
FOR ELECTRICAL INSTALLATION**

2014

MINISTRY OF ELECTRICITY & WATER

List of MEW Publications for Regulations and Codes of Practice:

Regulation or Code No.

- | | |
|---|----------|
| (1) Regulations for Electrical Installations Sixth Edition 2014 | MEW/R -1 |
| (2) Procedures for Approval of Electrical & A/C Drawings and connection of power supply for construction and buildings projects. 1st Edition 1983 | MEW/R-2 |
| (3) Electrical load form and explanatory memo 2nd Edition 1983 | MEW/R-3 |
| (4) Regulations for testing of Electrical installations before connection of power supply 1st Edition 1983 | MEW/R-4 |
| (5) General Guidelines for Energy Conservation in building 2nd. Edition 1983 | MEW/R-5 |
| (6) Code of Practice for Energy Conservation in Kuwait building and Appendices. 1st Edition 1983
Appendix No. (1): Properties and application of insulating material for buildings in Kuwait.
Appendix No. (2): Energy Conservation measures in Residential Sector Building.
Appendix No. (3): Energy Conservation Measures in Institutional and Commercial Sector Buildings.
Appendix No. (4): Energy Conservation Measures in Hospital Buildings.
Appendix No. (5): Effect of thermal mass and colour.
Appendix No. (6): Comparison between air-cooled and water cooled condensers. | MEW/R-6 |
| (7) Rules and Regulations for design of A/C System and Equipment. 3rd. Edition 1983 | MEW/R-7 |
| (8) Rules and Regulations for handing over Engineering Services (Electrical and Mechanical) to the Maintenance Authority. 2nd Edition 1983 | MEW/R-8 |
| (9) General specification for electrical installations 4th Edition 2014 | MEW/S -1 |

The Regulations can be obtained from Electrical Installation Department

Ministry of Electricity & Water

P.O. Box 12, Safat

Kuwait.

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A - GENERAL CLAUSES.

A.1 SCOPE:

A.1.1 This specification covers the supply, delivery to site, erection and commissioning of all materials and equipment required in connection with the Electrical Services of Government Projects and all other projects where this specification is specifically applied.

A.1.2 This specification does not cover street and external lighting on lighting columns. All street and external lighting including walkway lighting shall be dealt with by the Street Lighting Department - Electrical Distribution Networks Sector - MEW.

A.1.3 The external lighting that includes shaded car park lighting, decorative lighting, lighting bollards, lighting on boundary walls, up lights for trees, stair lighting, floor lighting, façade lighting, etc. are to be designed and installed in accordance with these regulations.

A.1.4 The designs of street and external lighting systems whether or not the electrical power supply is fed from the project itself or by MEW, shall be submitted to the MEW's Street Lighting Department for approval prior to submitting the drawings to the Electrical Installation Department of MEW.

A.2 GENERAL:

A.2.1 The entire works shall be carried out in strict accordance with this specification, the various electrical drawings, the schedule of points and latest issue of the Rules and Regulations for the Electrical Installation works issued by the Ministry of Electricity & Water (MEW R-1) and amendments.

A.2.2 The General Conditions of Contract and any special conditions shall be applied to the Electrical Installation, in as far as they are applicable.

A.2.3 The tenderer shall complete the form (E) for the experience of the electrical contractor or the sub-contractor and shall submit them with the offer.

A.2.4 The contractor shall refer only to those items of this specification which are applicable for the particular project.

A.2.5 The Contractor shall refer to section of "Particular specifications" for any details not included in this Standard Specifications but is required in the particular project.

A.2.6 The contractor shall refer to all relevant civil, mechanical, A/C...etc. drawings and obtain for himself the location and routes of all gas and water services, A/C ducts, etc., so as to maintain adequate clearance between electrical and other services.

The position of all fittings, fans, equipment, apparatus, etc... indicated on the drawings are to be taken as approximate only and are intended to indicate generally the arrangement of the works. The exact positions of all fittings, fans, equipment, apparatus, etc....shall be co-ordinated with other works and services and prior approval of Engineer is required.

A.2.7 Approval of Engineer does not relieve the contractor from his contractual obligation if later on found that these do not comply with (specification and) site arrangements.

A.2.8 Should any portion of the works be reasonably and obviously be inferred as necessary for the complete, safe and satisfactory operation of the installation as a whole, but not expressly described or specified, the Contractor shall notify the Engineer before executing such works.

A.2.9 The contractor shall submit all the required samples, technical details, original catalogues in English language, drawings, wiring diagram called for in the individual clauses of this specifications.

Any deviation from the specification should be mentioned clearly in the submittal under heading deviation or else the Engineer shall have the right to reject any material at any period of the contract.

A.3 ELECTRICAL SUPPLY:

All electrical works, equipment, accessories and fittings shall be designed and manufactured to operate continuously in the electricity supply system having the following characteristics:

Voltage : 415 Volts \pm 6%, 3 phase, 4 wire

240 Volts \pm 6%, single phase.

Frequency : 50 Hz \pm 4%.

Neutral : Solidly earthed, T.T. system

Fault levels : 31, 35 & 43 MVA at 415 volts, respectively for 1000, 1250 & 1600 KVA Kuwait Rating transformers.

Fault duration : 0.5 seconds

A.4 CLIMATIC CONDITION:

Extremes of temperature and humidity are experienced in Kuwait. Periods of high humidity are common and humidity of 100% has been recorded at 30°C.

Violent sand and dust storms occur and even on comparatively calm days fine dust is carried in the atmosphere.

All apparatus and equipment shall be capable of continuous and prolonged operation in the ambient temperature stated below:

Max. ambient temperature if installed within buildings of substantial construction having good heat insulating properties and adequate ventilation: .. 40°C.

Max. ambient temperature in Summer : .. 55°C.

Temperature within transformer room, engine rooms and boiler rooms, etc...may rise to: .. 55°C.

Max. sun radiation temperature in Summer: . . . 84°C.

Minimum ambient temperature in Winter. . . - 6 °C

A.5 DERATING:

Unless otherwise mentioned due allowance has been made in the design of the electrical installations described in this specifications and drawing, for the severe climatic conditions of Kuwait and all equipment, wires, cables, switches, etc., specified herein have been adequately derated.

A.6 ELECTRICAL CONTRACTOR:

The electrical works shall be carried out by an Electrical Contractor or sub-contractor who is on the Central Tenders Committee's approval list of Electrical Contractors and under categories specified in the particular condition of the project.

The Electrical Contractor must have at least one electrical engineer registered in Kuwait Society of Engineers and electrical supervisor for ensuring proper supervision of the work. The electrical engineer shall be available at site periodically and during the time as per particular condition of Contract or as agreed by the Engineer. The electrical supervisor should be available at site during working hours.

The Contractor shall visit the site and acquaint himself of any conditions whatsoever which may in any way affect the carrying out of his works as no claims will be allowed for lack of knowledge in this respect.

A.7 MATERIALS:

Attention of all Tenderers is hereby drawn to the following:

A.7.1 All materials, equipment and components shall be the best of their respective kind, from the standard range of product of reputed manufacturers and shall be suitable for prolonged and trouble-free service in the climatic conditions specified under A.4. All individual items of material shall be of the same make throughout the project unless specifically approved by the Engineer and shall comply as a minimum with the latest relevant recommendations of the International Electro-Technical Commission (I.E.C.) and if this is not available to the latest relevant British Standard Specifications (B.S.S). Materials of other national standards may also be employed provided they are comparable with I.E.C./B.S.S. This applies to quality of material and testing etc. If standards as mentioned above contradict with this tender specifications, then the requirements of this specifications shall apply.

A.7.2 Electrical Contractors who wish to base their offers on standards other than those mentioned under (A.7.1) may do so provided that they confirm in their offers that such standards meet the requirements under (A.7.1) as a minimum, and in due time, the successful Electrical Contractor will be asked to prove this and if needed, be verified by the Inspectors appointed by the Engineer.

A.7.3 The successful Electrical Contractor shall submit to the Electrical Engineer full details and particulars of all the equipment he proposes to install along with the documents listed against each item.

A.8 WORKING DRAWINGS:

The working drawings shall be prepared with AutoCAD and the Contractor shall provide at least four (4) sets of working drawings unless otherwise specified showing the following:

a) Cabling, 415 V Switchgear & Distribution Board:

Exact cable routes of all underground cables whether laid underground or on cable ducts. Location of 415 volt switchgear and distribution boards should also be shown. (Scale not more than 1:200)

Section of each portion of the routes to show the cable arrangement, spacing, fixation, filling, manholes....etc. Dimension shall be shown where applicable (Scale of Section to be 1:50).

In addition to above a further layout drawings shall show in detail the location of the 415 volts switchgears, method of fixation and cable connections, cable trenches, duct....etc. (Scale to be 1:50).

These drawings shall be submitted within one month from handing over the site and approval of the Engineer should be taken before commencing any portion of the work.

b) Trunking and conduits:

The run of conduits and trunkings for lighting and power shall show the size of the conduit or trunking, the number and size of wires in each conduit or trunking, draw in and draw out junction boxes. Scale to be 1:50 maximum.

NOTE:- If separate lighting and power drawings shall be submitted scale can be 1:100.

The drawings shall be submitted within two months from handing over the site and at least one month from the commencement of the work.

c) Earthing system:

Complete design of earthing system with detailed description of particulars.

A.9 FINAL RECORD DRAWINGS:

Upon completion of the electrical work and at least three weeks before the date of inspection, the contractor shall hand over to the Engineer one mother print of diazo polyester film of minimum thickness of 0.064 mm (2.5 mill) and five white paper prints of the "as fitted" electrical installation drawings made out in five sets, each set in a binder form, giving particulars of the positions of all switchgear, distribution boards, lights and power outlets, fittings, equipment, etc. together with the schedule of circuits and all other information relevant to the electrical services. The "as fitted" electrical installation drawings shall be prepared with AutoCAD and the Electrical Contractor must also submit CAD files of all "as fitted" drawings in three (3) complete sets of Compact Discs (CD).

A.10 MICRO-FILM:

3 sets of standard 35 mm. Micro-film aperture cards photographed from "as fitted" drawings shall be submitted along with above mentioned drawings and compact discs.

Details on the reverse side of the micro film aperture card shall include -

Supplier:
Contract number:
Title of the Project:
Title of the Drawings:
Drawing number:
Reduction ratio:
Date:

Front face of the card must be left blank.

A.11 MAINTENANCE AND INSTRUCTION MANUALS:

Three sets at least one original of maintenance and instruction manuals and catalogues enclosed in adequate binders should be submitted for composite equipment and as directed by the Engineer.

A.12 SPARES:

The contractor shall supply and deliver to owner's stores all spare materials as listed in the Bills of Quantity.

A.13 INSPECTION AND TESTING:

The contractor should submit the necessary "Test Form", "Load Form" duly filled in along with one set of approved drawings and 2 sets of "as fitted" drawings (not working drawings) to the Engineer, at least two weeks before requesting for inspection and testing of the installation.

A.14 COMMISSIONING:

The Contractor shall commission all equipment included in the Electrical installation after the electrical supply has been connected to the main switchboard.

B. 415 VOLT SWITCHBOARDS & MOTOR CONTROL CENTRES

B.1. STANDARDS:

Switchboards and motor control centres shall comply with the following standards as appropriate:-

IEC/BS EN 61439-1	Low-voltage switchgear and controlgear assemblies – Part 1: General rules
IEC/BS EN 61439-2	Part 2: Power switchgear and controlgear assemblies
IEC/BS EN 61439-3	Part 3: Distribution boards intended to be operated by ordinary persons (DBO)
IEC/BS EN 61439-4	Part 4: Particular requirements for assemblies for construction sites (ACS)
IEC/BS EN 61439-5	Part 5: Assemblies for power distribution in public networks
IEC/BS EN 60947-1	Low-voltage switchgear and controlgear – Part 1: General rules
IEC/BS EN 60947-2	Part 2: Circuit-breakers
IEC/BS EN 60947-3	Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units
IEC/BS EN 60947-4-1	Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters
IEC/BS EN 60947-5-1	Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices
IEC/BS EN 60947-6-1	Part 6-1: Multiple function equipment - Transfer switching equipment
IEC/BS EN 60529	Degrees of protection provided by enclosures
IEC/BS EN 60269-1	Low-voltage fuses - General requirements
IEC/BS EN 61869-1,2	Instrument/Current Transformers
IEC/BS EN 62052-11	Electricity metering equipment (AC) - General requirements, tests and test conditions –Part 11: Metering equipment
IEC/BS EN 62053-11	Electricity metering equipment (a.c.) - Particular requirements –Part 11: Electromechanical meters for active energy (classes 0,5, 1 and 2)
BS 159	High-Voltage Busbars and Busbar Connections

B.2 GENERAL:

B.2.1 Switchboards generally denote the following:-

a) Main Low Tension Boards (M.L.T.B)

Switchboards fed directly from transformer.

b) Main Switchboards (M.S.B)

Switchboards fed from a separate feeder of the Main Distribution Network or fed from (M.L.T.B)

c) Sub-Main Switch Boards (S.M.S.B.)

Switchboards fed either from (M.L.T.B.) or (M.S.B.)

d) Motor Control Centres (M.C.C.)

Switchboards fed directly from transformer or from either (M.L.T.B) or (M.S.B.)

B.2.2 The Switchboards shall be metal clad cubicle pattern floor mounting unit construction equipped with air circuit breaker, moulded case circuit breakers, switches, switch fuses, and motor starters as detailed on the drawings. **The Switchboards and all components shall be rated for the maximum ambient temperature specified and encountered in Kuwait (55°C).**

B.2.3 The switchboards shall also be equipped with relays, instruments, transformers and auxiliary devices necessary for operation, protection or measurement purposes as indicated on the drawings.

B.2.4 All normal components, fittings and accessories required for safe and proper operation of the switchgear shall be provided, whether specifically mentioned herein or not.

B.2.5 All switchboards of the same project shall be supplied by one manufacturer or assembler using the same make for each internal switchgear components. The switchboards manufacturer or assembler must have a previous record of satisfactory service in Kuwait for at least 3 years.

B.2.6 **Unless otherwise specified or indicated on the drawing the fault level of all Electrical components of switchboard shall be selected in accordance with the fault through current of the feeding transformer (Refer Cl. A.3). In general, minimum fault breaking capacity shall be as follows:-**

- a) 50 KA r.m.s. for M.L.T.Bs & M.C.C. if fed directly from transformer
- b) 22KA r.m.s. for M.S.Bs, M.C.C. and S.M.S.Bs if fed from M.L.T.B.
- c) 14 KA r.m.s. for S.M.S.Bs & M.C.C. if fed from M.S.B
- d) 10 KA r.m.s. for individual M.C.C.B.

B.2.7 Each incomer to M.L.T.B., M.S.B. and M.C.C. if fed from the distribution network shall be supplied with the following instruments.

- a) KWH Meter
- b) Voltmeter with selector switch
- c) 3 number ammeter

- B.2.8** Spare ways indicated on the single line diagrams shall be fully equipped.
- B.2.9** The Contractor shall submit before ordering complete technical details of the material and equipment covered by this specification. These details shall include the following where applicable:-
- All Technical data and supporting catalogues (In English Language) and Test Certificate of all components from an internationally recognized testing authority.
- B.2.10** The Contractor shall submit before ordering 415 volt switchgear the following Drawings and Wiring Diagrams.
- a) Plan, front and side elevation dimensional drawing showing the arrangement of all components, instruments, indication and the dimensions of all bus-bars.
 - b) Single line diagram of the circuits showing the rating of all components, the type and size of the incoming and outgoing feeders.
 - c) Wiring diagram for the switchboard showing the control, protection and instrument wiring.

B.3 CONSTRUCTION:

- B.3.1** Switchboard shall be factory built, totally enclosed, front and/or rear accessible. Size, rating arrangements shall be as indicated on the drawings.
- B.3.2** The switchboard shall consist of standard cubicles assembled together on continuous base channels to form a rigid in line flush fronted free standing, continuous switchboard assembly.
- Frames shall be constructed from 2.0mm thick folded sheet steel, strengthened where necessary by horizontal folded channels. Frames are enclosed by 1.5mm thick sheet steel screwed on the frames. Hinged doors of 1.5mm thick sheet steel strengthened where necessary. The cubicle shall be sufficiently rigid to withstand all operating forces without deformation or damage. **All steel fabrications shall be from Zinc coated or pre hot dip galvanized sheet steel.**
- B.3.3.1** For M.L.T.B. & M.C.C., each cubicle shall be divided into segregated bus-bar section and circuit section. The circuit section shall be further divided into segregated compartments for housing the specified circuit breakers, fuse switches, switches, moulded case circuit breakers, motor starters and other devices. Access to internal components of any compartment must be feasible by isolating its particular switch. The hinged door shall be mechanically interlocked with the switch in such a manner that the door can only be opened in OFF position.
- B.3.3.2** M.S.B. and S.M.S.B. shall be one cubicle of the panel board type, with a vertical bus-bar in the middle of the panel board. The outgoing M.C.C.Bs shall be mounted horizontally on a back plate. A separate front plate shall be provided so that no live part may be touched. The panel board shall be provided with hinged door with lockable handle.
- B.3.4** The Switchboards shall be totally enclosed, all hinged doors, covers shall be gasketed to provide reasonable protection against dust.

B.3.5 The switchboards shall be provided with suitable cable glands to suit the type, size and number of cables as indicated on the drawing. The cable glands or bracket where require shall be adequately mounted inside the switchboard. Sufficient spaces for cable connection and adjustments at site shall be provided. The Boards shall be provided with the proper cable fixing clamps and terminal lugs for incoming and outgoing cables as well as the earth bonding connection.

B.3.6 Labels:

All the components in the switchboards shall be identified by means of white labels of an approved design engraved with 5 mm. black lettering adequately describing the function of the unit to which it is attached and shall be secured by screws to the outside of each item. Special outlets and equipment shall be fitted with labels in a similar manner. Labels secured by adhesive are not acceptable. Labels shall be engraved in both Arabic and English and shall be approved by the Engineer.

B.4 SWITCHBOARD WIRING:

B.4.1 Switchboards shall be furnished completely wired including all cleats and terminal blocks.

B.4.2 Control and instrument wiring shall be made with a standard switchboard cable with fire resistant braid. No cables sizes small than 2.5 mm² shall be used.

B.4.3 The wiring on instrument panels shall have flexible connections to the terminal blocks.

B.4.4 The ends of every wire shall be numerated with the number as stated in the control circuit wiring diagram of the manufacturer, also numerating the terminal blocks.

B.4.5 A sufficient number of terminal connections including 15% spare terminals shall be provided for all control and instrument wiring.

B.5 BUSBAR:

B.5.1 Main and auxiliary busbars shall be hard drawn high conductivity electrolytic copper with 99.9% purity.

B.5.2 All busbar connections and joints shall be either silver plated or tin plated.

B.5.3 A neutral busbar shall be provided having the same current carrying capacity of main busbar. Half size Busbar is accepted for M.L.T.B and MCC's.

B.5.4 Unless otherwise specified main and auxiliary busbars shall be air insulated type.

B.5.5 A copper earth busbar sized at least 50% of the phase busbar shall be provided along the full length of the board.

B.5.6 Phase identification of the busbar shall be done by painting the busbar by non-inflammable painting material or covered by a coloured heat resisting non shrinkable P.V.C. sleeving.

B.6 AIR CIRCUIT BREAKER:

B.6.1 The air circuit breaker shall be of Utilization Category B and shall have rated service short-circuit breaking capacity equal to 100% rated ultimate short-circuit breaking capacity.

B.6.2 The air circuit breaker shall be of the air-insulated, conventional type (Not M.C.C.B). The breaker shall be provided with trip free handle mechanism arranged as a withdrawable unit with isolating plugs and sockets and mechanical interlocks to prevent mal-operation.

B.6.3 The air circuit breaker shall be provided with over current, short circuit and earth fault protection having the following characteristics.

1. Adjustable long time delay current setting with varied tripping time.
2. Adjustable short time delay current setting (400% -1000%) with variable tripping time
3. Instantaneous tripping for heavier over current adjustable from 400%-1600% of base current
4. Adjustable Earth fault trip current setting (20%-60%) with variable tripping time.

B.6.4 Components and accessories shall be included in A.C.B:

1. Aux. contacts
2. Arc Chutes
3. Folding Extension rail
4. Charging handle
5. Open and close push buttons
6. Over current trip indicator
7. Key lock on trip button
8. Spring charge condition indicator
9. Breaker position indicator
10. Making current release
11. Automatic shutters for the B/B terminal
12. Carriage for every size of A.C.B. exceeding 25Kg in weight.

B.6.5 The circuit breaker used on Bus-section shall be identical to Air circuit breaker specified before but without any of the protection and instruments specified but with the following indications:

- a - circuit breaker closed
- b - circuit breaker open
- c - circuit breaker tripped on fault

B.7 SWITCHES AND SWITCH FUSES:

B.7.1 All switches, switch fuses/fused switches, fuse combination units shall be air break, quick make, quick break with a front operating handle with ON/OFF indication and inter locked to prevent opening the cover when the switch is in the "ON" position.

B.7.2 The switch, switch fuse/fused switch, fuse combination unit shall be single or triple pole with neutral link (SP & N or TP & N) as required and the fuses shall be HRC type.

B.7.3 Separately mounted switches must be housed in metal clad enclosure in addition to an earth terminal.

B.8 MOULDED CASE CIRCUIT BREAKERS:

B.8.1 The moulded case circuit breaker shall be of Utilization Category B and shall have rated service short-circuit breaking capacity equal to 100% rated ultimate short-circuit breaking capacity..

B.8.2 The breaker shall be fitted with thermal and magnetic over load trips on each pole, quick make, quick break trip free mechanism.

B.8.3 The magnetic trip shall be adjustable type for rating of 200A and above.

B.8.4 The breaker shall be provided with mechanical indication on ON/OFF tripped.

B.8.5 Separately mounted molded case circuit breakers must be housed in metal clad enclosure and must be provided with earth terminal.

B.9 MANUALLY OPERATED CHANGE-OVER SWITCH:

B.9.1 The change-over switch shall mainly be used for mains network and emergency source and shall be one of the two types specified hereunder.

- a) Change-over switch, four pole, double throw, quick break and slow make action, and the neutral pole shall be arranged to make first and break last.
- b) Change-over switch(four or double pole) in corporate two non-automatic moulded case circuit breakers capable of breaking the load up to the rated current and arranged with load Busbars.

B.9.2 The change-over switch shall be complete with handle having "OFF" position which shall be mechanically inter locked to prevent opening cover in any position than "OFF".

B.9.3 If the change-over switch used individually it shall be housed in metal clad enclosure suitable for surface or semi-flush mounting. The enclosure shall be provided with earth terminal.

B.10 CONTACTORS:

B.10.1 The Contractor shall have minimum making and breaking capacity in accordance with Utilization Category AC3 and shall be suitable for intermittent duty Class1.

B.10.2 The mechanical rated life of the contactor shall not be less than 3million operation.

B.10.3 The N.T.P. rating of any contactor shall be at least 1.5 the rated load it controls.

B.10.4 Contactors used in T.S. shall have minimum making and breaking capacity in accordance with Utilization Category AC 4.

B.10.5 Contactor used for control lighting circuits or lighting distribution board shall be magnetically operated, mechanically held (latch type) and shall be rated for Tungsten, fluorescent and discharge lighting load.

B.10.6 Contactors over 100 amperes shall have main and Arcing contacts. Contacts shall be replaceable and provided with arc quenching devices.

B.10.7 Unless otherwise specified the operation coils shall be suitable for 240Volt 50Hz single phase.

B.11 AUTOMATIC TRANSFER SWITCH (A.T.S.):

B.11.1 The A.T.S. shall be double throw, solenoid or motorized electrically operated switch. The neutral pole shall make contact before phases and break contact after phases (Overlapping neutral). The switch shall be draw-out type for current ratings of 600A and above. It shall be built-in and wired with protection relay for overload, short circuit and ground fault, and shall automatically disconnect from source when fault occurs until it is cleared. The A.T.S. shall be factory-built in an independent enclosure and installed at a suitable position apart from M.L.T.B. or M.S.B. for operation during emergency conditions. A.T.S. built-in together with M.L.T.B or M.S.B. is not acceptable since A.T.S. will not be functioning during maintenance of M.L.T.B. and during major fault in M.L.T.B.

B.11.2 In addition to the A.T.S. necessary By-pass switch shall be provided identical in construction to A.T.S. Both A.T.S. and By-pass switch shall be electrically and fail-safe mechanically interlocked so that two sources cannot paralleled. The arrangement shall be such that during By-pass to A.T.S. and reverse operation there must not be any interruption of electricity to the load side.

B.11.3 Control voltage of A.T.S. shall be normally fed from the main supply, generator supply, or dedicated control power supply as necessary in the project.

B.11.4 The arrangement wiring and components shall satisfy the requirements of the Diesel Generator manufacturer. His written approval shall be submitted.

B.11.5 In addition to the transfer switch the A.T.S. arrangement shall be equipped with the following:

- a) A selector switch to control the operation of A.T.S. on normal, emergency. Automatic and off.
- b) Adjustable- 3 phase voltage sensing relays sense failure in a phase/phases and voltage drop below 70% of the normal voltage and pick-up at 90% of the normal voltage (pick-up and drop out voltages are adjustable within the range 70-100% of the normal voltage).
- c) Visual mechanical indicator for transfer switch position.
- d) Indicator lamps to show transfer switch position normal, emergency and off.
- e) An adjustable time delay relay of 1-3 seconds for starting signal to the generator set after cutting of main supply.
- f) An adjustable time delay relay of 0-3 minutes which allows A.T.S. from (NORMAL) to (EMERGENCY) after the voltage build-up relay of the generator has sensed 90% rated voltage when frequency within 90% of rated frequency.
- g) An adjustable time delay relay of 1-10 minutes to allow A.T.S from (EMERGENCY) to (NORMAL).
- h) An adjustable time delay relay of 0.5-5 seconds to prevent instantaneous transition from (EMERGENCY) to (NORMAL) i.e. the delay allows time sufficient for the residual motor voltage to decay to a safe switching level.
- i) An adjustable time delay relay 1-5 minutes to allow the engine to shut down after a cool down unload time delay after the A.T.S. has been switched to (NORMAL) position.

B.12 EARTH LEAKAGE RELAY:

- B.12.1** The relay shall comprise, core balance transformer, tripping, mechanism and reset testing button.
- B.12.2** The relay should operate within 0.2 sec. when the fault current exceeds specified sensitivity and as detailed on schematic diagrams.
- B.12.3** The relay should be connected to the load side and the testing device to be connected to the supply side.
- B.12.4** The relay shall with stand available short circuit. In case of using with MCCBs, integrated E.L. relay in MCCB can be accepted.

B.13 AUDIBLE AND VISUAL ALARM EARTH LEAKAGE RELAY:

- B.13.1** Similar in construction to earth leakage relay except it operates an audible and visual alarms located in the boards or remotely positioned in lieu of shunt trip of the breaker.
- B.13.2** Audible alarm shall be of sufficient level.
- B.13.3** Audible alarm may be cancelled by suitable reset button but visual indicator remaining on until fault is cleared.

B.14 AMMETER:

- B.14.1** The ammeter shall be moving iron type flush pattern with dust and moisture proof enclosure.
- B.14.2** The dial size shall be 10 x 10 cm approximately.
- B.14.3** Accuracy shall be one percent of full scale values.
- B.14.4** Moving elements shall be provided with zero adjustments located at face of dial.
- B.14.5** The ammeter shall be capable of withstanding twice the rated current for 10 minutes and overload sustained under fault conditions without damage or loss of accuracy.
- B.14.6** For main incomers, M.L.T.B. and M.S.B. shall be provided with 3 Ammeters to read the current on each phase. Ammeter with selector switch to read line current can be used for incomers or feeders other than main incomer if specified.

B.15 VOLTMETER:

- B.15.1** The voltmeter shall be moving iron type flush pattern with dust and moisture proof enclosure.
- B.15.2** The dial size shall be 10 x 10 cm. approximately.
- B.15.3** Accuracy shall be one percent of full scale.
- B.15.4** Moving elements shall be provided with zero adjustments located at face the dial.

B.15.5 Voltmeters shall have a measuring range from 0 to 500V and shall withstand twice the rated full scale voltage for 1.0 minute without damage.

B.15.6 The voltmeter selector switch shall be of the rotary type with cam operated contactor. It shall have (7) positions off, R-Y, Y-B, B-R, R-N, Y-N, B-N.

B.16 CURRENT TRANSFORMERS:

B.16.1 Current transformers shall be of class 3 accuracy for indication and class 0.5 accuracy for metering purposes.

B.16.2 Transformers shall be rated not less than 5 VA and shall have thermal and mechanical rating at least equal to those of the main breakers.

B.17 KWH METER:

B.17.1 The Kwh meters for the Ministry of Electricity and Water metering shall be suitable for operation on 415/240volts, 3 phase, 4 wire, 50Hz supply. The meters shall be of class 2 accuracy or better.

B.17.2 The meter shall be absolutely dust and vermin proof, protected from corrosion due to high humidity and compensated against the effect of temperature up to 55°C.

B.17.3 The meters shall maintain their accuracy over many years of service under Kuwait climatic conditions. The counters shall be of the cycle-meter type with six digits and shall give a direct reading of power consumption to six figures, the lowest figure being units and not tenth of units. Pointer type counters are not acceptable.

B.17.4 Multiplying factors shall not be used except for the larger size of current-transformer operated meter, where 10 and 100 may be used. The calibrating adjustments shall be operated by screw-driver only.

B.17.5 The meter cover and cases shall be of metal and not plastic.

B.17.6 The ratings for direct connected whole current meters shall be 50, 75 and 125 amperes maximum per phase and the terminal holes shall not be less than 6, 9 or 12 mm. diameter respectively.

B.17.7 Higher rating meters shall have not less than 5 mm. diameter terminal holes and shall be operated through current transformers with 5 amperes rating to the secondary side and the counter or the meter shall be calibrated to read the primary Kwh passing through the current transformers.

B.17.8 The current transformers shall be of the ring, slide on busbar type, shall be of Accuracy Class 0.5 and shall comply in all respects to IEC/BS EN 61869.

B.17.9 Three current transformers of the following standard sizes shall be provided for each meter. 200/5, 400/5, 800/5, 1000/5, 1500/5, 2000/5.

B.17.10 All meters shall be handed over to the Ministry of Electricity and Water for calibration before final erection and connection.

C. DISTRIBUTION BOARDS

C.1. STANDARDS:

Distribution board shall comply with the following standards as appropriate:-

IEC/BS EN 61439-1	Low-voltage switchgear and controlgear assemblies – Part 1: General rules
IEC/BS EN 61439-2	Part 2: Power switchgear and controlgear assemblies
IEC/BS EN 61439-3	Part 3: Distribution boards intended to be operated by ordinary persons (DBO)
IEC/BS EN 61439-4	Part 4: Particular requirements for assemblies for construction sites (ACS)
IEC/BS EN 61439-5	Part 5: Assemblies for power distribution in public networks
IEC/BS EN 60947-1	Low-voltage switchgear and controlgear – Part 1: General rules
IEC/BS EN 60947-2	Part 2: Circuit-breakers
IEC/BS EN 60947-3	Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units
IEC/BS EN 60947-4-1	Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters
IEC/BS EN 60947-5-1	Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices
IEC/BS EN 60947-6-1	Part 6-1: Multiple function equipment - Transfer switching equipment
IEC/BS EN 60898-1	Electrical accessories - Circuit breakers for overcurrent protection for household and similar installations Circuit-breakers for a.c. operation
IEC/BS EN 61008-1	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's): General rules
IEC/BS EN 60529	Degrees of protection provided by enclosures
IEC/BS EN 60269-1	Low-voltage fuses - General requirements
IEC/BS EN 61869-1,2	Instrument/Current Transformers
BS 159	High-Voltage Busbars and Busbar Connections

C.2 ENCLOSURE:

C.2.1 Distribution Board shall be flush or surface mounting. Enclosure shall be fabricated from Zinc coated or pre hot dip galvanized sheet steel of minimum thickness of 1.5mm.

C.2.2 The Distribution Board shall be provided with fixed cover and a hinged door with padlocking which can be opened without any obstruction about 120° and conduit knock outs from the top and bottom. The hinged door can be an integral part of the fixed cover.

C.2.3 The steel Enclosure shall be protected to IP31 for internal use with neoprene gasket for the doors and IP54 for outdoor and damp locations.

C.3 GENERAL:

C.3.1 The arrangement of the enclosure shall be such that the switch, MCB and RCCB cannot be operated without opening the hinged doors. To obtain access to MCB & RCCB it should be necessary to remove the fixed cover.

C.3.2 Miniature circuit breakers (M.C.B) or H.R.C. fuses can be used as detailed in the Drawings for Distribution Board used as sub-main Switchboards. For final Distribution Board Miniature Circuit Breakers shall be used, unless otherwise specified.

C.3.3 Final Distribution Boards serving lighting and power shall be of split type, adequately rated copper busbar pattern with 30mA current operated earth leakage circuit breaker (RCCB) serving one Busbar and maximum 300mA RCCB serving the lighting busbar.

C.3.4 The final Distribution Boards shall be controlled by an adequately rated ON load switch to interrupt the supply to the entire Distribution Board.

C.3.5 The number of ways of any Final Distribution Board shall not exceed 12 way for TP&N D.B's and 16 ways for SP&N D.B's including spare. Separate Distribution Boards for lighting and power can be used in case of intent to exceed the limited above.

C.3.6 The arrangement of the M.C.B. in the triple pole Distribution Board shall allow replacing a triple pole M.C.B. with three adjacent single pole M.C.B's and vice versa.

C.3.7 The Distribution Board shall be equipped with neutral and earth bars, each having separate terminal for each way of the Distribution Board and one for each of the main neutral and earth. The Distribution Board shall be provided with cable gland where required.

C.3.8 A circuit label shall be provided to indicate the area served by each M.C.B.

C.3.9 The Contractor shall submit before ordering the Distribution board full technical details of the components complete with supporting Manufacturer's catalogues, in addition to a dimensional drawing showing the internal arrangement of the component.

C.4 RESIDUAL CURRENT CIRCUIT BREAKER (RCCB):

C.4.1 Current operated earth leakage circuit breaker shall provide accident protection by interrupting dangerous contact with voltages which may be present in faulty electrical appliances as a result of frame faults, insufficient insulation or misuse.

C.4.2 The RCCB shall also provide a high degree of protection against earth leakage, fires and electric shock and shall withstand at least 3 K.A. of short circuit making and breaking current. The breakers shall fully comply with the requirements of IEC/BS EN 61008-1.

C.4.3 The breaker shall consist of a core balance transformer, a tripping coil with contact assembly, main supply contacts, ON/OFF switch, a test button and a trip free mechanism, all enclosed in a robust body of all insulated materials.

C.4.4 Degree of protection against earth leakage throughout the electrical installation shall be of the following:

- Maximum 10mA trip rating - for under water lighting
- Maximum 30mA trip rating - all socket outlets and domestic apparatus
- Preferably 300mA and
Maximum 500mA trip rating - Lighting circuits and all other apparatus and equipment such as A/C plants, lifts, pumps, etc...

C.5 MINIATURE CIRCUIT BREAKER (MCB):

C.5.1 The M.C.B. shall comply with IEC/BS EN 60898 and shall have a tripping characteristics of Type B, except for motor circuit application where Type C shall be provided. The rated short circuit breaking capacity of MCB shall be at least 3000A and the energy limiting class shall be of class 3 in accordance with table ZA1 and ZA2 of IEC/BS EN 60898.

C.5.2 The frame size of all M.C.B.'s shall be the same for possible interchangeability.

C.5.3 The M.C.B. shall either be of the plug in or bolt-on type.

C.5.4 Circuit breakers dollies shall be of the trip free pattern to prevent closing the breaker on a faulty circuit, and shall be engraved to indicate "ON/OFF" position and rated current.

C.5.5 Miniature circuit breakers of built in earth leakage protection shall be used when required.

D. CABLES & WIRES:

D.1. STANDARDS:

D.1.1 Cables and wires shall comply with the following standards as appropriate:-

IEC/BS EN 60502-1	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) - Part 1: Cables for rated voltages of 1 kV (Um = 1,2 kV) and 3 kV (Um = 3,6 kV)
IEC/BS EN 60228	Conductors of insulated cables
BS EN 10257-1	Zinc or zinc alloy coated non-alloy steel wire for armouring either power cables or telecommunication cables
BS 5467	Electric cables -Thermosetting insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V
BS 6004	Electric cables - PVC insulated and PVC sheathed cables for voltages up to and including 300/500 V, for electric power and lighting
BS EN 50525-2-71	Electric cables - Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U) Cables for general applications.
IEC 60227-1	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V - Part 1: General requirements
IEC 60227-2	Part 2: Test methods
IEC 60227-3	Part 3: Non-sheathed cables for fixed wiring
IEC 60227-4	Part 4: Sheathed cables for fixed wiring
IEC 60227-5	Part 5: Flexible cables (cords)
IEC 60227-6	Part 6: Lift cables and cables for flexible connections
BS 2897	Specification for wrought aluminium for electrical purposes. Strip with drawn or rolled edges
IEC 60245-1	Rubber insulated cables - Rated voltages up to and including 450/750 V - Part 1: General requirements
IEC 60245-2	Part 2: Test methods
IEC 60245-3	Part 3: Heat resistant silicone insulated cables
IEC/BS EN 60702-1	Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V - Part 1: Cables

D.1.2 Cable termination shall comply with the following standard specifications:-

BS 6121-1	Mechanical cable glands - Armour glands – Requirements and test methods
BS EN 50262	Cable glands for electrical installations
IEC/BS EN 60702-2	Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V - Part 2: Terminations
IEC/BS EN 61238-1	Compression and mechanical connectors for power cables for rated voltages up to 30 kV (Um = 36 kV) - Part 1: Test methods and requirements

D.2 MULTI-CORE 600/1000 VOLT PVC INSULATED ARMoured (PVC/SWA/PVC) CABLE:

D.2.1 The conductors shall be stranded of plain annealed copper or aluminium wires of high conductivity.

D.2.2 The conductors shall be insulated by PVC and the core insulation shall be coloured as stated below for identification.

D.2.3 The bedding shall consist of an extruded layer of PVC for which a single layer of galvanized steel wires shall be provided as armouring and earth continuity conductor.

D.2.4 The cable shall have final serving over the armour comprising of a black extruded PVC sheath.

D.2.5 The PVC used for the core insulation, bedding and sheath shall be of the hard type and the insulation of the cable shall conform to Type TI3, Table 1 of BS EN 50363-3:2005. The PVC used for the sheath shall be to Type 9, Table 1 of BS: 7655-4.2:2000.

D.2.6 The core of multi-core PVC insulated armoured and non-armoured cables shall be identified by the following colours.

Number of Cores	Colour
Two	Red, Black
Three	a) Red, Yellow, Blue b) Red, Black, Green/Yellow
Four	Red, Yellow, Blue, Black

NOTE - When a single core PVC/SWA/PVC cable is required the armouring shall be single layer aluminum wires.

D.3 MULTI- CORE 600/1000VOLT PVC INSULATED NON-ARMoured, PVC SHEATHED (PVC/PVC) CABLE:

The cable shall be as D.2 above in every respect except without armouring.

D.4 MULTI-CORE 600/1000 VOLT ARMOURED CROSS-LINKED POLYETHYLENE CABLE:

D.4.1 The conductor shall have stranded annealed copper or aluminium wires of high conductivity.

D.4.2 The conductor shall be insulated by extruded cross-linked polyethylene (XLPE) compound, suitable to permit operation of the cables at a maximum sustained conductor temperature of 90°C.

D.4.3 The bedding and over sheath shall be extruded PVC of the heat resisting and hard type complying with Type 9, Table 1 of relevant B.S. or equivalent.

D.4.4 The armouring shall be of single layer galvanized steel wires.

D.4.5 Identification of cores shall be as follows:

Number of Cores	Colour
Two	Red, Black
Three	a) Red, Yellow, Blue b) Red, Black, Green/Yellow
Four	Red, Yellow, Blue, Black

NOTE - The armouring for single core XLPE/SWA/PVC cable shall be single layer aluminum wires.

D.5 SINGLE CORE PVC INSULATED CABLES (NON-ARMOURED):

D.5.1 The conductors shall be from plain annealed copper or aluminium wires of high conductivity.

D.5.2 Conductors of nominal cross-sectional area of 4 mm² and above (4 mm² included) shall be of stranded wires.

D.5.3 Conductors of nominal cross-sectional area of 1.5 and 2.5 mm² may be solid wires, but stranded wires are preferable.

D.5.4 The insulation shall be from hard PVC complying with Type TI3, Table 1 of BS EN 50363-3:2005.

D.5.5 The P.V.C. insulation of the cores shall be identified by the following colours:

Phase conductor	Red, Yellow, Blue
Neutral conductor	Black
Earth conductor	Green/Yellow

D.6 FLEXIBLE CORDS:

D.6.1 Flexible cords shall be 450/750 Volt, Three core.

D.6.2 Flexible cords shall be circular, silicon rubber insulated, glass fiber braided.

D.6.3 The conductors shall be tinned annealed copper.

D.6.4 Identification of cores shall be Brown, Blue and Green/Yellow

D.7 PVC SHEATHED M.I.C.C. CABLES:

D.7.1 M.I.C.C. cables of 1000 Volt grade shall be of copper solid conductors mineral insulated.

D.7.2 Seals for M.I.C.C. cables shall be of the cold screw-on pot type consisting of a brass pot complete with anchoring wedges and caps.

NOTE - Heat shrinkable termination is acceptable.

D.7.3 All saddle shall be of copper of the spacer bar stand-off pattern.

D.8 SUBMITTALS:

The following shall be submitted for approval:

- a) Full technical details and Manufacturer's catalogues of each type & size of the wire and cable proposed to be used in the Electrical works.
- b) Copy of test certificate from an Independent Testing Authority confirming that the wires and cables are complying with the relevant clauses of this specification.
- c) A sample of each type & size of the wire & cable proposed to be used to M.E.W central work shop for testing and approving.

E. CONDUIT & CONDUIT FITTINGS:

E.1. STANDARDS:

E.1.1 Conduits and conduit fittings shall comply with the following standards as appropriate:-

BS 4607	Non-metallic conduit fittings for electrical installations - Specification for rigid conduits, fittings and boxes of insulating material
IEC/BS EN 61386-1	Conduit systems for cable management - General requirements
IEC/BS EN 60423	Conduit systems for cable management - Outside diameters of conduits for electrical installations and threads for conduits and fittings

E.2 NON-METALLIC CONDUITS:

E.2.1 Non-metallic conduits and conduit fittings shall be high impact, non-hygroscopic, rigid PVC and unthreaded push type. Conduit and conduit fittings shall be in accordance with BS 4607: Part 1 and 2, IEC/BS EN 61386 or equivalent.

E.2.2 The conduit and conduit fittings shall be suitable for installation at temperature -5°C to $+85^{\circ}\text{C}$ and they shall not soften or suffer any degradation at these temperatures, conduit and conduit fittings shall be self-extinguishing type.

E.2.3 Rigid PVC Conduit and conduit fittings shall be fully suitable for installation, storage or transport temperatures encountered in Kuwait and at this temperature the material shall not soften or suffer any structural degradation.

E.2.4 All PVC Conduit and conduit fittings shall be suitably marked and identified by the Manufacturer. Conduits used throughout the Project shall be of one manufacturer and marking on the conduit shall include the nominal size. All markings shall be indelible and easily legible.

E.2.5 The inside and outside surfaces of conduits shall be smooth and free from burrs, flash and other similar defects. The interior and ends of conduit fittings shall have no sharp edges and surfaces and corners over which the cables are likely to be drawn shall be smooth and well rounded.

E.2.6 The conduit entries of fittings shall be so designed that reliable water tight joint can be made between the conduit and fitting. It shall be constructed in such a way that it will be possible to bend the conduit easily with the aid of a simple tool e.g. bending spring.

E.2.7 All joints shall be made with proper fittings and by using sealing cement (Vinyl Solvent Paint) to ensure a watertight joint. The cement shall be of a type that remains in a sticky condition.

E.3 GALVANIZED STEEL CONDUITS:

E.3.1 Steel conduits and fitting should be of heavy gauge, longitudinally welded type and comply with IEC/BS EN 60423, IEC/BS EN 61386 or equivalent.

E.3.2 The nominal minimum outside diameter of any rigid conduit to be used should be 16 mm with a minimum wall thickness of 1.4 mm. and the conduits shall be completed with all necessary threaded fittings, couplings and connecting devices having galvanised equivalent finish.

E.3.3 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.

E.3.4 All conduits and fitting 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 by weather and water whilst stored on the site.

E.3.5 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.

E.3.6 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 and moisture. All coupling shall be equipped with earthing ring or earthing conductor.

E.3.7 All conduit runs shall be fixed using spacer bar pattern saddles giving not less than 3mm 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.

E.3.8 All steel conduit installation should be made mechanically and electrically continuous throughout, be effectively earthed and comply with IEC/BS EN 60423, IEC/BS EN 61386 or equivalent.

E.4 METALLIC FLEXIBLE CONDUITS:

E.4.1 Flexible steel conduits should comply with IEC/BS EN 61386 or equivalent. Flexible conduits shall comprise a flexible steel core with P.V.C. over-sheath. Liquid tight flexible conduit fittings shall be used at the terminating end of all flexible conduits.

E.4.1 Flexible conduits shall be used for protection in final connection of cables to electric motors and other equipment subject to adjustment of position and vibration to the fixed wiring and at similar position.

E.4.3 Flexible steel conduit should not be used as a protective conductor and it should have a separate circuit protective conductor of adequate size for earth continuity.

E.5 NON-METALLIC FLEXIBLE CONDUITS

E.5.1 The conduit shall be heavy gauge, P.V.C. Pliable, round, either plain or corrugated of self-extinguishing plastic material.

E.6 SUBMITTALS:

The Contractor shall submit before ordering cut-away samples of all sizes of conduits and one conduit box of each type fixed on a wooden board, together with manufacturer's catalogues and a test certificate from an internationally recognized authority to confirm that the offered conduits and accessories comply with this specification.

F. TRUNKINGS:

F.1. STANDARDS:

Cable trunking and Bus-bar trunking shall comply with the following standards as appropriate:-

BS EN 50085-1	Cable trunking systems and cable ducting systems for electrical installations - General requirements
BS EN 50 085-2	Cable trunking systems and cable ducting systems for electrical installations - Cable trunking systems and cable ducting systems intended for mounting on walls and ceilings
BS 4678-2	Cable trunking - Steel under floor (duct) trunking
IEC/BS EN 61439-1	Low-voltage switchgear and controlgear assemblies – Part 1: General rules
IEC/BS EN 61439-6	Low-voltage switchgear and controlgear assemblies – Part 6: Busbar trunking systems (busways)
BS EN 10346	Continuously hot-dip coated steel flat products. Technical delivery conditions

F.2 STEEL CABLE TRUNKING:

- F.2.1** Steel cable trunking shall be made of painted zinc coated steel.
- F.2.2** The cable trunking shall have inward turned flanges on the body for strengthening.
- F.2.3** The cable trunking shall be complete with easily fitted covers which are locked in place by flush pattern turn button.
- F.2.4** Standard trunking accessories: Tees, angle tees, four way through boxes, off sets, etc., shall be used. These accessories shall be made by the same steel trunking manufacturers.
- F.2.5** Each length of the cable trunking and accessories shall be complete with coupling and earth copper links.

F.3 NON-METALLIC CABLE TRUNKING:

- F.3.1** Non-Metallic cable trunking and its accessories shall be made from high impact non- combustible polyvinyl-chloride with precise extruded section suitable for use a thigh temperature.
- F.3.2** All cable trunking shall be provided with removable covers. Cover shall be maximum 1.5 metre in length.

F.4 BUSBAR TRUNKING:

- F.4.1** The Busbar trunking shall be three phase and neutral. Rating shall be as indicated on the drawings. The trunking system shall be designed, manufactured and type tested to IEC 61439-6, and shall be rated for continuous operation at the maximum ambient temperature specified and encountered in Kuwait (55°C).
- F.4.2** The Busbars shall be hard drawn high conductivity copper of 99.9 % purity, shall be of sandwich construction and all insulated. The material used for insulation shall conform to Class 'H' or 'F' and it shall be fully suitable to prevent moisture that reduces dielectric strength of the insulation and to provide safety against flame propagation and fire hazards. Insulation by means of PVC tape or sleeve, paper, polyester sheet and derivatives or any other flammable material is not acceptable. All contact surfaces including joints of the busbars shall be silver or tin plated.
- F.4.3** The Busbars shall be housed in a totally enclosed duct, vermin proof enclosure made of painted zinc coated sheet steel or extruded aluminium.
- F.4.4** Joints shall be accomplished by means of an insulated bolt passing through the conductors. Joint bolt shall provide an easily detected visual indication that the bolt has been tightened. Inspection plates shall be provided to permit periodic joint examination without disturbing joint pressure.
- F.4.5** The enclosure shall be constructed to withstand the electro-mechanical forces that may be induced by the prospective short circuit current.
- F.4.6** Each length of Busbar shall provide tap-off positions at different intervals not exceeding 5ft. and shall be so designed that each length of the Busbar is free to expand and contract without detriment to itself or to adjacent part of installation.
- F.4.7** Tap-off boxes shall be constructed of sheet steel and complete with securing devices to insure rigid connection to the Busbar.
- F.4.8** Tap-off boxes shall incorporate a moulded case circuit breaker or fused switch. They shall be of the type which can be plugged in to the Busbar when it is live.
- F.4.9** Tap-off units shall be mechanically interlocked with Busbar housing to prevent removal of the plug-in units while the switch is in the ON position. Covers should be provided with releasable type interlocks to prevent the cover from being opened while the switch is in the ON position.
- F.4.10** The operating handle shall retain control of the switching mechanism at all times, and shall be padlockable.
- F.4.11** Tap off units shall be equipped with an indicator flag to indicate the "ON" or "OFF" position of the switching mechanism.
- F.4.12** Blanking plates shall be fitted to all tap off positions that are not fitted with tap off units.
- F.4.13** The Busbar trunking shall be provided with fire barrier whenever the Busbar trunking passes through a fire compartment barrier or through walls or floors.
- F.4.14** A suitable weather proof fitting must be provided where Busbar trunking passes through a roof.
- F.4.15** A dead end of bus way shall be closed.
- F.4.16** For long busbar run, phase transposition of busbar shall be incorporated in accordance with manufacturer's recommendation.

F.5 EARTH ELECTRODES:

Earth electrode shall comprise of 3 sections, each section to be 1200 mm long and 16 mm diameter. The electrode rod shall be made of high strength steel with copper for non-rusting. The copper shall be molten welded, the steel core for laminating electrolytic action. **The radial copper coating shall be minimum 250 microns with 99.9% copper content.** One end of the rod shall be pointed without application of heat and driving head shall be provided at the other end. The sectional rods shall be coupled with strong bronze couplers. The coupler shall be threaded to fit the rod section. The rod shall be driven into the earth by means of a power hammer. Clamps shall be provided for connecting external copper strips to the electrode, the clamps shall be of adequate size to take 25 X 3 mm strips.

F.6 SUBMITTALS:

The Contractor shall submit before ordering full technical details and manufacturer catalogues of the proposed trunking and accessories for approval.

F.7 CABLE TRAYS AND RACKS:

- F.7.1** Cable trays shall generally consist of sheet metal or steel profiles being of the ladder or the perforated channel type with a maximum width of 600mm and a supporting distance not exceeding 1500mm.
- F.7.2** Cable trays of the ladder type shall consist of metal profiles riveted together having horizontal spacing's between two rounds not exceeding 300mm.
- F.7.3** Cable tray of the ladder type shall have a minimum carrying capacity of 200 Kg/m and under normal conditions the sag is not to exceed 3mm.
- F.7.4** The cable trays shall be part of a module system having available all required accessories and transition pieces from one to another direction or elevation.
- F.7.5** All bolts and screws shall be cadmium-plated or electrolytically galvanized.
- F.7.6** Every cable tray shall be marked at both ends and at intervals of 20m.with the pertaining registration number.
- F.7.7** Cover or sunshades shall be provided where trays are exposed to the sun.
- F.7.8** The metal thickness of perforated channel cable tray shall not be less than 1.6 mm (6G) before galvanizing and vertical stem shall have a minimum height of 45 mm with return flange.
- F.7.9** Cable trays arranged one above the other shall have spacing in relation to their width not exceeding a ratio of 1:2 with a minimum distance of 150mm.
- F.7.10** All trays, supporting steel members, clamps and other accessories shall be of one manufacturer and shall be hot-dipped galvanized after fabrication.

G. WIRING ACCESSORIES:

G.1.1 STANDARDS:

Wiring accessories shall comply with the following standards as appropriate:-

IEC/BS EN 60669-1, 2	Switches for household and similar fixed-electrical installations
BS 67	Specification for ceiling roses
IEC/BS EN 60670-1	Boxes and enclosures for electrical accessories for household and similar fixed electrical installations - Part 1: General requirements
BS EN 55014-1	Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus Emission
BS 1363	13 A plugs, socket outlets, adapters and connection units
IEC/BS EN 60309	Plugs, socket-outlets and couplers for industrial purposes
IEC/BS EN 61558	Safety of power transformers, power supplies, reactors and similar products - Part 1: General requirements and tests
BS 1362	Specification for general purpose fuse links for domestic and similar purposes (primarily for use in plugs)
BS 4662	Boxes for flush mounting of electrical accessories. Requirements, test methods and dimensions
BS 546	Specification for Two-pole and earthing-pin plugs, socket-outlets and socket-outlet adaptors
BS 5733	General requirements for electrical accessories
BS 4177	Specification for cooker control units
IEC/BS EN 61184	Bayonet lamp holders
IEC/BS EN 60238	Edison screw lamp holders

G.1.2 All individual items of materials shall be of the same make throughout the project unless specifically approved by the Engineer.

G.2 SINGLE POLE SWITCHES:

G.2.1 For Indoor Use:

- a) The switches for indoor use shall be of the grid type.
- b) The switch cover shall be brass finished matt chrome. The dolly or rocker shall be insulated with ivory finish.
- c) The switch shall be rated 5 or 15 amps. as required. The grid shall be provided with suitable earthing terminal.

G.2.2 For Outdoor Use:

- a) The switches for outdoor use shall be water-tight and metal clad.
- b) The case shall be of robust cast iron and galvanized finish or die cast aluminum.
- c) The rating of switch to be 5 or 15 amps as required

G.3 DOUBLE POLE SWITCHES:

G.3.1 The double pole switches shall be with indication neon lamps and shall be rated 20amps.

G.3.2 The face plate shall be of brass finished matt chrome and shall be engraved "WATER HEATER", "WATER COOLER", "AIR CONDITION", "INCINERATOR", as required.

G.3.3 The dolly or rocker shall be insulated and ivory finish.

G.4 PUSH BUTTON SWITCHES FOR LIGHT:

G.4.1 Push button switches for the operation of contactor controlled lights shall be of the push to make and push to break type.

G.4.2 The push button plate shall be finished in the same manner as light switch plates.

G.5 BELL PUSHES:

G.5.1 Bell push for indoor use shall have a cover of brass finished matt chrome and shall be connected to the earth.

G.5.2 The push shall be insulated and ivory finish marked with bell symbol.

G.6 SOCKETS & PLUGS:

G.6.1 For Indoor Use(240 Volts)

- a) The 13A switched socket outlet shall be 3 pin rectangular type.
- b) The 15A switched socket shall be 3 pin round type.

- c) The face plate of the switch socket shall be of brass finished matt chrome and shall be connected to the earth terminal of the socket.
- d) The dolly or rocker of the switch shall be insulated and ivory finish.

G.6.2 For Outdoor and water tight Use (240 Volts)

- a) Switched socket outlet shall be water tight, 3-pin, rectangular pins for 13 amperes, and round pins for 15/16 amperes rating.
- b) The case shall be of robust cast iron and finished galvanized or die cast aluminum.
- c) Each socket shall be complete with metal clad plug top.
- d) A screw type metal cover shall be provided for covering the socket outlet when the plug top is removed. The cover shall be chained to the case of the socket.

G.7 THREE PHASE SOCKET AND PLUGS:

- G.7.1 Three phase socket outlets shall be 5 pin (3 phase + Neutral + Earth).
- G.7.2 Three phase socket outlet shall be combined with Switch so interlocked with the plug that the plug cannot be withdrawn or inserted with the switch in the "ON" position.
- G.7.3 The current rating of three phase socket shall be 16, 32, 63, 125A.
- G.7.4 Three phase socket used indoor shall be splash-proof (IP-X4).
- G.7.5 Three phase socket used outdoor shall be water tight (IP-X7).
- G.7.6 One matching plug shall be furnished with each socket outlet installed.

G.8 COOKER CONTROL UNITS:

- G.8.1 Cooker control unit incorporating a 45amps double pole main switch and a 13 amps switched socket outlet and neon indicator lights for both cooker and socket.
- G.8.2 The cooker control unit shall be surface or flush mounted as required.

G.9 DIMMER SWITCHES:

- G.9.1 The dimmer switches shall be designed to meet the requirement of IEC/BS EN 60669 for switches and IEC/BS EN 61000-4-3 for radio frequency interference suppressed.
- G.9.2 Dimmer switch shall be for the control of incandescent lamps or for fan speed control. The rating of the dimmer switch shall be as shown in the schedules or drawing.
- G.9.3 The dimmer switch shall consist of a control knob of spun aluminum, heat resisters back cover and face plate of brass finished matt chrome. The operation of the knob shall be in a clock-wise rotation for "ON" position. "ON" and "OFF" positions shall be clearly marked on the face plate. The dimmer switch shall be switched off with definite click dimmer switch with combined push on/push off switch and rotary dimmer shall also be accepted.

- G.9.4** The dimmer switch used for control incandescent lamps shall be suitable for fixing on standard switch boxes.
- G.10 JUNCTION BOX:**
- G.10.1** The junction box shall be complete with a terminal block suitable for connecting up to 10 mm² copper conductor (phase, neutral and earth) and an all insulated moulded white cover plate.
- G.10.2** The cover plate shall be raised for connecting outgoing cable.
- G.11 FUSED SPUR-BOX:**
- G.11.1** The fused spur-box shall be flush type, unswitched and suitable for 240 volts, single phase, 50Hz. supply.
- G.11.2** The spur-box shall have a fuse base with carrier and 13 amps fuse link complying to BS 1362. During the replacement of a fuse no live metal shall be touchable.
- G.11.3** The spur-box shall be provided with earth terminal. The terminals shall accommodate three core 4mm² cables.
- G.11.4** The front plate of the spur-box shall be brass finished matt chrome and shall have outlet for flexible cable.
- G.12 LAMP HOLDERS:**
- G.12.1** Lamp holders shall be so designed and constructed that in normal use, their performance is reliable and without danger to the user or surroundings.
- G.12.2** Lamp holders shall be in general of the Bayonet cap up to 200 watt and Edison screw E 40 for lamps of 300 watts and above.
- G.12.3** Lamp holders shall be in general of the all insulated material heat resisting suitable for conditions up to a lamp cap temperature.
- 165°C temperature mark T 1 for Bayonet cap of cord grip or open shade
- 210° C temperature mark T 2 for Bayonet cap of cord grip of closed shade.
- G.12.4** Bayonet cap metal lamp holders, Edison screw E27 either all insulated or metal may be accepted in relevant cases.
- G.13 CEILING ROSES:**
- G.13.1** Ceiling rose shall be of three or four plate type as required, the terminals shall be clearly marked to indicate the phase (or line), neutral and earth conductors.
- G.13.2** The base fixing screw hole slotted to accept a variation in fixing. Screw centers are suitable for mounting over small circular conduit boxes.

G.14 MOUNTING BOXES:

G.14.1 Mounting boxes shall be one gang or two as specified and shall be manufactured from hot-dip galvanized steel.

G.14.2 Each box shall have brass earth terminal fitted in base and include ample knockouts and adjustable lug.

G.15 BELL INDICATORS:

Bell Indicators shall be of bakelite base and cover complete with brass fixing screws, fitted with glass screens, suitable for operation at A.C. up to 12 volts, 50 Cycles.

G.16 INDOOR BELLS:

Indoor bells shall be electric tumbler metal framed, bakelite case, round gong approximately 3" diameter operated at low voltage A.C. (up to 12 volts) 50 cycles.

G.17 OUTDOOR BELLS:

Outdoor electric bells shall be electric tumbler in weather-proof metal case no less than 6" diameter round gong, suitable for operating on 240 volts, 50 cycles, 1 phase A.C. Supply.

G.18 BELL TRANSFORMERS:

Bell Transformers shall be of bakelite base and cover, primary coil wound for input 240 volts, 50 cycles, 1 phase A.C. supply. Secondary coils for output of up to 12 volts, A.C. with fuses in two outer L.V. leads, core connected to earth terminals, all complying with the latest relevant IEC/BS specifications.

H. MOTORS & CONTROLS:

H.1. STANDARDS:

H.1.1 Motors and control shall comply with the following standards as appropriate:-

IEC/BS EN 60034 (All applicable parts)	Rotating electrical machines
BS 5000	Rotating electrical machines of particular types or for particular applications
BS 5372	Specification for Dimensions of cable terminations for multi-core extruded solid dielectric insulated distribution cables of rated voltages 600/1000 V and 1900/3300 V having copper or aluminium conductors
IEC/BS EN 60085	Electrical insulation - Thermal evaluation and designation
BS EN ISO 12100	Safety of machinery – General principles of design – Risk assessment and risk reduction
IEC/BS EN 61800	Adjustable speed electrical power drive systems
IEC/BS EN 60068-2-6	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)
IEC/BS EN 60068-2-27	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock
IEC/BS EN 61000-4-3	Electromagnetic compatibility (EMC) Testing and measurement techniques. Radiated, radio-frequency, electromagnetic field immunity test

H.1.2 This specification is not applicable to Direct Expansion Air Conditioning central units which are covered under separate specification

H.1.3 The Contractor shall submit before ordering the following catalogues and technical details:

- a) Technical catalogues for all types of motors with detailed list of the types, HP and speed.
- b) Technical catalogues for all types of starters used with detailed list of types and rating of contactors and the motor they control.
- c) Technical catalogues for protection devices for motors above 50HP.
- d) Wiring diagram for the starter/starters showing the protection devices, measuring instruments.

H.2 ELECTRIC MOTORS:

Motor shall generally be totally enclosed, fan cooled type protection class IP44 for indoor motors and IP 55 for outdoor motors unless otherwise specified.

All motors shall comply fully with the requirements of the appropriate standard specification mentioned above.

H.3 Motors shall be fully suitable for service in Kuwait climatic conditions.

H.4 Unless otherwise specified motors shall be of the squirrel cage type.

H.5 The rated voltage of the motors shall be:

- a) 1-phase, 240V, 50 Hz for motors up to and including 1 H.P. Motors up to 5 H.P. may be single phase under special conditions and prior approval shall be obtained.
- b) 3-phase, 415 V, 50 Hz for motors ratings above 1 HP.

H.6 All motors windings and slot insulation shall be non-hygroscopic of class B, other superior classes may be applicable so that the temperature rise of the motor as declared by the manufacturer + ambient temp. is at least 10° C below the maximum operating temp. of the insulating material used. The ambient temp. in plant room should be taken as 55°C.

H.7 Motors shall be of high power factor.

H.8 Inherent protection shall be embedded in the motors 50 HP and above.

H.9 3-phase motors up to and including 7.5 H.P may be started direct on line (D.O.L). Motors above 7.5 H.P. and up to 50 HP shall be of the reduced current or reduced voltage starting, such as Star-Delta Starter, to ensure that starting current does not exceed 2.5 times the full load current. Motor above 50 HP shall have solid state soft motor starting system (Soft starter).

The soft starter shall be a power electronic type motor starting device. It shall control the voltage applied to the motor smoothly by varying the conduction angle of the solid stage a.c. switches which can be triacs, reverse parallel connected SCR-diode circuit or reverse parallel connected SCR-SCR circuit, etc. or using other similar technique. It shall be manufactured in conformance with IEC/BS EN 60068-2-6, IEC/BS EN 60068-2-22 and IEC/BS EN 61000-4-3.

UNDER NO CIRCUMSTANCES shall the power factor correction equipment be connected between the soft starter and the motor. If power factor correction equipment is employed, it shall be connected to the supply side of the soft starter.

H.10 Motor starters shall be mounted on mounting plates enclosed in a separate cell.

Individual motor starter shall be enclosed in a casing protection IP 41 for indoor mounting and IP 55 for outdoor mounting and shall house all the starter components, contactors, protection devices, metering...etc. as applicable.

H.11 Each motor rated of 1HP and above shall be provided with:

- a) Means of isolation from electricity supply for purpose of adjustment and maintenance.

- b) M.C.C.B's or fuses suitable rating for short circuit protection.
- c) Means for automatically disconnecting it from the electricity supply in the event of:
 - i) Failure of supply
 - ii) Serious drop in voltage
 - iii) Flow of excess current

Where main incomer for a motor control center (MCC) is provided with audible and visual alarm earth leakage relay (Clause B.13) motors 45 HP and above shall be provided with individual earth leakage relay (Clause B.12).

For individual motor starters controlling motors less than 50 HP and above 15 HP shall be provided with R.C.C.B. (Clause. C.4). Motors from 50 HP and above shall be provided with earth leakages relay (Clause B.12) unless the M.C.C.B. feeding the motor starter is provided with earth leakage protection.

- H.12** The over load relays provided with motor starters shall be of the magnetic type or of the thermal type with automatic compensation for variation in ambient temp. between 0°C and 55°C. The over load shall be of 3 phases.
- H.13** For motors 25 HP and above current transformer operated over load protection shall be used. Separate single phase preventer shall be provided for motors 25 HP and above.
- H.14** Unless otherwise specified, starters for motor rated 25 HP and above shall be provided with an ammeter with selector switch.
- H.15** Unless otherwise specified starters for motors rated 25 HP and above shall be provided with red and green indicating lamps to show status of each motor.
- H.16** Motor starters and push buttons shall be clearly labeled showing the machines they control.
- H.17** Stop push buttons shall have large mushroom head and/or coloured red.
Start push buttons shall be shrouded to prevent accidental operation and must be coloured green
- H.18** Motors driving Air handling units shall be controlled by Latch type contactors unless the Air handling unit is remote controlled from the Motor Control Centre.
- H.19** Starter controlling chiller compressors shall conform to NEMA/ANSI and NEC standards normally used with the chillers provided.
 - a) The chiller manufacturer confirms that they normally use the offered starter with their chillers and recommend its use.
 - b) Fulfill the requirements of starter specified above.
- H.20** Each starter in addition to the auxiliary contacts used for electrical interlocking shall have at least one extra normally opened and one normally closed contact.

I. FANS:

I.1 CEILING FANS AND REGULATORS:

I.1.1 Ceiling fans shall be propeller type with 3 or more blades operating in free air and shall comply with IEC 60879 and BS 5060 and shall be as specified hereunder.

I.1.2 The fans and their associated regulators shall be suitable for operation on an electricity supply of 240V, single phase, 50Hz. Fans shall be of the higher power factor, high efficiency type preferably with split phase capacitor shall be such that the power factor of the fans and regulators shall be 0.85 or better at full speed. Fans and regulators shall be suitable for continuous operation in an ambient temperature of 55 degree centigrade.

I.1.3 Fans and regulators shall be of robust construction throughout and shall be finished on all surfaces with suitable lacquer or other preparation to make them proof against rust during transit, storage and operation. The fan body shall be cast or fabricated from high grade ferrous metal or be die-cast in a hard approved alloy. If the later, particular attention shall be given to bearing housing as detailed hereafter.

I.1.4 The motor body shall be totally enclosed. The terminal block and capacitor shall either be housed in a terminal box or shall be installed directly above the motor body and covered by a canopy. An earth terminal shall be provided at a suitable location.

I.1.5 The blade shall have a diameter or sweep as specified in the schedules. They shall be supplied in accurately balanced and in marked sets. Blades shall be of pressed metal sheet with a longitudinal stiffening rib if necessary.

I.1.6 The suspension shall be of the insulated type, the crutch holding the insulated bobbin shall be of steel or cast iron and welded to the down rod or secured in a similar manner to the joint at the motor as specified below. A canopy, large enough to enclose completely the suspension crutch, hook and ceiling rose, shall be supplied.

I.1.7 Regulators shall be of the choke type or electronic type and shall either be of all insulated construction or assembled on a substantial metal frame and provided with an earth terminal. Thermo plastic covers shall be proof against discoloration and shall be of robust construction so as to prevent breakage when accidentally dropped from 5ft. height. The design of the regulator shall be such that it shall not be possible for any live metal to come into contact with the frame, even if assembly screws are in adequately tightened. Regulators shall be capable of reducing the speed of the fan by at least 50% of the full speed. Fans shall be capable of running of any of the contacts of the regulator at the rated voltage and shall have an off and at least 5 speed positions, (speed positions are not applicable to electronic type regulator).

I.2 TABLE FANS:

400mm Table Fans, oscillating, induction type motor, oscillating mechanism, adjustable to several positions from Zero up to 90°, with regulator having three speeds and OFF positions, suitable for operation on 240 volts, 50 Hz, single phase A.C. supply, to be continuously rated, complete with wire guard. Sound level at maximum speed to be very low.

I.3**PEDESTAL FANS:**

400mm. Pedestal Fans oscillating, with telescopic column and base, suitable for indoor use with integral regulator having minimum three speeds and OFF positions, induction type motor suitable for operation on 240 volts, 50 Hz., A.C. supply, complete with wire guard. Sound level at maximum speed to be very low.

J INCINERATOR

- J.1** The incinerator shall comply with the latest relevant IEC/BS specifications.
- J.2** The incinerator shall permit the immediate disposal of sanitary towels, dressings, etc., by complete incineration.
- J.3** The Incinerator shall be suitable for wall mounting and shall be of robust all metal construction, the components being mounted on a heavy gauge metal chassis.
- J.4** The incinerator shall be so designed that as soon as the access door is opened the heater circuit shall be closed for a pre-determined time, by suitably rated time switch.
- J.5** The unit shall be so designed that the user is absolutely protected from electrical current and undue heat.
- J.6** The incinerator shall be of trouble free services and shall be complete with 8 cm. diameter flue pipe.
- J.7** Necessary arrangement shall be provided in the unit for easy connection to 240 volts, 50Hz. Single phase supply.
- J.8** The rating of the incinerator shall be near to one indicated on schedule of points.

K. ELECTRICAL WATER HEATER:

K.1 GENERAL:

K.1.1 Electric storage type water heaters shall generally be either of the vented and open to the atmosphere so that under no condition of use the pressure at the surface of the water be other than atmospheric, or of the cistern type in which the feed cistern is an integral part of the appliance or a separate part located immediately above the water heater. All water heaters shall be provided with thermostats unless otherwise specified for temperature regulation of the both water and to prevent excessive rise in temperature

K.1.2 Where pressurized circulating hot water system is required M.E.W. recommends to install central pressurized water boiler of reputed manufacturer and the safety precautions shall be carried out as per the manufacturer's recommendation and instructions, but not less than the following minimum requirements.

- I. Temperature and pressure relief valve factory provided.
- II. Manual staging thermostat for each element.
- III. Safety temperature limiter to disconnect the power supply in the event of water temperature exceeds 90°C.

Where individual hot water heaters are installed in pressurized water system the following conditions and safety precautions shall be fulfilled.

- I. Each individual heater shall be provided with the following:-
 - a) Adjustable automatic thermostat of 20 amps. min. rating for temperature regulation.
 - b) Non-adjustable safety temperature limiter (Energy shut off device) to protect the heater from overheating and disconnect the electrical supply if the water temperature exceeds 90°C.
 - c) Temperature relief valve of reputed manufacturer.
 - d) Pressure relief valve of reputed manufacturer.
N.B.: Combined temp. & press. relief valves can be accepted
- II. Adequate water filtration system shall be provided, (preferably sand Filters) water treatment is recommended in addition to filtration.
- III. All water piping (Pipes, Fittings, Joints etc.,) cold and hot shall be copper.
- IV. Heaters shall be installed in a safe ventilated location where it can be easily maintained and seen.
- V. When replacing any water heater the new water heater must be provided with the same safety precaution devices mentioned above. Furthermore a warning instruction to this effect shall be written on the boiler.
- VI. The technical information and declaration sheet Appendix (1) shall be filled and signed by the owner, and shall be submitted with the test form for inspection.

K.2 VENTED TYPE STORAGE WATER HEATERS

The water heaters shall be electric, thermal storage low and medium pressure type as described hereunder and manufactured by a reputable manufacturer, and shall comply with Kuwaiti Standard Specifications KSS 40-1973.

K.2.1 Construction:

K.2.1.1 The designed working pressure of the low pressure inner container shall be 1.8 KG/CM² and the test pressure shall be 3.6KG/CM². The designed working pressure of the medium pressure inner container shall be 3.6 KG/CM² and the test pressure shall be 7.2 KG/CM².

K.2.1.2 The unit shall generally consist of a cylindrical inner container constructed either of cold rolled copper sheet tinned internally with all seams over lapped and brazed, or copper sheet tinned internally and enveloped in a cylindrical sheet steel envelope contiguous to copper container.

K.2.1.3 The outer casing shall be made of high grade sheet steel, rust proof with two coats of anti-rust paint inside and outside and finished in white baked on hard wearing enamel, Space between inner and outer container shall be padded with efficient thermal lagging.

K.2.1.4 The unit shall be provided with P.S.P.T. connections for cold water inlet, hot water outlet, and with drainage device. Inlet pipe shall enter the container from bottom and outlet pipe can be from bottom or top. The arrangement of inlet and outlet pipe inside the container shall not permit emptying the container or water under any condition except through the drain connection which shall be in the lowest bottom and provided with drain valve and extended nipple for loose connection (Fig. 2).

K.2.1.5 Each unit shall be equipped with the following:-

- a) Immersion heating element
- b) Adjustable automatic thermostat
- c) Safety temperature limiter
- d) Indication light

K.2.2 Installation:

K.2.2.1 The unit shall not be connected directly to water mains or through any water network having pressure regulating system.

K.2.2.2 The unit shall be fed from an elevated storage feed tank and a vent or expansion pipe from the top of the inner container shall be provided for each unit to discharge water freely to the elevated feed tank as shown in the attached figure (1) and recommended by the manufacturer.

K.2.2.3 No valves shall be installed between the discharge of the unit and the vent pipe.

K.2.2.4 The maximum height of the elevated tank feeding the low pressure unit shall be 18 metres and 36 metres for the medium pressure unit.

K.2.3 Immersion Heating Element:

K.2.3.1 The immersion heating element shall be constructed from nickel chromium resistance wire sheathed in a mineral filling, the whole being cased in a copper tube sealed against moisture.

K.2.3.2 The immersion heating element shall be provided with cover terminals and shall be screwed or flanged to the inner container from outside the vessel. The heating element shall be easily removable for servicing; also it shall be possible to remove the element plate assembled completely for descaling. The immersion heater shall satisfactorily pass all high voltage tests.

K.2.3.3 Immersion heater and terminal block shall have a substantial earth terminal connected to the inner container and outer casing. All exposed metal parts which in the event of failure of insulation could become a live shall be ineffective electrical contact with earth terminal.

The loading of the heater shall be 3 KW Heaters shall be suitable for single phase, 240 Volts, 50HZ.

K.2.4 Thermostat:

K.2.4.1 The adjustable automatic thermostat shall be of 20 Amps. minimum rating for temperature regulation from 32°C-85°C.

K.2.4.2 The thermostat shall be of high grade and shall be factory internally wired and shall be removable for servicing or replacements.

K.2.5 Safety Temperature Limiter:

The safety temperature limiter shall be non-adjustable and of high grade to protect the heater from overheating and consequently should disconnect the water heater from the electricity supply in the event of water temperature exceeding 90°C. The temperature limiter shall be factory internally wired, and shall be removable for servicing or replacement.

K.2.6 Indication Light

The unit shall have an indicator light which, when on, shows that the appliance is in the heating phase, it turns off when the water in the tank reached the desired temperature.

K.2.7 Capacity and Mounting of the Unit:

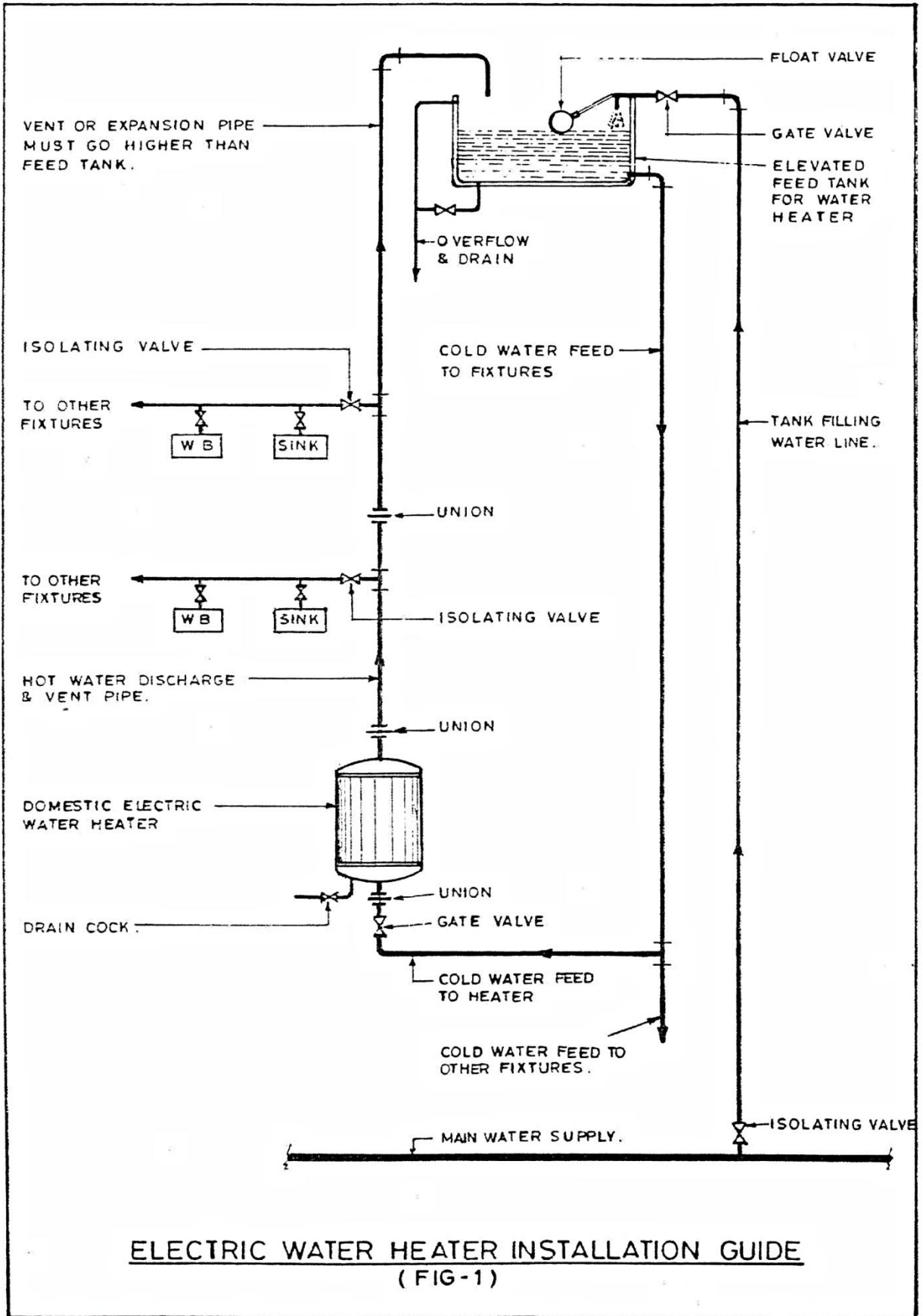
The capacity of the storage water tank shall be 80 or 150 litres and shall be suitable for wall mounting with standard wall brackets, nuts and bolts supplied by the unit manufacturer, and mounting arrangement shall be approved by the Engineer before installation.

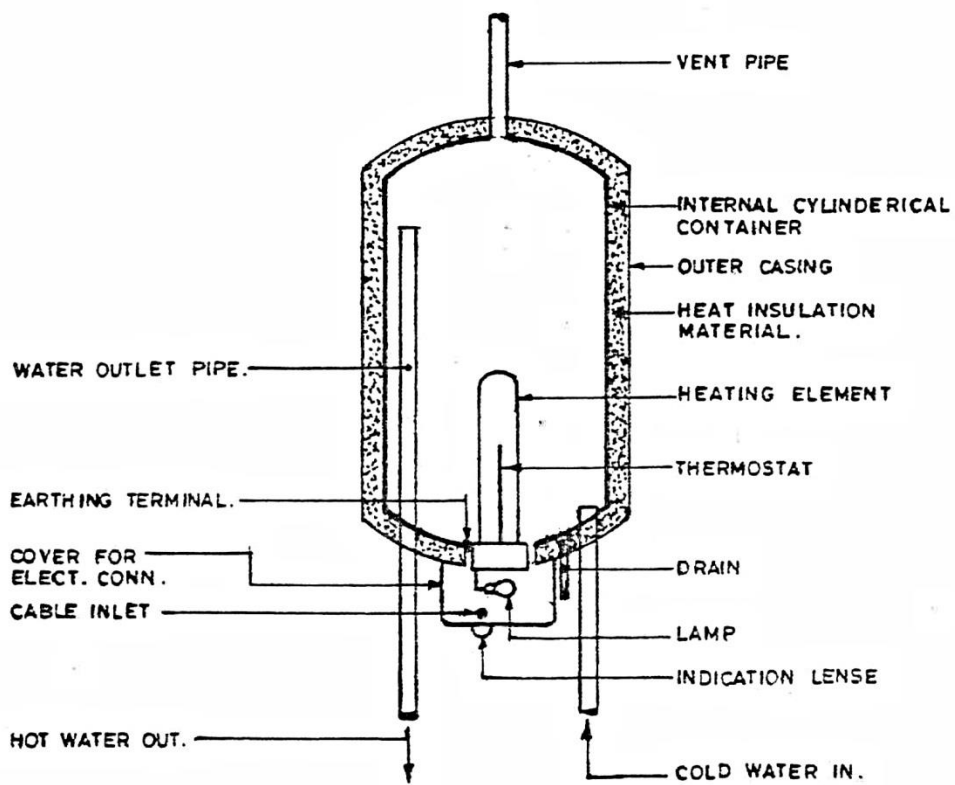
K.2.8 Elevated Feed Tank:

Elevated feed tank shall be supplied and installed complete with float valve, vent pipe, valved inlet connections to city mains, outlet connections to the water heater, valved drain connection and an overflow connected together and run to the nearest visible drain approved by the Engineer.

Tank shall be of approved moulded fiber glass or approved material of suitable shape mounted over concrete saddle. The float valve shall be suitable for 6 atmospheres working pressure. Tank size shall be 250 litres capacity.

All as shown in the attached installation guide figure (1) & (2).





DOMESTIC ELECTRIC WATER HEATER MAIN COMPONENTS
(FIG.-2)

APPENDEX (I)

TECHNICAL INFORMATION & DECLARATION

The following technical information and declaration shall be filled and attached to the test application, to fulfil the M.E.W. Regulations otherwise the Boilers installations shall not be accepted.

Project Name: _____ File No. _____

Area: _____ Block: _____ Plot: _____

Total quantity of heaters.....heater

1. Water Heater:

Make: _____ Capacity: _____ Working Pressure: _____ Bar.

2. Safety Devices:

Press relief valve make: _____ Operating Press: _____ Bar:

Temp. relief valve make: _____ Operating Temp.: _____ oc.

Adjustable thermostat provided _____ Yes/No

Safety temperature limiter provided _____ Yes/No

3. Filtration system provided _____ Yes/No

4. Water treatment System provided _____ Yes/No

5. Copper pipes & fittings used _____ Yes/No

We/I declare that

A) The above mentioned items are correctly installed

B) When replacing any water heater, the new one shall be provided with all the above mentioned safety devices.

C) The necessary maintenance will be carried out in order to assure their adequate functions

Name

Address:

Signature:.....

Date:

L. LIGHTING FITTINGS:

L.1 FLUORESCENT LIGHTING FITTINGS:

L.1.1 STANDARDS:

Fluorescent fittings shall comply with the following standards as appropriate:

IEC/BS EN 60598-1	Luminaires - Part 1: General requirements and tests
IEC/BS EN 60598-2-1	Luminaires. Part 2-1: Particular requirements - Fixed general purpose luminaires
IEC/BS EN 60598-2-2	Luminaires - Part 2-2: Particular requirements - Recessed luminaires
IEC/BS EN 60529	Degrees of protection provided by enclosures
IEC/BS EN 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
IEC/BS EN 60081	Double-capped fluorescent lamps - Performance specifications
IEC/BS EN 60901	Single-capped fluorescent lamps - Performance specifications
IEC/BS EN 60921	Ballasts for tubular fluorescent lamps - Performance requirements
IEC/BS EN 60929	A.C. Supplied Electronic Ballasts for tubular fluorescent lamps - Performance requirements
IEC/BS EN 61347-2-1	Lamp controlgear - Part 2-1: Particular requirements for starting devices (other than glow starters)
IEC/BS EN 61347-2-3	Lamp controlgear - Part 2-3: Particular requirements for a.c. and/or d.c. supplied electronic controlgear for fluorescent lamps
IEC/BS EN 61347-2-7	Lamp controlgear - Part 2-7: Particular requirements for battery supplied electronic controlgear for emergency lighting (self-contained)
IEC/BS EN 61347-2-8	Lamp controlgear - Part 2-8: Particular requirements for ballasts for fluorescent lamps
IEC/BS EN 61547	Equipment for general lighting purposes - EMC immunity requirements
IEC/BS EN 60061	Lamp caps and holders together with gauges for the control of interchangeability and safety. Part 1: Lamp caps
BS EN 55015	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment

IEC/BS EN 61000-4-2	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
BS EN 55014-1	Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus Emission
BS EN 60432	Incandescent lamps. Safety specifications Tungsten halogen lamps for domestic and similar general lighting purposes
IEC/BS EN 61195	Double-capped fluorescent lamps - Safety specifications

L.1.2 Submittals:

The contractor shall submit the following for approval before ordering the lighting fittings:

- a) Fully detailed technical Manufacturer Catalogues showing the type of the fitting proposed, photometric data, rated voltage, insulation class, degree of protection, max. working temperature, type & size of internal wiring, etc..
- b) Full technical details of the electronic ballast including manufacturer, type, max. temperature rise, etc..
- c) Sample of each type of the proposed lighting fitting.

L.1.3 All fluorescent fittings shall be of first class quality, made by reputable manufacturers from the standard ranges of product and illustrated in their catalogues and suitable in all respects for trouble free operation at 240 volts, 50 Hz single phase supply and at an ambient temperature of 45°C. Fluorescent fitting shall be complete with all internal wiring.

L.1.4 All fittings and associated equipment shall be of the proven best quality and current models, for which replacement parts and lamps are and will be available for the normal expected useful life of the fittings and associated equipment.

L.1.5 The fluorescent fittings shall have Class-1 insulation with provision of earthing and shall be manufactured and tested to fully comply with the requirements of IEC/BS EN 60598. For special applications the Class of Insulation of the fitting shall selected accordingly and shall be approved by the Engineer.

L.1.6 Each fluorescent fitting shall be protected against environmental conditions at which the fitting will be fixed and shall comply with individual specification of each type of fitting described in the following General Standard Fitting Drawings.

L.1.7 Lamp holders shall be of good heat resisting insulating material capable to prevent, in extended normal use, any electrical or mechanical failure. Contacts shall be resilient and shall provide adequate contact pressure.

L.1.8 Fluorescent tube shall be Day Light colour with a colour temp. between 5000 to 6400 K. The tube shall be T8 or T5 having diameter 26 mm. and less. T12 tube is not acceptable.

L.1.9 The fluorescent lighting fitting shall have electronic controlgear/ballast with integrated inrush current limiter, harmonic suppresser, flicker free warm start, suitable for high switching frequency and shall meet the following specifications:-

- a) The electronic ballast shall be suitable for operation of all types of fluorescent lamps and for 240 Volts, 50 Hz single phase supply and an ambient temperature of up to 55 degrees centigrade.
- b) The ballast shall be either discrete electronic or integrated circuit, rapid or instant start and designed to operate at a frequency of 30 KHz or greater.
- c) It shall withstand power line transients as defined in IEC 61000 and shall tolerate a supply voltage variation of (+/-) 10 percent.
- d) The power factor rating shall be 0.95 or higher.
- e) The lamp crest factor shall measure 1.7 or less.
- f) The total harmonic distortion (THD) of the input current to the integrated circuit ballast shall not exceed 20 percent of the input current.
- g) The Ballast Lumen Factor of the ballast shall not be lower than 0.95 or higher than 1.05 with reference to a standard conventional ballast.
- h) The maximum inrush current of the ballast shall not exceed 15A peak at starting and shall not last longer than 0.5 milliseconds.
- i) The electronic ballasts shall be Class "A" sound rated and UL Class "P" thermally protected.
- j) The ballast shall fully comply with the relevant IEC/BS specifications concerning the generation of both EMS (electromagnetic interference) and RFI (radio frequency interference).
- k) The ballast case temperatures shall not exceed 20 degree rise above a 45 degree C ambient.
- l) The ballast shall be compatible with other electrical equipment including, infrared and ultrasonic occupancy control devices, energy management systems, variable frequency motor controls and personal computers.

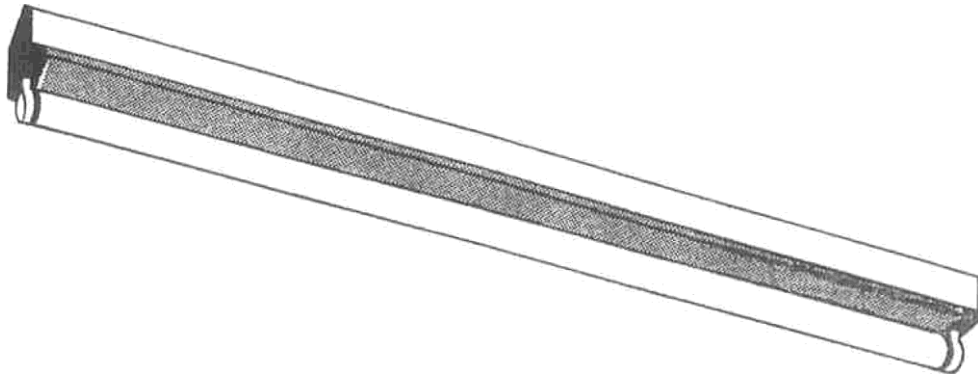
L.1.10 Individual ballast shall be provided for each lamp. Twin lamps of up to 21 watt may have a common instant start ballast.

L.1.11 The internal wiring shall be not less than 0.75 mm² size with silicone rubber insulation or high temperature rated P.V.C., clipped neatly in position. Other heat resisting wires with similar properties may be accepted.

L.1.12 Earthing terminal shall be provided for each fitting.

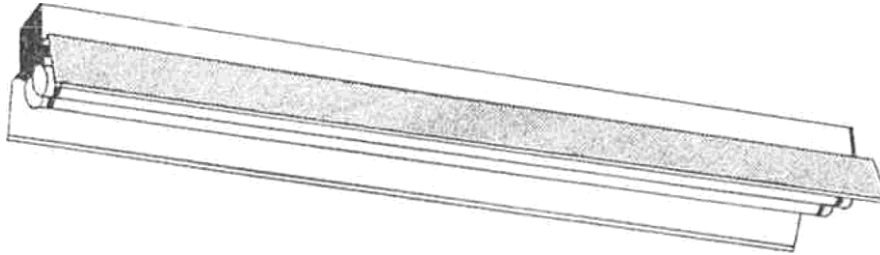
L.1.13 A dimmable electronic ballast with DALI (Digital Addressable Lighting Interface) control having control input of 1-10 volts shall be provided as and where deemed necessary and applicable.

**Fluorescent Fitting Batten Type
Fitting Series A1**



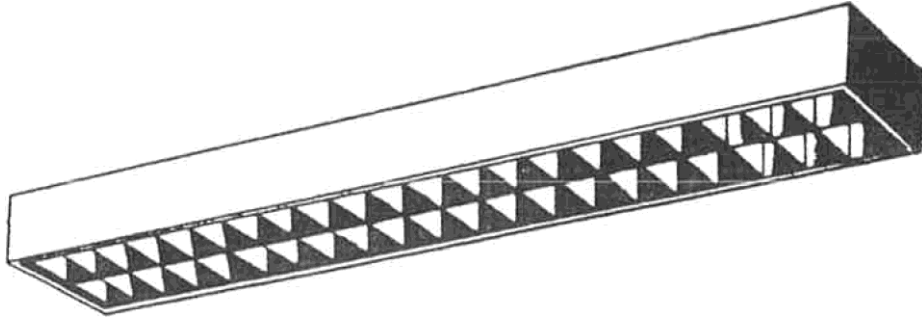
Protection Class	IP20
Construction	Batten type fluorescent fittings comprising of white stove enamel finished heavy gauge steel sheet channel section base with cover of ample dimensions to house electronic controlgears.
Mounting	Fitting shall be suitable for fixing directly to the ceiling or wall.
Ballast	Electronic, 220 - 240 V / 50 Hz
Lamp	Linear fluorescent lamp, T8 or T5, Colour temp. Min. 5000 K.
Type of fitting	Nos., Nominal Length & Wattage of Tubes
A1/1/14	1 - 550 mm - 14 watts
A1/1/18	1 - 600 mm - 18 watts
A1/1/28	1 - 1150 mm - 28 watts
A1/1/35	1 - 1450 mm - 35 watts
A1/1/36	1 - 1200 mm - 36 watts
A1/1/58	1 - 1500 mm - 58 watts
A1/2/35	2 - 1450 mm - 35 watts
A1/2/36	2 - 1200 mm - 36 watts
A1/2/58	2 - 1500 mm - 58 watts

**Fluorescent Fitting Reflector Type
Fitting Series A2**



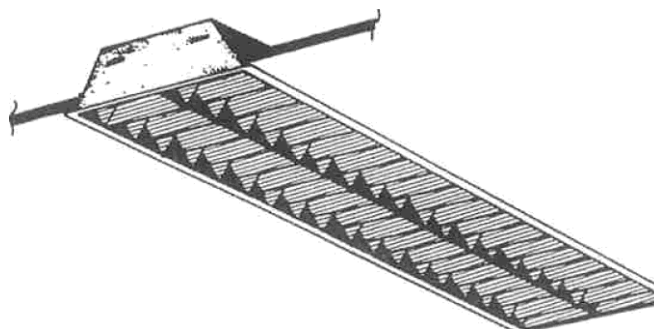
Protection Class	IP20
Construction	Body shall be stove enamelled sheet steel channel section base of ample dimensions to house electronic controlgears and provided with a stove enamelled sheet steel reflector, white inside and other approved colour outside.
Mounting	Fitting should be suitable for fixing direct to the ceiling or suspended from the ceiling by means of two 3/4" dia. conduits.
Ballast	Electronic, 220 - 240 V / 50 Hz
Lamp	Linear fluorescent lamp, T8 or T5, Colour temp. Min. 5000 K.
Type of fitting	Nos., Nominal Length & Wattage of Tubes
A2/1/35	1 - 1450 mm - 35 watts
A2/1/36	1 - 1200 mm - 36 watts
A2/1/58	1 - 1500 mm - 58 watts
A2/2/35	2 - 1450 mm - 35 watts
A2/2/36	2 - 1200 mm - 36 watts
A2/2/58	2 - 1500 mm - 58 watts

**Fluorescent Fitting With Diffuser
Fitting Series A3**



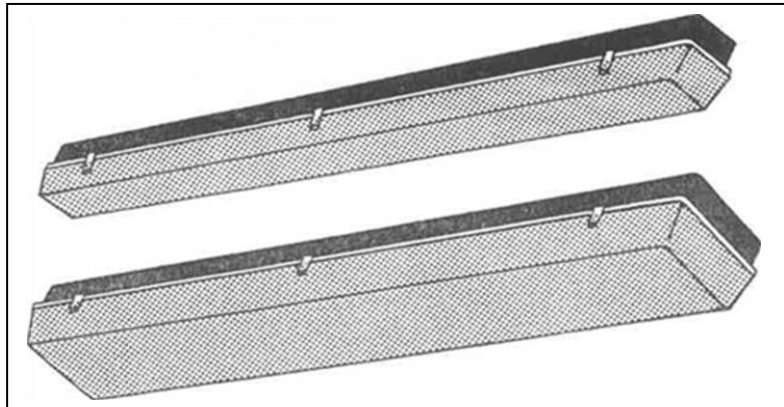
Protection Class	IP20
Construction	<p>Body shall be made from heavy gauge sheet steel or aluminum stove enamelled white inside and outside, or other approved colour outside. The fitting shall be provided with low brightness louvre ensuring minimum glare according to International Standards. The louvre shall be white stove enamelled finish with V shape longitudinal and transverse vanes to give optimum light distribution.</p> <p>The louvre shall be so arranged that it can be easily removed for maintenance. Louvres fixed by screws are not accepted.</p> <p>All electronic controlgears and accessories shall be so housed within the fitting in such a way that they cannot be seen from below.</p> <p>The fitting shall comply with IEC/BS EN 60598.</p>
Mounting	Fitting should be suitable for fixing directly to the ceiling or suspended from the ceiling by means of two suspension rods with ceiling bracket by fitting manufacturer only.
Ballast	Electronic, 220 - 240 V / 50 Hz
Lamp	Linear fluorescent lamp, T8 or T5, Colour temp. Min. 5000 K.
Type of fitting	Nos., Nominal Length & Wattage of Tubes
A3/1/35	1 - 1450 mm - 35 watts
A3/1/36	1 - 1200 mm - 36 watts
A3/1/58	1 - 1500 mm - 58 watts
A3/2/35	2 - 1450 mm - 35 watts
A3/2/36	2 - 1200 mm - 36 watts
A3/2/58	2 - 1500 mm - 58 watts
A3/4/14	4 - 550 mm - 14 watts
A3/4/18	4 - 600 mm - 18 watts

**Fluorescent Fitting Recessed Type
Fitting Series A4**



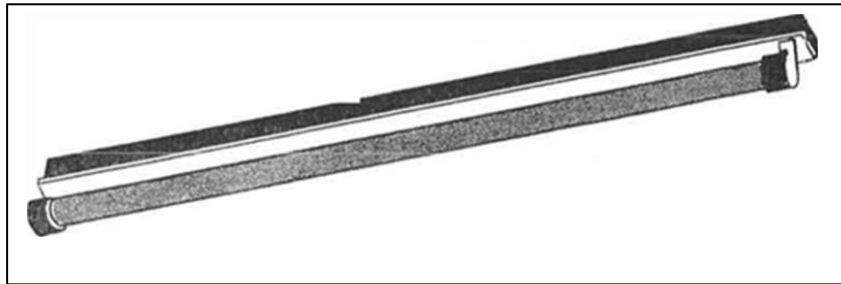
Protection Class	IP20
Construction	<p>The fitting shall be fully recessed mounted in the false ceiling and matching the type of false ceiling used. Body shall be made from heavy gauge sheet steel, or aluminum stove enamelled white inside. The fitting shall be provided with low brightness louvre ensuring minimum glare according to International Standards. The louvre shall be mirror finish and from polished anodized aluminum with V shape longitudinal and transverse vanes to give optimum light distribution.</p> <p>The louvre shall be so arranged that it can be easily removed for maintenance. Louvres fixed by screws are not accepted.</p> <p>All electronic controlgears and accessories shall be so housed within the fitting in such a way that they cannot be seen from below.</p> <p>The fitting shall comply with IEC/BS EN 60598-2-2.</p>
Mounting	Fitting shall be suitable for installation with the type of false ceiling and shall be co-ordinated with false ceiling details and suitable for fixing into false ceiling by means of both ends threaded hanger rods with anti-rust coated nuts.
Ballast	Electronic, 220 - 240 V / 50 Hz
Lamp	Linear fluorescent lamp, T8 or T5, Colour temp. Min. 5000 K.
Type of fitting	Nos., Nominal Length & Wattage of Tubes
A4/1/35	1 - 1450 mm - 35 watts
A4/1/36	1 - 1200 mm - 36 watts
A4/1/58	1 - 1500 mm - 58 watts
A4/2/35	2 - 1450 mm - 35 watts
A4/2/36	2 - 1200 mm - 36 watts
A4/2/58	2 - 1500 mm - 58 watts
A4/4/14	4 - 550 mm - 14 watts
A4/4/18	4 - 600 mm - 18 watts

**Vapour, Chemical and Dust Proof Fluorescent Fitting
Fitting Series A5**



Protection Class	IP54
Construction	<p>The housing shall be of glass fibre reinforced non-flammable polyester resistant to aggressive chemical reactants. The diffuser shall be of non discolouring plastic material from clear polymethacrylate or poly carbonate and the fitting shall be provided with white enamelled steel reflector or aluminum. All electronic controlgears shall be mounted on a hinged tray. The fitting shall be suitable for outdoor use where the maximum temperature may reach 84°C.</p> <p>The fitting shall comply with IEC/BS EN 60598.</p>
Mounting	The fitting shall enable versatile, individual or row mounting either directly on ceiling or wall or horizontal suspension as recommended by manufacturer.
Ballast	Electronic, 220 - 240 V / 50 Hz
Lamp	Linear fluorescent lamp, T8 or T5, Colour temp. Min. 5000 K.
Type of fitting	Nos., Nominal Length & Wattage of Tubes
A5/1/35	1 - 1450 mm - 35 watts
A5/1/36	1 - 1200 mm - 36 watts
A5/1/58	1 - 1500 mm - 58 watts
A5/2/35	2 - 1450 mm - 35 watts
A5/2/36	2 - 1200 mm - 36 watts
A5/2/58	2 - 1500 mm - 58 watts

**Weather Proof Fluorescent Fitting
Fitting Series A6**



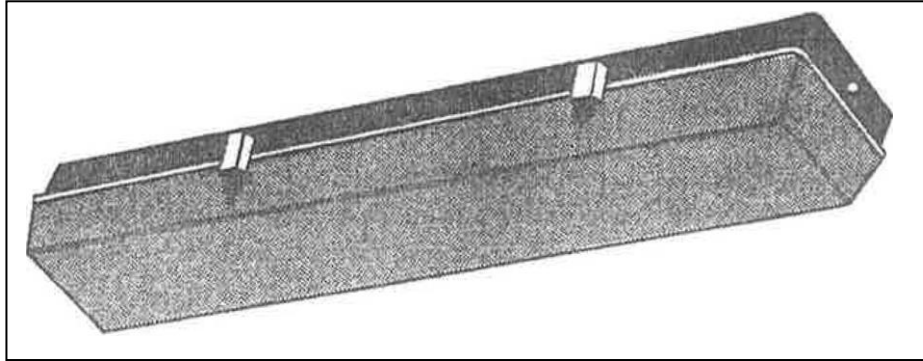
Protection Class	IP54
Construction	Weatherproof and dust tight fluorescent light fitting shall consist of a glass-fibre reinforced base for housing the electronic controlgears and water proof lamp holders as required. The fitting shall be suitable for outdoor use where the maximum temperature may reach 84°C. The base should be provided with 3/4" dia. conduit entry at the top and at the two ends and necessary covers shall be provided for unused conduit entry. The fitting shall comply with IEC/BS EN 60598.
Mounting	The fitting shall be suitable direct fixing to ceiling or wall.
Ballast	Electronic, 220 - 240 V / 50 Hz
Lamp	Linear fluorescent lamp, T8 or T5, Colour temp. Min. 5000 K.
Type of fitting	Nos., Nominal Length & Wattage of Tubes
A6/1/35	1 - 1450 mm - 35 watts
A6/1/36	1 - 1200 mm - 36 watts
A6/1/58	1 - 1500 mm - 58 watts
A6/2/35	2 - 1450 mm - 35 watts
A6/2/36	2 - 1200 mm - 36 watts
A6/2/58	2 - 1500 mm - 58 watts

**Water Proof Fluorescent Fitting
(For Marina & Similar Locations)
Fitting Series A7**



Protection Class	IP65
Construction	<p>The housing shall be of Alu-zinc sheet steel, deep drawn, seamless with epoxy powder coated finish in grey or other approved colour. The diffuser shall be of clear non discolouring acrylic material of minimum 5 mm. thickness sealed with neoprene gasket and the fitting shall be provided with white enamelled steel reflector or aluminum. All electronic controlgears shall be mounted on a hinged tray. The fitting shall be suitable for outdoor use where the maximum temperature may reach 84°C.</p> <p>All electronic controlgears and accessories shall be so housed within the fitting in such a way that they cannot be seen from below.</p>
Mounting	The fitting shall be suitable for direct bulkhead or deckhead mounting.
Ballast	Electronic, 220 - 240 V / 50 Hz
Lamp	Linear fluorescent lamp, T8 or T5, Colour temp. Min. 5000 K.
Type of fitting	Nos., Nominal Length & Wattage of Tubes
A7/1/35	1 - 1450 mm - 35 watts
A7/1/36	1 - 1200 mm - 36 watts
A7/1/58	1 - 1500 mm - 58 watts
A7/2/35	2 - 1450 mm - 35 watts
A7/2/36	2 - 1200 mm - 36 watts
A7/2/58	2 - 1500 mm - 58 watts

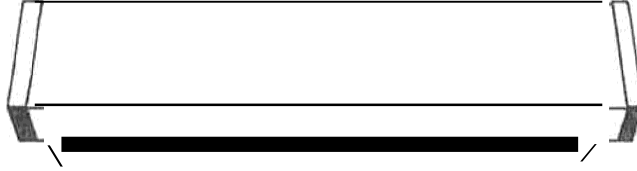
**Fluorescent Fitting For Explosive
Atmospheres of Gas or Vapour
(Division 2 areas as defined in BS5345 Part 7 •1979)
Fitting Series A8**



Protection Class	IP65
Construction	<p>The housing shall be of glass-fibre reinforced non-flammable polyester resistant to aggressive chemical reactants. The diffuser shall be of acrylic or polycarbonate material and the fitting shall be provided with white enamelled steel reflector or aluminum. All electronic controlgears shall be mounted on a hinged tray.</p> <p>The fitting shall comply with IEC/BS EN 60598-2-5.</p> <p>Test certificate to prove that fitting suitable for zone 2 shall be provided.</p>
Mounting	The fitting shall enable versatile, individual or row mounting either directly on ceiling or wall or horizontal suspension as recommended by manufacturer.
Ballast	Electronic, 220 - 240 V / 50 Hz
Lamp	Linear fluorescent lamp, T8 or T5, Colour temp. Min. 5000 K.
Type of fitting	Nos., Nominal Length & Wattage of Tubes
A8/1/35	1 - 1450 mm - 35 watts
A8/1/36	1 - 1200 mm - 36 watts
A8/1/58	1 - 1500 mm - 58 watts
A8/2/35	2 - 1450 mm - 35 watts
A8/2/36	2 - 1200 mm - 36 watts
A8/2/58	2 - 1500 mm - 58 watts

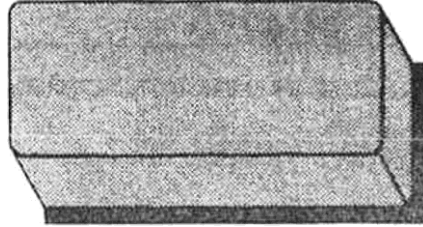
**Fluorescent Fittings for Mirror and Ceiling
or Wall of Bathrooms**

Fitting Series A9



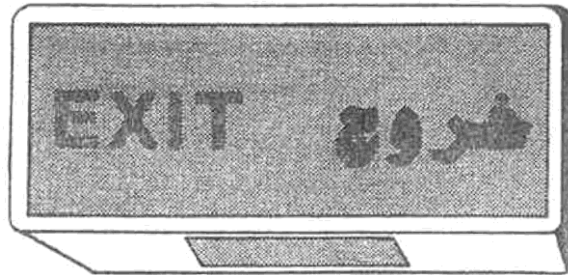
Protection Class	IP65
Construction	<p>Body shall be made from metal or fiber-glass. The diffuser shall be of non discolouring plastic material. The fitting shall comply with IEC/BS EN 60598 and suitable and completely safe for use in bathrooms.</p> <p>All electronic controlgears and accessories shall be so housed within the fitting in such a way that they cannot be seen from below.</p>
Mounting	Fitting shall be suitable for fixing direct to the ceiling or wall.
Ballast	Electronic, 220 - 240 V / 50 Hz
Lamp	Linear fluorescent lamp, T8 or T5, Colour temp. Min. 5000 K.
Type of fitting	Nos., Nominal Length & Wattage of Tubes
A9/1/14	1 - 550 mm - 14 watts
A9/1/18	1 - 600 mm - 18 watts
A9/1/14S	1 - 550 mm - 14 watts. The fitting shall be provided with shaver socket complying with IEC/BS EN 61558.
A9/1/18S	1 - 600 mm - 18 watts . The fitting shall be provided with shaver socket complying with IEC/BS EN 61558.

**Self-Contained Emergency Light Fittings
Fitting Series A10**



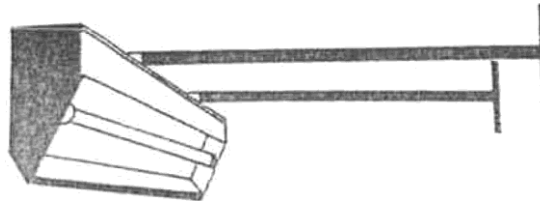
Protection Class	IP40
Construction	<p>The fittings shall comprise of metal housings stove enameled white inside and other approved colour outside. The unit shall contain sintered nickel cadmium battery. A constant current charger, silicone transistor inverter and solid state change-over switch. The batteries shall be capable of supplying power to the fluorescent tubes as specified in the schedule for 3 hours under normal conditions. These light fittings will not operate, but on the failure of normal supply, they shall be immediately switched on. The battery should recharge automatically on supply resumption. The fittings shall be provided with a vandal-resistant opal poly-carbonate or acrylic diffuser.</p> <p>The fitting shall comply with IEC/BS EN 60598.</p>
Mounting	Fitting shall be suitable for ceiling or wall mounting.
Ballast	Electronic, 220 - 240 V / 50 Hz
Lamp	Linear fluorescent lamp, Colour temp. Min. 5000 K.
Type of fitting	Nos., Nominal Length & Wattage of Tubes
A10/1/8	1 - 300 mm - 8 watts
A10/2/8	2 - 300 mm - 8 watts

**Exit Sign Self-Contained Luminaires
Fitting Series A11**



Protection Class	IP20
Construction	<p>Surface mounted exit sign constructed from sheet steel or aluminum, with internal surfaces finished in white stove enamel and external surface in white or other approved colours.</p> <p>The face panel is constructed from self-extinguishing opal diffuser with the legend "EXIT" in English and Arabic, 125mm high screen-printed in green.</p> <p>The fitting shall be suitable for fluorescent tubes as specified in the schedule.</p> <p>The fitting comprises a sealed, sintered nickel cadmium battery, a constant current charger, a silicon transistor inverter and solid state change-over circuit. In the event of mains failure fluorescent tube provide instant emergency lighting for 3-hours.</p> <p>The fitting shall comply with IEC/BS EN 60598-2-22.</p>
Mounting	Fitting shall be suitable for either wall mounting or suspended from the ceiling by 2 suspension rods provided by fitting manufacturer.
Ballast	Electronic, 220 - 240 V / 50 Hz
Lamp	Linear fluorescent lamp, Colour temp. Min. 5000 K.
Type of fitting	Nos., Nominal Length & Wattage of Tubes
A11/1/8M	1 - 300 mm - 8 watts fluorescent tube (Maintained)
A11/2/8	2 - 300 mm - 8 watts fluorescent tube (Sustained i.e. one mains one emergency)
A11/1/8N	1 - 300 mm - 8 watts fluorescent tube (Non-Maintained)

**Black Board Lighting Fitting
Fitting Series A12**



Protection Class	IP20
Construction	<p>The housing shall be of heavy gauge sheet steel white stove enamel finished inside green or approved colours outside. The reflector shall be asymmetrical pure aluminum.</p> <p>The fitting shall comply with IEC/BS EN 60598.</p>
Mounting	<p>The fitting shall be either wall mounting by bracket or suspended from the ceiling by rods.</p> <p>All bracket mounting shall suspension rods shall be provided by fitting manufacturer.</p>
Ballast	Electronic, 220 - 240 V / 50 Hz
Lamp	Linear fluorescent lamp, T8 or T5, Colour temp. Min. 5000 K.
Type of fitting	Nos., Nominal Length & Wattage of Tubes
A12/1/35	1 - 1450 mm - 35 watts
A12/1/36	1 - 1200 mm - 36 watts
A12/1/58	1 - 1500 mm - 58 watts

L.2 DISCHARGE & INCANDESCENT LIGHTING FITTINGS (GENERAL):

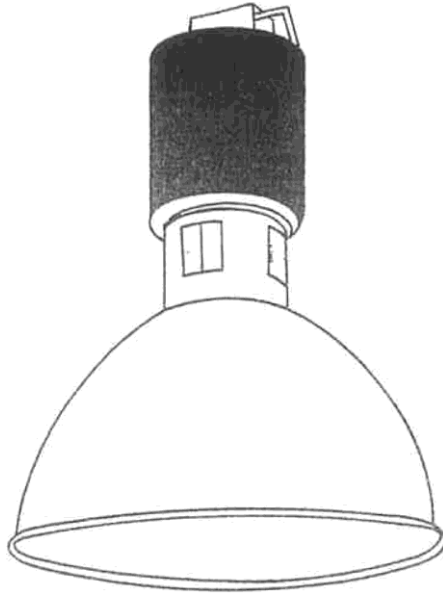
L.2.1 STANDARDS:

Discharge and incandescent lighting fittings shall comply with the following standards as appropriate:

IEC/BS EN 60598-1	Luminaires - Part 1: General requirements and tests
IEC/BS EN 60598-2-1	Luminaires. Part 2: Particular requirements. Section One: Fixed general purpose luminaires
IEC/BS EN 60598-2-5	Luminaires - Part 2-5: Particular requirements - Floodlights
IEC/BS EN 60923	Auxiliaries of Lamps - Ballasts for discharge lamps - Performance requirements
IEC/BS EN 61049	Capacitors for use in tubular fluorescent and other discharge lamp circuits. Performance requirements
IEC/BS EN 60064	Tungsten filament lamps for domestic and similar general lighting purposes - Performance requirements
IEC/BS EN 60188	High-pressure mercury vapour lamps - Performance specifications
IEC/BS EN 60662	High-pressure sodium vapour lamps - Performance specifications
IEC/BS EN 61547	Equipment for general lighting purposes - EMC immunity requirements
IEC/BS EN 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
IEC/BS EN 60061	Lamp caps and holders together with gauges for the control of interchangeability and safety. Part 1: Lamp caps
IEC/BS EN 61347-2-1	Lamp controlgear - Part 2-1: Particular requirements for starting devices (other than glow starters)
IEC/BS EN 61347-2-3	Lamp controlgear - Part 2-3: Particular requirements for a.c. and/or d.c. supplied electronic controlgear for fluorescent lamps
BS EN 55015	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment

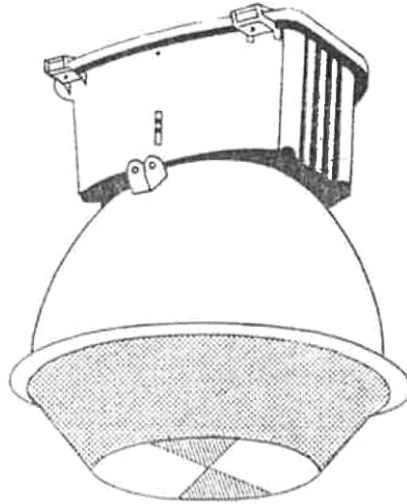
- L.2.2** The light fitting and their component (Lamp holder, Controlgear, lamps, wiring) shall comply with the relevant IEC/BS wherever specified and fully suitable for use in the climatic condition of the site.
- L.2.3** All lighting fitting shall be furnished complete with internal wiring, lamp holders, lamps and suspension accessories in addition to integral controlgear for mercury, sodium and metal halide light fitting.
- L.2.4** All high pressure mercury vapour, sodium and metal halide light fittings shall be provided with 240 volt, 50 Hz., ballast complying with IEC/BS EN 60923 and power factor correction capacitor, leak-proof metallic container type, complying with IEC/BS EN 61049 for improving power factor to 0.85 or better and suitable ignitor for sodium and metal halide lamps.
- L.2.5** The drawing of the light fitting is given as general shape for guidance.

**HIGH BAY FITTING
FITTING SERIES BI**



Protection Class	IP20	
Construction	The body shall be of aluminum finished in grey or other approved colour for housing the controlgear. The reflector shall be of anodized pure aluminum. The fitting shall comply with IEC/BS EN 60598.	
Mounting	Hook on 20mm conduit.	
Type of fitting	Wattage of Lamp	Type of Lamp
B1/1	250W	High pressure mercury vapour lamp
B1/2	400W	High pressure mercury vapour lamp
B1/3	150W	High pressure sodium lamp
B1/4	250W	High pressure sodium lamp
B1/5	400W	High pressure sodium lamp
B1/6	250W	Metal halide
B1/7	400W	Metal halide

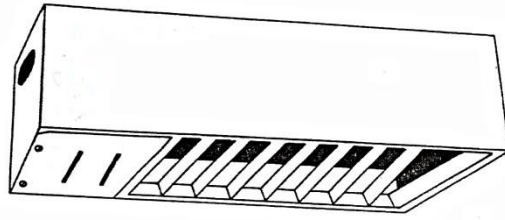
**LOW BAY FITTING
FITTING SERIES B2**



Protection Class	As mentioned.		
Construction	<p>The body shall be of Die-Cast Aluminum finished in grey or other approved colour for housing the controlgear.</p> <p>The reflector shall be of anodized pure aluminum with prismatic acrylic or polycarbonate refractor.</p> <p>The fitting shall comply with IEC/BS EN 60598.</p>		
Mounting	Suspension recommended by manufacturer.		
Type of fitting	Degree of Protection	Wattage of Lamp	Type of Lamp
B2/1	IP20	125W	High pressure mercury vapour lamp
B2/2	IP54	125W	- do -
B2/3	IP20	250W	- do -
B2/4	IP54	250W	- do -
B2/5	IP20	125W	High pressure sodium lamp
B2/6	IP54	125W	- do -
B2/7	IP20	250W	- do -
B2/8	IP54	250W	- do -

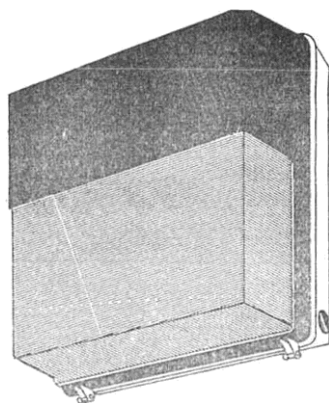
HORIZONTAL LOW BAY FITTING

FITTING SERIES B3



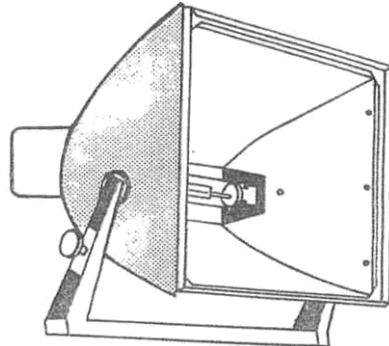
Protection Class	IP20	
Construction	<p>The fitting housing is of sheet steel or aluminum white stove enamelled finished or other approved colour.</p> <p>The Transverse louvers shall be fabricated from steel white stove enameled finished or aluminum.</p> <p>The fitting shall comply with IEC/BS EN 60598.</p>	
Mounting	Fitting shall be suitable for fixing directly to the ceiling	
Type of fitting	Wattage of Lamp	Type of Lamp
B3/1	125W	High pressure mercury vapour lamp
B3/2	250W	- do -
B3/3	150W	High pressure sodium lamp
B3/4	250W	- do -

**SECURITY PERIMETER AND ROADWAY LUMINAIRE
FITTING SERIES B4**



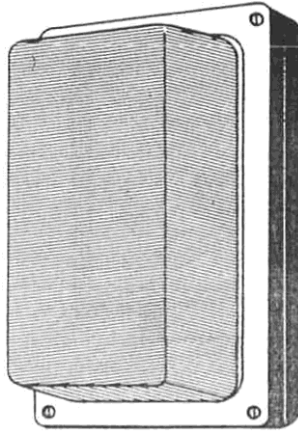
Protection Class	IP65	
Construction	<p>The body shall be from die-cast aluminum finished in bronze or other approved colour. The front cover shall be moulded prismatic polycarbonate or thermal shock-resisting glass.</p> <p>The fitting shall be suitable for outdoor use where the maximum temperature may reach 84°C.</p> <p>The fitting shall comply with IEC/BS EN 60598.</p>	
Mounting	Fitting shall be suitable for fixing directly to the wall.	
Type of fitting	Wattage of Lamp	Type of Lamp
B4/1	80W	High pressure mercury vapour lamp
B4/2	125W	- do -
B4/3	70W	High pressure sodium lamp
B4/4	150W	- do -

**FLOOD LIGHT
FITTING SERIES B5**



Protection Class	IP65	
Construction	<p>Housing shall be of die-cast aluminum or die-cast silumin.</p> <p>Attachment bracket of hot-dip galvanized steel and the reflector of anodized high purity aluminum.</p> <p>Stainless steel toggles</p> <p>Toughened heat resistant front glass.</p> <p>The fitting shall comply with IEC/BS EN 60598.</p>	
Mounting	Mounting by flood light bracket.	
Type of fitting	Wattage of Lamp	Type of Lamp
B5/1	1x250W	High pressure mercury vapour lamp
B5/2	1x400W	- do -
B5/3	1x150W	High pressure sodium lamp
B5/4	1x250W	- do -
B5/5	1x400W	- do -
B5/6	1x250W	Metal halide
B5/7	4x400W	- do -

**BULK-HEAD FITTING
FITTING SERIES B6**



Protection Class	IP65	
Construction	<p>The body and front frame shall be of cast metal. Front frame shall be screwed to the body by stainless-steel screw.</p> <p>The diffuser shall be of prismatic glass and reflector shall be of pure Aluminum.</p> <p>The fitting shall be suitable for outdoor use where the maximum temperature may reach 84°C.</p> <p>The fitting shall comply with IEC/BS EN 60598.</p>	
Mounting	Fitting shall be suitable for fixing directly to the wall or ceiling.	
Type of fitting	Wattage of Lamp	Type of Lamp
B6/1	60W	Incandescent lamp
B6/2	100W	- do -
B6/3	50W	High pressure sodium lamp
B6/4	70W	- do -
B6/5	80W	High pressure mercury vapour lamp
B6/6	125W	- do -

**DISPERSIVE REFLECTOR
FITTING SERIES B7**



Protection Class	IP20 for Indoor and IP65 for Outdoor	
Construction	Dispersive Reflector suitable for indoor or outdoor applications, constructed of Heavy Gauge sheet steel finished vitreous enamel, white inside and other approved colour outside. Reflectors to be fitted with "Saaflux" detachable tops and shall be suitable for suspension by means of 3/4" B.T. conduit complete with skirted all-porcelain lamp holder. Diameter of reflector & type of lamp holder as specified	
Mounting	Suspension.	
Type of fitting	Nominal Diameter of Reflector	Type of Lamp
B7/1	350 mm.	150W. G.L.S
B7/2	400 mm.	250W. G.L.S
B7/3	450 mm.	300/500W. G.L.S
B7/4	500 mm.	1000/1500W. G.L.S

L.3 LED LIGHTING FITTINGS:

Aiming at a greener environment, MEW, Kuwait has taken a step ahead on the energy conservation program by introducing the use of LED technology for lighting. MEW encourages and recommends the use of LED lighting for all new projects where suitable. Keeping in mind the rapid and continuous development of the LED technology, the below standards and specifications are to be considered as a basic guideline and such standards/specifications when applied shall comply with the latest versions of the said standards and established recommendations from IEC/BS/IES/IESNA/IEEE/ANSI.

L.3.1 STANDARDS:

LED lighting fittings shall comply with the following standards as appropriate:

IEC/BS EN 60598-1	Luminaires - Part 1: General requirements and tests
IEC/BS EN 60598-2-1	Luminaires. Part 2-1: Particular requirements - Fixed general purpose luminaires
IEC/BS EN 60598-2-2	Luminaires - Part 2-2: Particular requirements - Recessed luminaires
IEC/BS EN 62504	General lighting - LEDs and LED modules - Terms and definitions
IEC/BS EN 62717	LED Modules for general lighting – Performance requirements
IESNA TM-16-05	Technical Memorandum on Light Emitting Diode (LED) Sources
IESNA TM-21-11	Projecting Long Term Lumen Maintenance of LED Light Sources
IES/IESNA LM-79-08	Approved Method: Electrical and Photometric Measurements of Solid- State Lighting Products
IES/IESNA LM-80-08	Approved Method for Measuring Lumen Maintenance of LED Light Sources.
IES/IESNA LM-82-12	Approved Method for Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature
ANSI/NEMA C78.377-2011	American National Standard for Chromaticity of Solid State Lighting Products.
ANSI/IESNA RP-27.3-07	Recommended Practice for Photobiological Safety for Lamps - Risk Group Classification and Labeling
NEMA SSL 3-2010	High-Power White LED Binning for General Illumination
IEC/BS EN 60529	Degrees of protection provided by enclosures

IEC/BS EN 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
IEC/BS EN 62471	Photobiological safety of lamps and lamp systems
BS EN 55015	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
IEC/BS EN 61547	Equipment for general lighting purposes - EMC immunity requirements
IEC/BS EN 61000-3-2	Electromagnetic compatibility (EMC) Limits. Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)
IEC/BS EN 61000-3-3	Electromagnetic compatibility (EMC) Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase
IEEE 519-1992	IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.
IEEE C62.41.2-2002	Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits

L.3.2 Submittals:

The contractor shall submit the following for approval before ordering the lighting fittings:

- a) Fully detailed technical Manufacturer Catalogues showing the type of the LED fitting proposed, overall dimensions, photometric data, rated voltage, insulation class, degree of protection, max. working temperature, type & size of internal wiring, etc..
- b) Full technical details of the driver including manufacturer, type, catalogue number, driver efficiency, input watts, max. temperature rise, etc.. Manufacturer's technical catalogue shall also be submitted.
- c) Lighting calculations using the latest version of DIALux lighting design software for all typical lighting installations of the project.
- d) Light distribution tables per 1000 lumens including IES files.
- e) Test reports from an independent test laboratory that shows total lumens of the luminaire (absolute photometry) and test report for other electrical tests.
- f) LM79 test report for the luminaire with all significant product data and all performance data including including Total Luminous Flux, Luminous Efficacy (lm/W), Correlated Color Temperature (CCT), Color Rendering Index (CRI), Power Factor, Wattage, Driver Current, Chromaticity Coordinates and so on.
- g) LM80 report from LED vendor for LED used in luminaire with all pertinent data concerning conditions of testing, ambient conditions, type of equipment, type of LED source including numbers tested, operating cycle, drive current for life test, initial luminous flux, lumen maintenance data, failures, etc.

- h) LM82 test report for the luminaire detailing on the results of measurement of electrical and photometric properties as a function of temperature with all significant product data and all performance data including Input Power/Voltage/Current, Luminous Flux, Luminous Efficacy (lm/W), Chromaticity Coordinates, Correlated Color Temperature (CCT), Driver Temperature and so on.
- i) Analysis of LED lumen maintenance that includes as a minimum i) Measured LED junction temperature for a given test condition and extrapolated for an ambient temperature of 45°C ii) LED drive current and iii) LED manufacturer's data that clearly correlates LED junction temperature and LED drive current to lumen maintenance.
- j) Factory Pre-release Reliability test reports for the LED (chip, diode or package) from Joint Electron Devices Engineering Council (JEDEC), or similar international approved equivalent organization.
- k) Report/Certification in accordance with the requirements of IEC/BS EN 62471 for the Photobiological Safety of the luminaire to ensure it is classed "Exempt".
- l) Thermal management test report
- m) UL listing certificate or CE certificate of conformity
- n) Five (5) years guarantee on the indoor luminaire, ten (10) years guarantee on the outdoor luminaire and ten (10) years guarantee the driver for free replacement.
- o) Sample of each type of the proposed lighting fitting.

L.3.3 All LED fittings shall be of first class quality, made by reputable manufacturers from the standard ranges of product and illustrated in their catalogues and suitable in all respects for trouble free operation at 240 volts, 50 Hz single phase supply and at an ambient temperature of 45°C. Fittings shall be complete with all internal wiring.

L.3.4 All fittings and associated equipment shall be of the proven best quality and current models, for which replacement parts, like drivers, LED modules, etc. are and will be available for the normal expected useful life of the fittings and associated equipment.

L.3.5 The LED fittings shall have Class-1 insulation with provision of earthing and shall be manufactured and tested to fully comply with the requirements of IEC/BS EN 60598. For special applications the Class of Insulation of the fitting shall selected accordingly and shall be approved by the Engineer.

L.3.6 Each LED fitting shall be protected against environmental conditions at which the fitting will be fixed and shall comply with individual specification of each type of fitting described in the Contract Drawings.

L.3.7 The LEDs shall be manufactured in accordance with ANSI/NEMA/ANSI C78.377-2011 or similar approved International Standard and shall be from MEW approved manufacturers.

L.3.8 The LEDs shall be high brightness white light emitting Diodes (LEDs) with individual efficacy of minimum 120 to 140 Lumens/watt arranged modularly to provide the required lighting output. All lumen figures shall be Deliver (Hot) Lumens.

L.3.9 The white LED binning structure must comply in all respects with the requirements of the NEMA Publication No. SSL 3-2010 "High-Power White LED Binning for General Illumination" as a minimum and the LEDs shall only be from MacAdam Ellipse Step-3 or Step-4 Bins.

L.3.10 The LEDs shall provide cool white light and the colour temperature shall be between 5000K and 6400K with a colour rendering index of not less than 70.

L.3.11 The LEDs shall be removable/replaceable on site by modular means without any possible risk to maintaining luminaire photometry and without the need to demount the luminaires for sake of future upgrading/maintenance requirements.

L.3.12 The LED luminaire system efficacy shall be greater than 100 lumens/watt at 45 degrees centigrade ambient temperature and 95% relative humidity. This shall be supported by the LM-82-12 test report from an accredited laboratory.

L.3.13 The driver of the LED luminaires unit shall be highly reliable one with a design life time of minimum fifteen (15) years at 45°C ambient temperatures. The LED drivers shall be an integral part of the LED luminaires and shall meet the following requirements:

- a) Drivers shall be 1-10v dimmable and have a minimum efficiency of 85%.
- b) Case (Tc oC) Temperature rating -40oC to minimum +80oC and at a minimum 95% Relative Humidity (RH). Driver/Fixture to have some means of built-in overheat thermal protection in the form of automatic dimming or stepping/holding down of the driver where temperature exceeds operational limits. Thermal cut-out devices which turn the fixture LEDs completely off are not acceptable.
- c) The Driver and driver output current must be shown to be fully tested and compatible with the exact LED chips/engine of the luminaire. All information provided and the cost analysis/payback calculations should be calculated with the exact drive current including the calculation for the life cycle, life and resultant increase or decrease of the energy consumption if applicable.
- d) Input voltage: 240V ± 10%, single phase, 50 Hz.
- e) Power supplies shall be UL Class 1 or II output or similar European CE or International equivalent.
- f) Surge protection: Must be tested in accordance to the requirements of IEEE Recommendation C62.41.2-2002, Scenario I Location Category C or International equivalent.
- g) Drivers shall have a Power Factor (PF) of L: ≥ 0.90.
- h) Drivers shall comply with BS EN 55015 and IEC/BS EN 61000-3-2, 3-3 with regard to the RFI and EMC compliances. Drivers shall also be RoHS Compliant.
- i) Drivers shall have a total individual luminaire Harmonic Distortion (THD) of: ≤ 20% in accordance with IEC/BS EN 61000-3-2 or ANSI C82.77 (2002). The Contractor shall measure the harmonic at the supply point (LV side of the distribution substation) after the installation of all the LED fixtures and adopt harmonic compensation methods to limit the total harmonics distortion in the supply voltage to maximum 5% as per IEEE 519 Regulations.

L.2.10 The internal wiring shall be not less than 0.75 mm² size with silicone rubber insulation or high temperature rated P.V.C., clipped neatly in position. Other heat resisting wires with similar properties may be accepted.

L.2.11 Earthing terminal shall be provided for each fitting.

M. PAINTING AND FINISHING

M.1 GENERAL

M.1.1 All painting and finishing shall be conducted generally in accordance with the following specifications:

BS EN ISO 1461 Hot Dip Galvanized Coatings on Iron and Steel Articles.

BS EN ISO 8501 Preparation of steel substrates before application of paints and related products.

BS EN ISO 14713 Zinc coatings. Guidelines and recommendations for the protection against corrosion of iron and steel in structures

M.1.2 All metal surfaces, whether painted or otherwise, shall be suitably protected against rust or corrosion. Metal work which is normally painted may have to be patched up or repainted after erection as necessary.

M.1.3 Where the installation is to be painted, all oil, dust and other foreign matter shall be removed from equipment and its accessories.

M.1.4 All metal surfaces shall be properly cleaned, prepared and primed before finish painting.

M.1.5 Unless otherwise specified all exterior and interior painted surfaces of switchboards, distribution boards, motor control centres, isolators, trunking, busbar trunking, etc. shall be finished light grey gloss finished, or other approved colour.

M.1.6 All fluorescent luminaires shall be finished gloss white. The ceiling plates modular flush luminaires shall be finished semi-gloss white.

M.2 GALVANIZING:

M.2.1 The surface preparation shall be as follows:

- a) Before galvanizing, surfaces shall be degreased and pickled. The pickling process shall be such as to ensure the removal of all mill scale and other surface defects. There after it shall be neutralized prior to galvanizing.
- b) Before zinc spray coating, surfaces shall be shot blasted.

M.2.1 Galvanizing shall be applied by the hot process to give an average coating minimum permissible value of 610 g/m² above 5mm. steel thick and 460 g/m² between 2 and 5mm. steel thickness for all fabricated steel articles.

M.2.2 Galvanized surfaces shall have an etching primer applied before painting.

M.2.3 Oversize tapping or retapping of female threads shall be provided where the bolt or male thread is hot dip galvanized. Nuts shall be tapped to 0.4 mm oversize after galvanizing and the threads shall be oiled. Bolts and screwed rods shall be galvanized after thread forming.

The threads of all bolts and screwed rods shall be cleared of spelter by spinning or brushing. A die shall not be used for cleaning the threads unless approved by the Engineer.

M.3 PAINTING OF GALVANIZED MATERIAL:

M.3.1 Before painting all galvanized parts shall be completely clean and free from rust, scale or grease and all external rough surfaces shall be filled.

M.3.2 Except for nuts, bolts and washers which may have to be removed for maintenance purposes, all external surfaces shall receive a minimum of three coats of paint.

M.3.3 The priming coat shall be applied immediately after cleaning, no further painting shall be done until the works tests have been carried out.

M.3.4 After inspection and test and before dispatch to site, all external surfaces shall be thoroughly cleaned, touched up as necessary and a second coat applied of a shade of colour easily distinguishable from the priming and final coat.

M.3.5 All surfaces shall be cleaned down, touched up as necessary and a final coat applied of a glossy and non-fading light grey colour paint.

M.3.6 Damage to paint work incurred during transport or erection shall be made good by thoroughly cleaning and applying the full number of coats originally specified.

M.3.7 Exposed un galvanized nuts, bolts and washers which may have to be removed for maintenance purposes shall have a minimum of one coat of paint after erection.

M.3.8 If the final coat is not applied at the works, the period between the application of the second and the final coats shall not exceed three months unless otherwise directed by the Engineer.

M.3.9 The internal surfaces of cubicles and boxes containing wiring or other apparatus which are dispatched to site in an assembled condition shall be finish painted before inspection and testing.

SECTION II
INSTALLATION DETAILS

AA. General Electrical Installation:

- AA.1** The installation shall be carried out in accordance with the latest issue of M.E.W. Regulations For Electrical Installation.
- AA.2** Throughout the electrical installation the Loop-In system of wiring shall be employed.
- AA.3** The general electrical installation shall be carried out by means of single core P.V.C. insulated Cables in conduits or in trunkings. Where the conduits are buried in the wall, ceiling or floor, P.V.C. conduits and accessories shall be used. For surface installation galvanized conduits and accessories shall be used in location where they will be subjected to mechanical damage.
- AA.4** Trunking with accessories shall be used where large numbers of single core P.V.C. insulated cables are run together. The size of trunking and accessories shall be such that a space factor of 45 % is not exceeded.
- AA.5** Particular attention shall be given to the following:-
- a) The installation shall be neat, tidy and all runs in walls shall be truly vertical or horizontal.
 - b) The conduit system, joint boxes, loop boxes etc., shall be firmly supported.
 - c) The system shall be clean and free of sharp edges, burrs etc.
 - d) Due allowance shall be made for expansion and contraction.
 - e) As far as possible conduit runs shall not cross building expansion joints; where they do, flexible conduit joints shall be provided.
- AA.6** Conduit shall be installed at least 150 mm clear of, and preferably under, hot pipes (steam or water) and 50mm clear of gas, water and any other services.
- AA.7** Not more than two right angle bends shall be allowed in any conduit run without the provision of an inspection fitting for drawing in purposes between them.
- AA.8** Conduits shall not be dismantled for wiring, and must be capable of being wired complete without draw wires being installed during erection.
- AA.9** Where false ceilings exist, all conduits shall be fixed to the truss or to the surface of the slabs and dropped to loop-in boxes at false ceiling level.
- Conduits shall not be run over the supports intended to carry false ceiling without prior permission of the Engineer.
- AA.10** For galvanized steel conduit all the joints shall be screwed, care shall be taken in planning the conduit runs to avoid the use of running joints. All conduit shall be free from rust patches or mechanical damage and shall be adequately protected from damage whilst stored on site. All exposed threads, die marks and other abrasions shall be painted with two coats of an approved metallic paint immediately the conduit is installed.

AA.11 For nonmetallic conduit all the joints shall be made with proprietary fittings and an approved adhesive. The conduits and fittings shall be entirely suitable for the environment and the temperature range that will be met in service. The installation shall cater for the differential expansion and contraction that will occur between the conduit and the structure to which it is attached.

AA.12 Where flexible conduits are installed a separate earth conductor shall be provided and under no circumstances shall the flexible tubing be used for earthing.

AA.13 The trunking shall be attached to the building frame work and walls or supported on hanger or brackets as appropriate.

All trunkings shall be free from rust patches or mechanical damage. All abrasions on metallic trunking shall be painted with two coats of an approved metallic paint immediately the trunking has been installed. Damaged trunking shall be replaced to the satisfaction of the Engineer.

Where trunking passes through ceiling and walls the cover shall be firmly fixed at 150mm either side in ceilings and floors and 250mm either side of walls. Approved fire resisting Internal barriers and external seals shall be provided to prevent the spread of fire through floors and walls, and ceilings.

Where trunking crosses a building expansion joint flexible connections shall be provided. In addition allowance shall be made for thermal expansion.

Cable trunking where specified or where offered instead of or in addition to conduit shall be complete with all the necessary proprietary bends, tees, sets, angles, cable restraining straps, covers and other accessories.

Cables shall not be installed in trunking until the section is complete. Each group of cables comprising a circuit shall be secured at 300 mm intervals with approved type, nonmetallic buckles. The circuit reference of each group shall be identified with an approved type of label, spaced at 1800mm intervals on straight runs, and 150mm back from all tees and bends.

A.14 For non-metallic cable trunking all joints between sections of the trunking shall be made with a connecting sleeve. Clip in metal or PVC partitions shall be provided where compartmented cable trunking is required. The partitions shall be of steel when screening and segregating mixed services. The installation shall cater for the differential expansion and contraction that will occur between the trunking and the structure to which it is attached. Adequate supports shall be provided to prevent any visible sagging of the trunking run.

BB. Light Fittings:

BB.1 Pendant fitting switch sphere shall be suspended by means of their standard manufacturer's suspension with ball swing joint.

BB.2 Pendant fluorescent fittings shall be suspended by means of two numbers of heavy gauge galvanized steel conduits and two numbers of ball dome covers.

BB.3 For light fittings fixed directly to the boxes, sufficient long sleeve of suitable heat resisting material e.g., Silicone bonded glass braiding shall be provided at the end of each conductor of the fixed wiring.

CC. Installation of Equipment:

Water heater, Water cooler, incinerators, Air conditioner, etc. shall be wired as specified in the schedule of points and shall be controlled by 20 amp. D.P. Switches.

From the control switch a conduit with 3x2.5 or 4 sq. mm. PVC insulated cable shall run to a junction box located near the equipment. From the junction box a 3 core 2.5 or 4 sq. mm. PVC Insulated PVC sheathed flexible cord shall be provided up to the terminal of the equipment except for water heaters. **For water heaters the connection from junction box shall be by Silicone rubber insulated flexible cord.**

DD. Installation of KWH Meter:

All Kwh meters should be handed over to the Ministry of Electricity & Water for calibration before final erection and connection.

EE. Installation of Underground Cables:

The underground cables shall be laid in trenches 75cm. below the ground level. The sides of trenches shall be trimmed neatly and the bottom shall be leveled and smoothed. The width of the trenches shall not be less than 40cm. After the cables are laid, the trenches shall be backfilled to a depth of 15cm. with fine selected soil free from lumps, metallic or other foreign Inclusions or, where required by Engineer, by washed sand. The remainder of the trench shall be back-filled in an approved manner with soil, which shall be rammed down and thoroughly consolidated.

Where two or three cables are laid in one trench, the cables shall be pulled straight and spaced not less than 15cm. (Centre line to centre line).

Where the cables cross the asphalted roads and enter into buildings they should pass through UPVC or HDPE pipes as indicated on the drawings. The duct should extend one metre beyond the kerb line of the road in either side.

The proposed routes of cables are shown on the layout drawings. The contractor should check location of other services and shall submit final cable routes drawings for approval of the Electrical Engineer before commencement of any cable laying work.

All cable joints shall be carried out by experienced and approved jointers and all jointing material shall be supplied by the contractor.

FORM E

This Form to Be Completed By The Tenderer As Well As Electrical Contractor & To Be Submitted With The Offer:

1. Name of Tenderer :
2. Name of Elect. Contractor :
3. Registration No. & C.T.C. Category reference of Electrical Contractor :
4. Detail of working hand with proposed Elect. Contractor:.....

Govt. Cont. NO.	Type of Building	Cont. Amount	Date of commencement & Completion.
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- 1
- 2
- 3
- 4
- 5

**Information of Electrical
Supervisory**

Elect. Engineer

Elect. Supervisor

- 1 Name and Age of
- 2 Technical qualification of
- 3 Previous Experience of

We confirm that:

1. The statements given above are true, to the best of our knowledge and it is known to us that C.T.C. reserves the right to refuse to award contract to us if the above statements are found to be incorrect.
2. The Electrical Engineer will be available for a minimum period of Two (2) hours, every second day at site and at exact time as arranged with the Engineer of Ministry of Electricity & Water.
3. The Electrical Supervisor will be available at site during working hours and he will not supervise any other project.

Tenderer

Electrical Contractor

Name of

Signature:

Position in company of the person
signing:

Date: