



***Construction of Additional Court / Record Room  
for District West and Extension of Bar Room-Karachi.***

***Electrical & Low Current systems***

SECTION – A  
TECHNICAL SPECIFICATIONS

The specification describes the requirements for the supply and installations of electrical/ low current systems.

**1. SCOPE OF WORK**

The works under these specifications includes providing of all materials & equipments and performing the work necessary for completion of work as shown on the drawings, specified in specification & bill of quantities. The work also include to obtain clearances, certificates etc. from the relevant authorities and also to give the required notices to local electrical authorities and assist the owner in getting electrical connections. The work shall by include but not limited to the following:

a) Electrical Works

- |      |                             |               |
|------|-----------------------------|---------------|
| i.   | Low Voltage Switchgear      | (Section - B) |
| ii.  | Low Voltage Cable and Wires | (Section – C) |
| iii. | Conduits and Pipes          | (Section – D) |
| iv.  | Wiring Accessories          | (Section – E) |
| v.   | Light Fixtures              | (Section – F) |
| vi.  | Earthing System             | (Section - G) |
| vii. | Cable Tray System           | (Section – H) |

b) Low Current Systems

- |      |                                    |               |
|------|------------------------------------|---------------|
| i.   | Voice & Data Communication Systems | (Section – I) |
| ii.  | Conventional Fire Alarm System     | (Section –J)  |
| iii. | CCTV System                        | (Section – K) |



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**2. MATERIALS ORIGIN**

- a) All material and equipment supplied by the Contractor shall be new and shall be in accordance with the details described in BOQ and/or shown on drawings. If the contractor desires to use different materials other than specified, he shall obtain the approval from consultant in writing before using the materials.
- b) The Contractor shall also be responsible to supply any other equipment not mentioned in specifications but which is necessary for completion of works, it shall be provided by the Contractor as part of the Contract.
- c) Material shall be in accordance with high standard specifications. The contractor shall submit the samples of materials with complete specifications etc for the approval of consultants, before ordering or installation of materials. Approval of materials/installations shall not relieve the contractor of any of his obligations or liabilities under the contract. The Consultants/Owners or Representatives reserve the right to inspect the materials in store or in installed at site and to reject any material not complying with specifications without any extra cost.
- d) When choice of manufacturers is allowed for any material/equipment, the contractor shall obtain the whole quantity required to complete the job from one manufacturer otherwise he shall provide evidence to the consultant for non-availability of material/equipment in market.

**3. RULES, REGULATION AND STANDARDS**

The entire electrical installation / work shall be carried out by licensed electrical contractor, issued by Electric Inspector. The work shall be carried out by qualified & experienced workers having permits/certificates issued by Electric Inspector to undertake such a job. The contractor's license number and supervisors competency certificate shall be submit before commencement of work.

All works shall be carried out in accordance with the latest edition of the Regulations of Electrical Equipment of Buildings issued by the Institute of Electrical Engineers - London, the Contract documents, the Electricity Rules 1937 and bye-laws that are in force from time to time. Any discrepancy between these specifications and any other rules and regulations shall be



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brought to the notice of Owner or his representative, and his decision shall be final and conclusive.

The Contractor shall be responsible to complete all the formalities/requirements and get the installations passed by the Electric Inspector and submit the test certificates to Owner/Electric Company without any extra cost.

All installations/equipment and materials shall conform to the following standards:

- a) International Electro-technical Commission (IEC)
- b) British Standards (BS)
- c) National Electric Code (NEC)
- d) National Standards
- e) Any other international standards

In the event of conflict between the standards, the most stringent shall prevail.

Whenever any electrical equipment is to be installed, which does not hold national standards, the Contractor shall take into account the specific standards chosen by the Owner and make sure that the equipment he has to install, meets any one of the above mentioned standards.

#### **4. INSTALLATION AND SERVICE CONDITIONS**

##### **4.1 Site Conditions**

All material and equipment supplied and installed shall be designed, manufactured and tested to meet the following ambient conditions unless specifically stated otherwise for any material / equipment:

- |    |                                     |   |                 |
|----|-------------------------------------|---|-----------------|
| a. | Maximum outdoor ambient temperature | : | 45 <sup>0</sup> |
| b. | Minimum Indoor ambient temperature  | : | 15 <sup>0</sup> |
| c. | Maximum relative humidity           | : | 90 %            |
| d. | Minimum relative humidity           | : | 26 %            |

##### **4.2 Service Conditions**



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- 4.3** Equipment shall be designed and built for continuous service with a minimum of supervision and maintenance.

**5. MAIN ELECTRICAL CHARACTERISTICS**

**5.1 Power Supply System**

Unless otherwise specified elsewhere, all equipment and material shall be designed to operate and function satisfactorily with the following minimum requirements without any de-rating:

- Voltage                      400V  $\pm$  10%
- Phase                         3phase, 4 wires system
- Frequency                  50 Hz.  $\pm$ 2 Hz.

**5.2 Degree of Protection of Enclosures**

For indoors, IP31 minimum degree of ingress protection of the enclosures against contact with line or moving parts and against ingress of solid foreign bodies or liquids, shall be selected, in accordance with IEC 60529.

**6. GUARANTEE**

- a) The Contractor shall furnish written grantee that the material & installations meet with this specification and the electrical systems are free from all grounds and all defective workmanship and materials and will remain so far a period of one year after handover of project. Any defect appearing within one year, shall be rectified by the contractor at his own cost.
- b) The contractor shall indemnify and save harmless the owner and consultant from and against all liabilities for damages arising from injuries to persons or property occasioned by any act or commission of the worker/sub-contractor/contractor including any or all expenses, legal or otherwise, which may be incurred, any and all expenses, legal or otherwise by the owner in the defense of any claim, action or suit

**7. SPECIFICATIONS & DRAWINGS AT SITE**

The Contractor shall have for ready access and refer a complete set of drawings/design, BOQ specification at site. He shall incorporate all changes, additions/ alterations made at site during installations and shall prepare a set of drawings indicating the work as actually and finally installed.



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**8. DISCREPANCIES IN TENDER DOCUMENTS AND DRAWINGS**

The Contractor shall carefully examine the documents and drawings and if he finds any discrepancies or omissions from the specifications, bill of quantities or drawings, or is in doubt as to the meaning, he shall consult with the consultants before starting the work. If such defective or modified work is carried out by the Contractor, he shall rectify the same at his own cost.

**9. MEASUREMENT OF WORKS**

The quantities set out in the bill of quantities are estimated quantities and they shall not be taken as actual and correct quantities of work to be executed by the Contractor. The Contractor shall carry out actual measurement of works at site and prepare bill accordingly

**10. INSTALLATIONS/PROTECTIONS/CO-OPERATION**

- A. The locations, routings, installation heights, and other details etc. for installations are shown on the drawings. If any information is not stated on the drawings or wherever modifications are required the Contractor shall obtain prior instructions from the Owner or consultants.
- B. The contractor shall protect his own work from damage and he shall likewise protect adjoining works of other trades during or after installations.
- C. The contractor shall co-operate and work as a team with all other contractors during the installation.

**11. DRAWINGS AND WORKMANSHIP**

The Contractor shall provide dimensional outline drawings, arrangement drawings and technical data to fit with architectural details as per instructions given to him.

- a. The plans are drawn on the basis of architectural drawings. The plans are diagrammatical and do not necessarily show all details to fit the building conditions. The location of outlets, fittings, fixtures & equipments are approximate and may be accommodate to site conditions.
- b. No major change shall be made without the approval of consultant. The contractor shall examine all approved shop drawings of other trades in detail and he shall frequently consult to ascertain any change that may have been made.
- c. The work shall be executed in the best and most thorough manner under the direction of consultants. The consultants reserved the rights to reject any installation/material, which is not in accordance with the drawings & specifications.



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**12. IDENTIFICATION**

- a. For each of the equipment, identification label shall be fitted in front of the casing. The label shall have block letter 7mm high, black on white back ground of trifoliate and fixed with screws.
- b. All DB's shall be provided with detail circuit sheet fixed inside the front cover indicating the function and circuit numbers. Spare circuit space shall be left blank.
- c. On AC system the phase sequence shall be maintained in the order of Red, Yellow and Blue from top to bottom and/or left to right. Neutral and earthing wires to be connected on respective link or bus-bars.
- d. Where 400 volts or above exists the equipment shall be marked "DANGER 400V" engraved in front of the equipment with the requirements of electricity rules and according to engineering practice.

**13. SWITCHGEAR TESTS**

All switchgear installed by the Contractor etc shall be fully tested at the manufacturer's place to meet the requirements of appropriate standards without any extra cost.

The Contractor shall inform the Engineer in writing about the date and time of test at least 3 days in advance. The witnessing of test by the Owner or his representative shall not absolve the Contractor from his responsibility for the proper functioning of the equipment and for furnishing the guarantees. All test results in the form of certificate/record certificates, signed by all the witnesses, shall be submitted to the Engineer 3 days before delivery to the site.

**14. STORAGE**

The Contractor shall store the equipment in dry warehouse and protect from damages. Fragile components shall be stored on shelves in their original packing, marked with identification labels.

The Contractor shall handle, store and fix each of the equipment as per the manufacturer's recommendations. He shall inform the Engineer if these conflicts with any other specified requirement and submit copies of manufacturer's recommendations to the Engineer if required.

**15. LABOR AND STAFF**

The Contractor shall provide all labor materials, tools and equipments for installation and testing of work as detailed below:



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- Skilled and unskilled labor required for performing the works as per specifications and drawings.
- Experienced supervising staff with requisite expertise to ensure quality of work in time.
- Administrative staff to ensure smooth functioning of site activities.
- Construction equipment, measuring tools, apparatus and working tools in good working conditions.

The Contractor shall be responsible for the performance of any sub-contractors, worker and manufacturer at his own cost and risk.

**16. SMALL INSTALLATION MATERIAL**

The Contractor shall supply and install all small installation and consumable materials such as nuts, screws, anchor, bits, bolts, washers, shims, angles, leveling materials, insulation tape, solder, PVC strap-on or heat shrinkable type cable tags, cable ties, bushes, sealing compound, lugs etc, required to complete the job without any extra cost.

**17. INSTALLATION INSTRUCTIONS - GENERAL**

The Contractor shall set out the works himself as per specifications and drawings and shall properly install the equipment on specified foundation / location as per manufacturer's instructions. Any defective or faulty operation of equipment the Contractor shall change/repair the same at his own cost.

**18. ASSOCIATED CIVIL WORKS**

The Contractor shall be carried out associated civil works under the direction of the Engineer.

The Contractor shall prepare drawings giving details of all associated civil works without any extra cost.

The following work to be carried out by the Contractor during installations:

- a. The cutting and forming of holes or conduits/pipe fixings in walls, floors, ceilings, partitions, roofs, etc., and bringing back the finish to the position that it was before.
- b. Formation of concrete bases or foundation pads.
- c. Excavation forming for underground services of ducts and courses and then covers it.



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- d. Excavation for and lying of cables or pipes etc.
- e. The painting of all pipes, tube and conduits etc. after fixing unless specified to the contrary.
- f. Sleeves through floors/walls, flush with walls/ceilings or finished floors of a size to accommodate the raceways.

All required holes through walls, floors and beams for pipes and ducts will be left out by the Contractor during the process of building and he should workout in advance the position of holes channels etc to the civil contractor where it's not possible for cutting or chipping etc.

Cutting, fitting, repairing, patching of plaster and finishing of carpentry work shall be done by skilled workers in their respective trades, when cutting is required it shall be done in such a manner as not to weaken structure, partitions or floors. The holes required to be drilled without breaking out around the holes. Where patching is necessary in finished areas of building, the Engineer shall determine the extent of such patching or refinishing.

## **19. TESTING**

Upon completion of installations, the Contractor shall perform all static, semi-dynamic (by simulation), and dynamic field testing on all the equipment and systems.

All tests shall be conducted in the presence of the Engineer for the purpose of demonstrating equipment or system compliance with specifications. The Contractor shall submit for Engineer's approval complete details of tests to be performed describing the test procedure, test observations and expected results.

The Contractor shall furnish all tools, instruments, test equipment, materials, etc., and all qualified personnel required for the testing, setting and adjustment of all electrical equipment and material including putting the same into operation.

All tests shall be made with proper regard for the protection of the personnel and equipment and the Contractor shall be responsible for adequate protection of all personnel and equipment during such tests. The cost of any damages or rectification work due to any accident during the tests shall be the sole responsibility of the Contractor. The Contractor shall record all test values and submit the same to the consultants.



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The witnessing of any tests by the Engineer does not relieve the Contractor of his guarantees for materials, equipment and workmanship, or as any obligations of Contract.

In addition to installation testing, the Contractor is to carry out operation testing of all sections to ensure that the entire installation is sound, complete and safe and will function properly and as intended.

The acceptance shall be made by the Owner.

The Contractor shall formally engage his direct responsibilities to the Owner or his representative, and likewise, shall assume all responsibility for work performed by sub-contractors and materials he has supplied and installed.

**19.1 Insulation Resistance Test**

Insulation resistance test shall be made on electrical equipment and wiring by using a meager of 1000 volts for circuits between 250 and 500 volts. The insulation resistance of distribution boards, cables, etc., shall be as per IEC, IEEE, BSS and Pakistan Electricity Rules.

The distribution boards shall be tested before wire connections. Insulation tests shall be made between open contacts of circuit breakers, switches and between each phase and earth.

If the insulation resistance of the circuit is less than specified values, the cause of the low reading shall be determined and removed. Corrective measures shall include dry-out procedure by means of heaters, if equipment is found to contain moisture. Where corrective measures are carried out, the readings shall be taken and repeated twice at 12 hours interval. The maximum range for each reading in the three successive tests shall not exceed 20% of the average value. After all tests have been made, the equipment shall be reconnected as required.

**19.2 Earth Resistance Test**

Earth resistance tests shall be made by contractor on the earthing system, separating and reconnecting each earth connection as may be required by the Engineer. If it is indicated that soil treatment or other corrective measures are required to lower the ground resistance values, the Engineer will determine the extent of such corrective measures.



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The electrical resistance of the E.C.C. together with the resistance of the earthing lead measured from the connection with earth electrode to any other position in the completed installation shall not exceed one ohm.

Earth resistance test shall be performed as per Electrical Inspector's requirements. Where more than one earthing sets are installed, the earth resistance test between two sets shall be measured by means of Resistance Bridge Instrument. The earth resistance between two sets shall not exceed one ohm.

**19.3 Phase sequence test**

Each circuit breaker shall be operated electrically and mechanically. All interlocks and control circuits shall be checked for proper connections in accordance with the wiring diagrams given by the manufacturer.

The Contractor shall properly identify the phases of all switchgear and cables for correct rotation of all motors and entire installation before final connection to supply line.

Trip circuits shall be checked for correct operation and rating of equipment served. The correct size and function of fuses disconnect switches, number of interlocks, indicating lights and alarms shall be in accordance with approved manufacturer drawings. Name plates shall be checked for proper designation of equipment served. Protective relays shall be tested and set at site prior to commissioning of the equipment.

**19.4 Low Current Systems Tests**

The testing of Low Current systems shall be carried out as per procedures or recommended by the manufacturer/supplier.

**19.5 Complete Tests**

After any equipment has been tested, checked for operation, etc., and is accepted by the Engineer, the Contractor shall be responsible for the proper protection of that equipment so that subsequent testing of other equipment do not cause any damage to the already tested equipment.

**20. ELECTRICAL CONNECTION**

Electrical connection shall be provided by Electric Supply Company but necessary but necessary arrangement coordination to be done by the Contractor. The temporary arrangements (including materials and labor) for installation/testing purpose to be made by the contractor without any extra cost.



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**21. DRAWINGS, SAMPLES AND MANUALS**

1. The contractor shall prepare shop drawings showing all routes, switches, sockets, DBs and junction/pull boxes locations etc. and submit to the consultant for approval before starting the work without any extra cost.
  - a. Single line diagram indicating all cables, with sizes and types, and rating of circuit breakers, fuses, etc.
  - b. Lighting, power, telephone, fire alarm, nurse call, public address, CCTV, queue management and data/voice systems, as applicable.
  - c. Control and Data/Voice wiring diagrams for the equipments installed by the Electrical Contractor
2. All changes/additions/alterations shall be carefully recorded during the work and the Contractor shall prepare as built drawings. On approval of drawings the Contractor shall provide two set of drawings to the consultant and owner before final payments.

The Contractor shall submit for approval of the manufacturer's instructions for installation, testing, commissioning, operation and maintenance manuals of the equipment before installation. Upon acceptance, the Contractor shall supply a copy to the Owner. The contractor shall also submit for approval the samples of materials to be used in the project, before starting the installations and approved list of materials/equipments to be handed over to owner.

**22. WORK COMPLETION**

The Contractor shall further repair/replace all defective works on completion and leave all installations in perfect working order up to the satisfaction of the Owner and consultant. The contractor shall meet all the requirements/instructions given in specifications.

The contractor shall complete each and every work as described and included in these specifications and BOQ as per owner's/consultant's instructions.



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**23. PAYMENT**

Running payments shall be made to the contractors at an interval not less than 15 days at a time. Contractors shall submit running bills to the consultant for verification. After due verification, the owner shall paid the bills to the contractor after deducting applicable taxes.

**SECTION - B  
LOW VOLTAGE SWITCHGEAR**

**1. GENERAL**

**1.1 Purpose**

This section describes the minimum requirement for the design, construction and performance of factory assembled LV switchboard.

**1.2 Scope of Work**

The job consists of supply, installation, testing, connecting and commissioning of switchboards as specified in BOQ or shown on the Drawings.

**1.3 Installation**

Switchboard shall be installed indoor. The equipment shall be capable of operation under the prevailing ambient conditions without any deleterious effect of any kind. Switchboard shall be suitable for continuous operation at full load rating under combined variation of both voltage and frequency.

**2. MAIN ELECTRICAL CHARACTERISTICS**

**2.1 Power Supply System**

Main characteristics of power supply system applicable to all switchboards are:

- Voltage 400 V  $\pm$  10%
- Phase 3 phase, 4 Wires.
- Frequency 50 Hz.  $\pm$  2 Hz.
- Neutral system firmly grounded.



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Main characteristics of auxiliary supply system are:

- Control / Command system 24 VDC.
- Space heater system 230 VAC.

**2.2 Ratings**

The equipment shall be capable of carrying the specified current continuously 24 hours per day, without exceeding the permitted temperature.

The current ratings must be guaranteed at the specified design temperature. Equipment shall be fully rated and constructed for withstanding, making and breaking the specified short circuit duty.

Pins of auxiliary circuits shall be sized for a rated circuit of minimum 10 Amp.

**3. ENCLOSURES**

The Switchboard shall be prefabricated metal clad cubicle(s), floor standing type, totally enclosed, dust tight and vermin proof and front access only. It shall complete in all respects with material and accessories, factory assembled, tested and finished all according to the specifications and to normal requirements. For indoor installations the international classification shall be IP42.

- a) The short service breaking capacity, ICs at 400 VAC, conforming to IEC 60947-2 unless otherwise stated on the drawings.
- b) To provide with adequate clearance from live parts so that flash over cannot be caused by switching, vermin, pests, etc.
- c) All components shall be rated for insulation class 600-volt minimum.
- d) It shall be designed for flush mounting of all instruments on the front side only.
- e) All incoming or outgoing connections from top or bottom shall be completed. The components mounted so as to facilitate ease of maintenance from the front. Common lamp test facility for all lamps.
- f) The wiring diagram on the inside of door. Be labeled with name plate on the front side of door.
- g) To provide 25% space for extension in future.



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**3.1 Cable Accessibility**

Switchboard shall preferably be arranged for bottom cable entries. Adequate space must be provided for cable entries and termination. It shall be possible to work easily and safely on cable of a main or control outgoing circuit in OFF position with the remainder of the board alive.

Adequate system shall be provided for installation and clamping of cables inside the cable compartment. Position of terminals and cables shall allow use of clamp ammeter.

Power and Control cable termination shall avoid obstruction to other cable termination and provide easy access for terminating cables. Cable supports shall be provided to avoid undue strain on cable termination. Easily accessible locations shall be reserved in the compartment for measuring transformers.

**3.2 Heaters**

Space heaters shall be provided for prevention of moisture in each cubicle. Heaters shall be wired together and shall be automatically controlled to avoid over heating the equipment. Heater shall be suitable for operation on 230 VAC supply from an external source (to be provide in main Distribution Board)

**3.3 Name plates**

On the front side, a name plate shall be provided at the top to indicate the name of manufacturer, system voltage and frequency and the current carrying capacity of switchboard.

Each breaker shall have a circuit identification label fitted below the breaker aperture or as suitable.

Drawing indicating the branch circuit names, breaker elements, cable sizes and connecting services shall be placed in a clear plastic pocket provided at the back of the front access.

Labels described shall have block letters 7 mm high on a white back ground, to be made from trifoliate and be fixed with screws.

Each incoming and outgoing circuit shall also be labeled with name plate 75 mm x 15 mm, as described above on the front side of door.



#### **4. CONSTRUCTION**

- 4.1** The switchboard shall be fabricated, welded; grinded, finished with angle iron frame work and clad with 2MM MS sheet, to form a rigid, free standing, flush mounting fronted assembly.

It shall be suitably divided into panels and compartments for accommodating the required number of circuit components, instruments and accessories. Each compartment shall be fully partitioned from its neighbor both horizontally and vertically, allowing safe cable routing / termination without shutting the switchboard down.

All live parts within cubicles, compartments or modules, which have to be accessible during normal maintenance operations, shall be adequately protected and / or buried to ensure protection of works and to avoid accidental contact. Barriers may be rigid, transparent, insulating material fitted with warning labels.

The doors shall be provided with hinges on the left-hand side and locking handles on the right hand side for fastening the door. The front assembly shall be fastened to the enclosure by means of self locating fasteners for quick and easy fixing.

All holes, cutouts shall be tool or jib manufactured and free from burrs and rough edges. All structural components shall be of standardized design to provide complete uniformity and interchangeability of common parts. Removable gland plates shall be provided at top and / or bottom as required.

The switchboard shall be supplied complete with foundation bolts and other installation materials as recommended by the manufacturer. Proper size cable clamping channels with galvanized steel clamps and brass cable clamps respectively for PVL/PVC and SWA cables shall be provided.

The cabling inside the Switchboard shall be suitably numbered and harnessed by means of straps or cords. Wiring to door mounted components shall be in flexible PVC conduit. All indicating, control and selecting equipment shall be suitably arranged and clearly labeled with indelible labels indicating the rating of fuses, switches, etc.



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All metal work of the switchboard shall be cleaned down to bare shining metal, phosphate and the surfaces chemically prepared for powder coating. Then these shall be coated with powder of color RAL 7032 and then baked in oven. The thickness of powder coating shall not be less than 120 microns.

**4.2 Bus Bars**

Bus bars and droppers supported on non - hygroscopic material are to be high conductivity electrolytic tinned copper, completely isolated and mechanically braced and rated to withstand the specified short circuit currents for one second duration.

Bus bars and droppers shall be housed in a separate compartment and shall be clearly marked with Red, Yellow and Blue colors. Bus bars shall be provided for three phases, neutral and multi - terminal earth. The temperature rise shall not exceed 50 degree centigrade at rated current. Neutral bus assembly shall consist of outgoing screw terminals with one terminal for every MCCB / MCB.

Removable metal covers on the bus bar chamber shall be provided with suitably sized labels at regular intervals, fixed with self tapping screws and warning of live metal work.

All bus bars connectors shall be tinned plated connections and joints. Horizontal bus bars shall be of the same current rating throughout their length.

**4.3 Earthing**

A copper earth bar of suitable section for the specified fault level shall extend the entire length of the Switchboard. Provisions shall be made for possible future extensions at both ends.

Earthing facilities shall be provided on each incoming and outgoing unit to permit earthing of the connections.

All metallic non-current carrying parts of the Switchboard shall be bonded together and connected to the Switchboard's earth bar.

Each circuit wiring shall be green / yellow color. Earthing mass continuity between withdraw able parts and fixed frame shall be correctly ensured whatever withdraw able



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part position.

Provision shall be made adjacent to cable termination for earthing cable armor to the earth bus bar.

Earthing switch shall be provided wherever mandatory as per rules and regulations / codes and standards and shall be manually operated. An interlocking system shall provide the following locking and safety functions:

- Impossibility of closing the earth switch if the switching device is closed.
- Visual check of earthing switch positions to be possible.
- Possibility of locking the earthing switch operating handle in open and closed position.
- The earthing of the bus bar shall be done manually by the operator without provision of general earthing system.

## **5. DISTRIBUTION BOARDS**

The enclosure of the LV Distribution Board shall be fabricated from electro-galvanized / zinc coated sheet steel.

The LV Distribution Board shall be fabricated with 1.6mm sheet steel recess or surface mounting. All components shall be installed on a component mounting plate inside the enclosure and protected from the front with screwed sheet steel safety plate. The door shall be fully gasket with hinges on the left hand side and locking handle on the right hand side for fastening the door. The locking handle should be detachable. The dead / front assembly shall be fastened to the enclosure by means of self - locating fasteners for quick and easy fixing.

The incoming and outgoing cable connections shall be according to the wiring requirements. If required, an adapter box of same material & finish shall be provided for accommodating the cables and conduits.

An earth bar or terminal strips shall be provided for connection of incoming and outgoing earth conductors. The earth bar or terminals shall be permanently connected to the body of Distribution Boards at two points. Flexible copper strip shall be provided for earthing of the door.



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Neutral bus assembly shall consist of outgoing screw terminals with one terminal for each MCB. All holes, cutouts, etc., shall be tool or jib manufactured and free from burrs and rough edges. Removable gland plates shall be provided at top/bottom, as required.

The cabling inside the distribution board shall be suitably numbered and harnessed by means of straps or cords. Wiring to door mounted components shall be in flexible PVC pipe. All indicating, control and selecting equipment shall be suitably arranged and clearly labeled with indelible labels indicating the rating of components etc.

All metal work of the distribution board shall be cleaned down to bare shining metal, phosphate and the surfaces chemically prepared for powder coating. Then these shall be coated with powder of color RAL 7032 and then baked in oven. The thickness of powder coating shall not be less than 120 microns.

## **6. COMPONENTS**

The switchboards shall be provided with all components as specified or shown on the Drawings and as necessary for the satisfactory operation of the Switchboard and electrical system. Typical specifications are given here under:

### **6.1 Circuit Breakers**

The circuit breakers shall be panel mounted, compact modular design, trip shall be standard and shall have built in overload and short circuit protection. The breakers shall have high performance, multifunctional type under modern design concept. The breakers should confirm international standards.

The breakers shall have inverse time limit characteristic, instantaneous magnetic trip element for short circuit and thermal overload protection.

#### **a) Molded Case Circuit Breakers (MCCB)**

The MCCB shall be three pole 400 / 500 volts rating. The breakers shall have both time delay over current and instantaneous short circuit protection.

The MCCB's shall be installed such that their switching levers are accessible through the dead front plate for operation. Circuit numbers / designation on all circuits shall be clearly marked to facilitate connection and maintenance.

The breakers shall have quick make - quick break toggle mechanism with



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positive 'ON', 'OFF' color indication and intermediate 'Tripped' positions.

Trip mechanism shall be trip free on overload or short circuit ensuring that the breaker will not close / remain close even if the close command is given while the circuit breaker has tripped due to short circuit or continuing overload.

**b) Miniature Circuit Breaker (MCB)**

The MCB's with current rating from 1 to 125 Amps shall be conforming to BS EN 60-898 or IEC 60947-2. The circuit breakers shall be suitable for DIN-rail mounting, maintenance-free and fully tropicalised.

The MCB's shall be designed for horizontal or vertical mounting, or reverse feeding, without any adverse effect on electrical performance.

The operating mechanism shall be quick make, quick break type, trip free, with all poles opening and closing simultaneously (except for the neutral pole, which if required shall be of the advance-closing and late-opening type). The operating toggle shall clearly indicate the ON and OFF color indications.

The individual operating mechanism of each pole of a multiple MCB shall be directly linked within the MCB casing and not by the operating handle.

Each pole of the MCB's shall be provided with bimetallic thermal element for overload protection and a magnetic element for short circuit protection.

**c) Earth Leakage Circuit Breakers (ELCB)**

ELCB's shall be four pole, current operated type with tripping current of 0.3A and tripping time not more than 0.1 seconds.

**6.2 Transformers/Meters etc.**

**a) Current Transformers**

Current transformers shall comply with the requirements of IEC 60185 (or equivalent).

Current Transformers shall be polyester resin insulated, ring type, air cooled having transformation ratio as indicated on the drawings. The current



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Transformers shall be of suitable burden having accuracy class 1.0. The Current Transformers shall have rated secondary current 5A / IA as required.

Current Transformers shall mechanically and thermally withstand the specified short circuit capacity. Test terminal blocks shall be provided for current Transformer secondary circuits having short circuiting provisions to allow portable apparatus to be connected.

**b) Voltage Transformers**

Voltage transformers shall comply with the requirements of IEC 60186 (or equivalent) and shall be of accuracy class 1.0.

Voltage Transformers shall be equipped with primary fuses with an interrupting capacity of the incoming circuit breakers. Test terminal block shall be provided for each Voltage Transformer system.

**c) Ammeters and Voltmeters**

Indicating instruments shall be semi-flush Switchboard type, moving Iron, spring controlled with standard scale having white background and black graduations and markings. The front dimensions shall be 144 x 144 mm for instruments on incoming side and 96 x 96 mm on all outgoing circuits.

Indicating instruments shall be 1.0 class percent of full scale basic accuracy class in accordance with IEC 60051.

The ammeter shall be suitable for connection to 5 Amp. Secondary of current transformer or directly through shunt as shown on the drawings. The instruments shall have measuring range indicated on the drawings. A red mark shall be provided at the working voltage on the scale of all voltmeters.

**d) Selector Switches**

Ammeter and voltmeter selector switches shall be complete with front plate, grip handle, R-Y-B and OFF position for ammeter and RY-YB-BR-RN and OFF positions for voltmeters.

The selector switches for controls shall be rotary cam type and shall be provided



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complete with knob and front plate, showing all positions as required.

**e) Push Buttons**

The push buttons shall be momentary make / break contact type (normally open / normally close) and suitable for flush mounting. The push button for ON and OFF switching shall be red and green respectively.

**f) HRC Fuses**

HRC Fuses shall be provided complete with fuse bases, fuse, etc. The fuses shall have a fusing factor as specified for class Q1 in accordance with BS 88.

**g) Pilot Lamps**

Switchboard shall be provided with phase indicating pilot lamps. The lamps shall be rated for 250 volts supply and suitable for flush mounting. The front of the lamps shall have colored rosettes for identification of phases.

**h) Line up Terminals**

Line up terminals wherever provided for Control or Power circuits shall be suitable for voltage and size of conductors as indicated on drawings. The Line up terminals for controls shall be suitable for channel mounting. All necessary accessories such as end-plates, fixing clips, transparent label holder caps and label sheets with marking shall be provided.

**i) Secondary Wiring**

All wiring shall be copper conductor, thermoplastic insulated, at least 1.5 sq. mm flexible, neatly arranged and clipped in groups.

Each conductor and its termination are to be identified and marked with numbered ferrules. All live terminals are to be shrouded.

Secondary wiring for Current Transformers shall be carried out with not less than 2.5 sq. mm. Terminals shall be specially marked to avoid opening of the circuit by accident.



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**7. POWER FACTOR IMPROVEMENT PLAN (PFI)**

The power factor improvement plant shall be used for improving the power factor of the system. The plant shall be automatic cum manual.

The PFI plant shall be aligned with main LT switch board and it shall be a part of that LT switchboard as shown on the drawing. The capacitors shall be suitable for three phases, 415 volts 50 Hz system and shall be self cooled, designed for indoor use in tropical climate for maximum ambient temperature of 45 degrees centigrade and relative humidity 90%. The capacitors shall be in the form of banks divided for 12 stages, 6 stages and 4 stages. Each capacitor bank unit shall be 12.5/25 and 50 KVAR. The total KVAR capacity shall be as indicated on the drawings. Each capacitor unit shall be complete with discharge resistors and internal fuses and shall be connected with control panel with proper size of single core PVC insulated cables.

The panels shall be supplied complete with a set of 3-phase, full capacity, isolated tinned copper bus bars, interconnections, risers, designation labels, cable sockets, holding down bolts, wiring with cleats and ferrules, earthing sockets and studs, etc. Each control panel shall comprise.

- 1 No. Multi stage power factor correction relay for automatic/manual control.
- 1 No. 3-phase, 4 wire, 415 volts, unbalanced load power factor indicator.
- 1 No. Auto-off-Manual selector switch
- 1 No. Current transformers with 5 amps secondary current having suitable output burden and accuracy.
- 3 Nos. Instrument protection fuses.

Following equipment shall be provided for every 250 KVAR capacitor bank:

- 1 No. 630 amps, triple pole 415 volts air break contractor with auxiliary contacts (2 N.O+2 NC)  
Contractor shall be suitable for AC 3 duty.
- 1 Set of 2 Nos 630 Amps H RC back-up fuses with base and carrier.
- 1 Set of ON and OFF push buttons.
- 1 No. Red lamp for "ON" indication to the contractor.



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**Requirement of Capacitor Banks**

According to IEC-83 1 -1 and 831-2.

Fully insulated terminals to be shielded by a cover.

Dielectric: Plastic poly-propylene, impregnated.

Electrodes: Aluminum coating vacuum metalized.

Safety features: Self healing. Over pressure tear-off fuse.

Withstand switching operations safely.

Maximum in rush current 200 times rated current.

Loading capacity: 1.1 times rated voltage. 1.3 times rated current at delta max.

Overloading capacity 1.5 times rated output at delta max.

Acceptable tolerances - 5/+ 10% of rated output at rated frequency.

Static life expectancy > 100,000 operating hours.

Test Specifications: Terminal versus terminal with an AC voltage 2.15 times rated voltage for 10 seconds duration. Terminals to casing with an AC voltage of 3 KV for 10 seconds duration.

## **8. INSTALLATION**

The LV Switchboard shall be installed at location shown on the drawing. The Contractor shall coordinate with civil & allied works for providing any openings, holes, etc. to avoid any breakage. In case the provisions in civil works for the installation of electrical equipment are not made or made incorrect the same shall be rectified by the Contractor at his own cost and to the satisfaction of the Engineer. The Contractor shall provide foundation bolts and grout them in cement concrete floor using non-shrinkable material with the approval of Engineer.

All installation material for physically erecting the switchboard, such as bolts, nuts, washers, supporting steel, etc., shall be provided and installed by the Contractor. The Switchboard shall be installed upright and in level and shall be firmly and rigidly bolted to the floor and concrete supports.

The switchboard shall be completely erected as per manufacturer's instructions and as approved by the Engineer. Loose parts dispatched by the manufacturer shall be installed and connected as per assembly drawing provided by the manufacturer. Any safety locking provided by the manufacturer for safe transportation shall be released only after the switchboard is erected in position.



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The incoming and outgoing cables shall be connected as recommended by cable manufacturer.  
The cable armor shall be connected effectively to ground.

The Switchboard enclosure shall be connected to earth terminal. The Switchboard shall be tested before energizing in the presence of the Engineer.



SECTION - C  
LOW VOLTAGE CABLES AND WIRES

**1. SCOPE OF WORK**

The work under this scope consists of supply installation, testing, connecting and commissioning of all material and services of low voltage cables and wires and the accessories as specified herein or shown on the Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with project Engineer and coordinate at site with other trades for exact route, location and positions of electrical cables and equipments etc.

**2. GENERAL**

All multi-core and single core wires for light circuits, socket outlets and circuits operating up to 250 volts shall be 300 / 500 volts grade. All single core sheathed cables shall be of 450 / 750 volt grade. Power cables for main feeders, main to sub-main feeders, power equipment, etc., armored or unarmored shall be of 600 / 1000 volts grade. Armoring of cables shall be done with appropriate size galvanized steel wire as per codes.

The conductors shall be stranded or solid, high conductivity, soft annealed copper. Conductor of single core cables shall be circular, whereas of multi-core cables may be circular or shaped according to standard practices and codes. The PVC insulation shall be extruded with a PVC compound having good flexibility, resistance to aging and ability to withstand the ambient temperatures. Cable should be capable of running 125% of full load current without any damage.

**3. STANDARDS**

All Cables & Wires shall be manufactured to confirm the following standards as given below:

BS 6004 / 6346	PVC insulated cables for lighting and power.
BS 6746	PVC insulation for electrical cables.
BS 6360	Copper conductors
BS 6500	Insulated flexible cords.



## **4. MATERIAL**

### **4.1 General**

The power, lighting and control cables shall be furnished and installed in accordance with the routes and requirements shown on the drawings. The single core cables shall be delivered as complete coils with wrapping & seal intact.

All cables shall have phase identification colors on insulation of each core. The color code for three phase circuits shall be red, yellow and blue for phases, and green for earthing.

Single phase circuits shall have insulation of red color for phase / line, black color for neutral and green color for earth conductor.

All DC circuits shall have insulation of red color for positive, black color for negative and green for earth conductor.

The ends of each length of multi-core armored or unarmored cables shall be properly marked for clock-wise and anti clock-wise sequence of core colors.

### **4.2 Cables for Conduit Wiring**

All cables / wiring in concealed or surface mounted PVC or MS conduits shall be single core PVC insulated of specified grade and size, unless specifically shown on the drawings or given in BOQ.

### **4.3 Cables on Surface / Concrete Trenches**

Cables for distribution system to be installed on surface, in cable ducts, in concrete trenches or on trays shall be single or multi-core PVC insulated and PVC sheathed of specified voltage grade and size, unless specifically shown on the drawings or given in BOQ.

### **4.4 Underground Installation**

Cables for laying directly underground shall be PVC insulated, PVC sheathed and armored with galvanized steel wire. Cables fully installed in underground ducts / pipes



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and mechanically protected from end to end shall be PVC insulated and PVC sheathed unless specifically shown on the drawings or given in BOQ.

**4.5 Cable Accessories**

All cable accessories such as lugs, ties, tapes, glands, flexible pipes, connectors, duets, clips, tags, bushes, etc shall be provided for the complete cabling and wiring system without any additional cost.

**5. INSTALLATION**

**5.1 General**

When the laying is effectuated by others, the contractor shall test the cable characteristics insulation and continuity, at all phases of these and communicate them in a report to the Engineer, as per recommendations of the standards according to which the cable is manufactured.

The cables shall be spaced by categories along their entire length as well as upon penetration into buildings and in their interiors, according to their following rated voltages:

- 30 cm at least between a cable carrying I KV - 30KV and other cables.
- 20 cm at least between a cable carrying voltages between 50V - 500V, and any power or control 10 cm at least between a cable carrying voltages lower than 50V and telephone or these possible being grouped.

All installation material, labor, tools and accessories for cable installation shall be furnished by the Contractor. The cable and accessories shall be installed as described in accordance with these specifications, drawings and manufacturer's instructions.

The wiring must be strict in accordance with layouts, details, schematic diagrams given in the drawings.

The light circuit and power circuits shall be run in separate pipe. The circuits/sub-circuits shall be provided identifications by numbers permanently attached. The wiring shall be done to maintain color coding.



## **5.2 Conduit Wiring**

The wiring in conduit shall be started only after the conduit system is completely installed and all outlet boxes, junction boxes, etc., are fixed in position. The filling rate inside the conduits shall not exceed 50 %. Cables directly embedded in the masonry are not accepted.

The wires shall be pulled in conduit with care to prevent damaging the wires, preferably without the use of any lubricant like soap, oil or grease. Where necessary and if approved by the Engineer, the cable manufacturer's recommended lubricant may be used. Where several wires are to be installed in the same conduit, they shall be pulled together along with the earth conductor. All wires of same circuit shall be run in one conduit.

The wires shall not be bent to a radius less than 10 times the overall diameter of the wire, or more if otherwise recommended by the manufacturer.

The wiring shall be continuous between terminations and looping-in system shall be followed throughout. Any joint in wires shall not be allowed. The use of connectors shall only be allowed at locations where looping-in is rendered difficult. The consent of the Engineer shall be required for using connectors. The connector shall be of suitable rating having porcelain body with sunk-in screw terminals. The connector shall be wrapped with PVC insulation tape after its installation. A minimum of 150 mm extra length of cable / wire shall be provided at each termination to facilitate repairs in future.

The size & quantity of cables contain in one pipe shall not be excess in accordance with IEE regulations.

## **5.3 Cables on Surface / Trenches**

All cables for installation on surface of wall, column, ceiling, trenches, etc., shall be fixed to the surface by means of galvanized steel clips, secured to a steel channel using suitable stud plate, nuts and washers.

The erection of cables and position of support shall be agreed by the Engineer on site, having taken into consideration the accessibility of all such routes. These shall be so



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arranged that cable crossing one another be minimized if cannot be avoided.

Cables shall be fixed throughout their length by means of approved saddles, clips, etc., at every 600 mm vertically and 900 mm horizontally.

Cables and equipment fixed to a building fabric, i.e., brickwork, concrete, etc., shall be fixed by means of appropriate fixing devices, i.e., Raw bolts, Hilti fixing devices, etc. Contractor shall be responsible for all drilling of steel work, brick work and masonry where necessary for fixing clamps and brackets for supports.

Cables shall not be pulled into conduit until the conduit system has been completed, cleared and free from obstruction and sharp edges cables shall be put into conduits in such a manner that there will be no cuts or abrasions in the cable insulation, protective braid and jackets. There shall be no link in the conductors.

Distance of saddles shall be used for installation of cables in defined condition of the surface of wall etc.

Grease or other injurious lubricants shall not be used in pulling cables. The use of talc or non injurious lubricants is permissible, if desirable.

The number of wires installed in any conduit shall be such that the resulting space factor does not exceed 50 %. Spliced wires shall not be pulled through conduits.

All conduit wiring shall be carried out in the loop - in principle from outlet box to outlet box and in no circumstances shall joints be used except in fixed base connection blocks housed in outlet boxes.

The vertical clearance between two adjacent cables at any point is 50 mm minimum. Common mounting, channels are to be furnished for cable along the same route. The Contractor can offer alternate cable fixing arrangement, which shall be approved by the Engineer before commencement of installation.

The wall crossings where the outdoor cables penetrate in the building shall be carefully obstructed by means of polyurethane foam. The Contractor shall be fully responsible for the perfect tightness of these cable penetrations.



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**5.4 Underground Cables**

The Contractor shall plan and take special care to prevent any damage to existing underground facilities such as piping, cables, foundations, etc. The Contractor shall notify the Engineer of any obstruction encountered and shall provide protective support or removal of such obstructions as instructed by the Engineer. Excavation adjacent to existing facilities, such as foundations manholes, ducts, underground pipelines and paving shall be braced and / or shored properly to protect those facilities during excavation and construction.

Sufficient slack shall be left in cables for this purpose that cut lengths of cables shall allow about 3% more in the measured lengths between terminations.

Cables, whether installed underground or in concrete trenches, shall not be bent to a radius less than 10 times the diameter of the cable or as recommended by the cable manufacturer, whichever is higher.

All cables shall be marked at least at each end, switch gear and equipment termination, where cable enter or leave underground cable trenches or channels, where cable rises from one level to another, at 30M intervals with predetermined identification numbers, by means of proprietary non-deteriorating type, PVC, heat shrinkable, strap-on type or equivalent, for the identification of cable and circuit. These shall be indelibly marked with cable number and securely fixed to the cable. Where conductors are left to be terminated by another party or left to be connected later, they shall be identified. The earth continuity conductor shall be laid in the trench with the cables.

Cables entering the buildings shall also be laid in protective pipes. The protective pipe ends, after installation of cables, shall be plugged water tight by means of polyurethane foam / bituminized Hessian or equivalent method as approved by the Engineer.

**5.5 Cable Termination and Joints**

Cables shall be terminated in a safe, neat and approved manner at the associated equipment, included that erected by others.

Compression type connectors (lugs) shall be of the correct size and approved type for the conductors concerned. Compression tools shall be supplied for specific use and shall be maintained in good order. After compression the conductor and terminal shall form a solid mass ensuring good conducting properties and mechanical strength. The



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compression jointing system used throughout the installation must be approved by the Engineer.

The Contractor shall be responsible for all drilling and if necessary, tapping entries where these have not been provided by others.

When preparing cables prior to fitting glands, the gland manufacturer's instructions for cable preparation shall be observed. In all cases where armored cables are used, care shall be taken to ensure that the lay of the armor is maintained after the gland is completely fitted.

Termination and joints shall be suitably insulated for the voltage of the circuits in which they are used.

Every compression joint shall be of a type, which has been the subject of a test certificate as described in BS 4579.

Cable ends, which are not terminated immediately after cutting, shall be sealed effectively to prevent ingress of moisture and shall be protected from damage until termination.

For all cables above 6 sq. mm in section, if a substantial mechanical clamp is not provided a compression type lug or socket shall be provided. At all equipment, cable shall be installed and terminated so that no strain is imposed on the cable or gland and due allowance made to counter the effect of vibration. At all termination an ample length of 'tail' shall be left.

Where joints in cable conductors and bare conductors are required, they shall be mechanically and electrically sound and they shall be accessible for inspection. Joints in non-flexible cables shall be made either by soldering or by means of mechanical clamps or compression type socket, which shall securely retain all the wires of the conductors.

Any joint in flexible cable shall be affected by means of cable coupler. Cable couplers and connectors shall be mechanically and electrically sound and shrouded in metal, which can be earthed. Where the apparatus to be connected require earthing every cable coupler shall have adequate provision for maintaining earth continuity.



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The insulation of cables must be brought into DB's switch boards or fixtures to which the cables are connected. All openings shall be sealed properly. The outdoor apparatus shall normally be connected by means of cables with conduit termination down to about 30 cm below ground level or concrete foundation. The conduit shall be firmly secured down to their penetration into the trench or channel.



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SECTION - D  
CONDUITS AND PIPES

**1. SCOPE OF WORK**

The job includes supply and installation of all Conduits, Pipes and Accessories as specified herein and / or shown on the Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical conduits.

**2. GENERAL**

The extent of works shown on the drawing does not indicate the exact position of conduit and pipes. The Contractor shall ensure exact location and route of conduit and pipes in coordination with other services drawings, as per site requirements and as directed by the Engineer.

The quality and material for the accessories of conduits and pipes such as sockets, elbows, bushes, bends, inspection / pull boxes, round boxes, etc., necessary for the completion shall be similar to that of conduit or pipes.

**3. STANDARDS**

The conduits, pipes and accessories shall confirm the following standards:

BS 31	MS Conduit and accessories
BS 1378	Galvanized Iron Pipes and accessories.
BS 3595	PVC Pipes and accessories.
BS 4607	PVC Conduits and accessories.

**4. MATERIAL**

**4.1 PVC Conduits, Pipes and Accessories**

The PVC conduits and accessories for lighting and power circuits shall be standard manufactured length of high tensile strength and sufficiently flexible to provide resistance against breakage. It should not dent or flatten under pressure and it should be



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chemical resistant to chemical action of the atmosphere. The conduit shall be self extinguishing and should not support combustion.

The PVC conduit withstand against concrete additives, electrolysis, corrosive atmosphere, soils, salts or excessive humidity and should be non-magnetic to reduce voltage drop and minimize power loss. The conduit should be non-conductive & non-sparking.

The PVC bends shall have enlarged ends to receive conduit without any reduction in the internal diameter at joint. Manufactured smooth bends shall be used where conduit changes direction.

The round PVC junction boxes for ceiling light or fan points shall have minimum dimensions of 64 mm diameter and 64 mm depth. The junction boxes for wall light points shall have minimum dimensions of 57 mm diameter and 40 mm depth. Round junction boxes shall be provided with one piece Bakelite cover plate fixed to the box by means of galvanized screws.

The PVC pipe shall be rigid and shall be minimum **d** class, unless otherwise stated on Drawings or Bill of Quantities. For jointing of pipe, all precautions and procedures recommended by manufacturer shall be followed.

**4.2 PE Conduit & Accessories**

The PE conduits & accessories shall be corrosion resistant, non-toxic, light weight, impact strength, weld ability and abrasion resistance. It should be manufactured as per ISO 4427 and other international standards.

**4.3 MS Conduit and Accessories**

All conduits shall be of 16 SWG steel, manufactured and tested in accordance with latest relevant standards.

The conduit shall be protected by two base coats of red oxide (antirust paint) and finished in first quality black enamel paint. The coating shall be of heavy enamel, which shall not flake or crack during installation and handling. Each conduit length shall be furnished with threaded ends and a threaded coupling at one end. Soft metal bushes shall be provided at conduit termination to prevent damage to cable during pulling operation.



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Junction boxes shall be 100 mm square, having minimum depths of 38 mm or 65 mm as required for accommodating the number of wires. The junction box shall be 16 SWG sheet steel provided with anti-corrosion paint and finished in heavy black enamel paint. The cast Iron outlet boxes for light points shall be round having 50 mm diameter and 63 mm depth. The above dimensions are given as minimum only, and the exact size shall be determined by the Contractor keeping in view the ease of Installation and maintenance. All outlet boxes and junction boxes shall be provided with one piece Bakelite cover plate of suitable design.

**4.4 Galvanized Iron Pipes and Accessories**

The G.I. pipes shall be galvanized from inside and outside by hot dip galvanizing method. The pipes shall be free from stains, burrs or any other defect. The accessories for G.I. pipes shall be galvanized from inside and outside. The conduit shall be NPT threaded, with at least 5 complete threads and assembled with TEFLON tape.

**4.5 Inspection Boxes / Pull Boxes**

The rectangular inspection boxes or pull boxes shall be of 16 SWG heavy gauge, sheet steel having nipples welded to box at entry holes to receive PVC conduit with force fit. The box shall be painted inside and outside with black enamel paint over a base coat of red oxide primer paint. The minimum length of inspection box shall not be less than six times the cable manufacturer's recommended bending radius of the cable. All concealed type pull boxes shall have ebonite sheet of appropriate size fixed to the box by means of galvanized screws.

**4.6 Pull Boxes**

Pull boxes shall be made of 16 SWG sheet steel box, painted and finished to the same quality as the light Distribution Board. The boxes shall be 50 mm in depth for conduits up to 25 mm diameter, 63 mm in depth for conduits up to 40 mm diameter and 87 mm in depth for conduits up to 50 mm in diameter. For conduits more than 50 mm in diameter, the minimum depth shall be two times the diameter.

**4.7 Conduit / Pipe Accessories**

Bushes, plugs, glands, etc., shall be of brass and all male bushes shall be of long thread pattern. Covers for boxes shall be screw fixed and finished as the boxes. Gaskets shall



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be fitted only when finish is galvanized unless otherwise specified.

## **5. INSTALLATION**

The contractor shall provide all conduits & accessories for the installation as required. The drawings show the approximate & terminal points of conduits. However if for any reason the contractor desire to use any alternative route, he may do so at his own responsibility without interference with other installations and get the prior written permission from Engineer.

Conduits shall be run atleast 150mm from flues, steam or water pipes. Where multiple conduits runs, these shall be arranged symmetrically to present a uniform and neat arrangement. The minimum size of conduit shall be 20mm diameter unless notified otherwise. Conduits are installed to confirm the location of conduit to avoid obstructions, furnaces, hot lines & other places of high temperature.

### **5.1 PVC Conduits - Concealed**

The conduit shall be installed concealed in roof, wall, column, etc.

At all joints and bends, PVC jointing solution of approved make must be used to strengthen and to seal the joint.

Manufactured smooth bends shall be used. Bending of conduits by heating or otherwise will be allowed in special situations only, for which the consent of the Engineer shall be required. The use of 90 degree bends and tees will not be allowed.

The conduit shall have a minimum of 38 mm cover of concrete. The conduit shall be laid above the steel of the slab and shall be firmly secured by tying to steel. Under any circumstances RCC structures chiseling not to be made.

All outlet boxes to be firmly supported and installed such that they finish flush with the soffit of slab or beam.

Where conduits have to be concealed in cement concrete work or in block masonry, the chiseling shall be made with appropriate tools and shall not be made deeper than required. The conduit shall than be fixed firmly in the recess and covered with cement



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concrete mixture to have to at least 25 mm cover before plastering. The work of curing in the cement concrete work or block masonry work shall be coordinated with the civil work. The Contractor shall obtain approval from Engineer for the route, to suit the site conditions before starting chiseling and cutting.

The termination of conduits at or near the Switchboard / Distribution Board is shown diagrammatically on the drawing. The exact locations of the termination shall be confirmed with the Switchboard / Distribution Board to be installed. Conduit ends pointing upwards or downwards shall be properly plugged in order to prevent the entry of foreign materials. All openings through which concrete may leak shall be carefully plugged and boxes shall be suitably protected against filling with concrete. At all termination of concrete, soft bushes shall be fixed to prevent sharp edges of conduit ends from cutting or damaging the wires or cables to be pulled through them.

The entire conduit system shall be installed and tested before plastering. Any obstruction found shall be cleared by use of cutting mandrel or other approved device and the conduit shall be cleaned out. Water that has entered in conduit shall be removed by drawing swabs through the conduit. No cable shall be pulled until the water has thoroughly dried out.

Pull boxes / Adaptable boxes shall be provided in conduit runs wherever required to facilitate pulling operation. The drawings are diagrammatic and do not indicate the position and spacing of pull boxes or adaptable boxes. However, these shall meet the following requirements:

- Pull boxes.  
For straight runs the spacing shall not be more than 30 meters.  
For runs with one 90 degree bend, the spacing shall not be more than 15 meters.
- Adaptable boxes.  
For conduits up to 25 mm diameter, the boxes shall be 50 mm in depth.  
For conduits up to 40 mm diameter, the boxes shall be 63 mm in depth.  
For conduits up to 50 mm diameter, the boxes shall be 87 mm in depth.

Wherever the conduit lengths cross the expansion joint either along the column or slab, suitable arrangement shall be provided so that when the conduit lengths in the



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expansion joint are stressed, the conduit neither develops any cracks nor breaks down.

Bending, offsetting and similar operations shall be performed through the help of proper bending tool to give a perfect bend of required angle without Desha ping of conduit to the least.

**5.2 Conduits on surface**

- a. The conduits accessories shall be firmly held with the surface of walls by means of PVC saddles, clamps, brackets etc. Rawal plugs or Phil plugs must be used for fixing such saddles etc. The saddles shall be fixed at an interval of 750mm, depending upon the size & weight of conduit. The MS clamps, brackets etc shall be painted anti-corrosion paint before and after fixing.
- b. In all areas where the conduit is exposed to damp or wet conditions, brass or stainless steel screws must be used for fixing.



SECTION - E  
WIRING ACCESSORIES

**1. SCOPE OF WORK**

The job consists of supply, installation and commissioning of switches, switch sockets, etc., and miscellaneous items as specified herein and / or shown on the Drawings and given in the Bill of Quantities.

**2. GENERAL**

The locations of the wiring accessories such as sockets, switches etc. are tentatively shown on the drawings. The Contractor shall ensure exact positions and locations of wiring accessories in coordination with other services drawings, as per site requirements and as directed by the Engineer. The Contractor shall be responsible for proper functioning of wiring accessories after installation and Commissioning.

**3. STANDARDS**

All wiring accessories shall confirm to the following international standards:

- BS 67 Ceiling roses.
- BS 1363:1984 13A fused plugs and un-switched socket outlets
- BS 116 Two and three terminal ceiling roses.
- BS 2135 Capacitors for radio interference suppression
- BS 3676 Switch for domestic and similar purposes.
- BS 4934 Safety requirements for electric fans and regulators.
- BS 5060 Performance of circulating fans and their regulators.

**4. MATERIAL**

**4.1 Switches**

Switches for controlling light and fan points shall be single pole, rated for 10 Amp, 250 VAC. The body of switches shall be made of poly carbonate / urea with white face plate suitable for flush mounting on sheet steel outlet box. The switches shall be gang type having silver tipped contacts and operate with snap action.



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The fixing of plates on outlet boxes shall be means of flat head counter sunk galvanized screws with the head of the screw finish flush with the surface of the plate. Except for switches controlling light points, all single switches for fans, sockets, etc., shall have identification symbols on the operating levers.

Two way switches shall be used to control lights from two different locations as shown on the drawings.

**4.2 Switch Socket Outlets**

Switch socket units shall be conformed to BS 1363. 2 and 3 Pin rated for 5 Amps. or 2 Pin rated for 5 Amps, 250V.

3 Pin 5 Amps./15 Amps switch sockets shall be mould type having white plastic face plate, suitable for mounting on a sheet steel box of appropriate dimensions. Switch sockets shall have shrouded live contacts such that the earth pin is engaged to socket earth before making with the live contacts. Where specified, the switch socket unit shall have spring loaded dust tight cover for mechanical protection.

**4.3 Sheet Steel Boxes**

The outlet boxes for installation of switches, fan dimmers and socket outlets shall be 16 SWG sheet steel having appropriate dimensions. The boxes shall have suitable knockouts or welded nipples for receiving the conduits. An earth terminal shall be provided for connecting at least three earth wires of 4 sq. mm. The outlet boxes shall be given two coats of anti-corrosion red oxide and one coat of enamel before installation. The boxes shall be suitable for mounting flush with the surface of wall or on the surface of wall as may be required. The boxes shall not be less than 75 mm x 75 mm (3" x 3"). All boxes shall be water tight where installed in the vicinity of liquids.

**4.4 Ceiling Rose**

The ceiling rose shall be suitable for 5 Amps. 250V AC. It shall have white plastic molded base plate, copper or brass terminals for connecting at least two wires of 2.5 sq. mm size. The ceiling rose shall have a cover with cable inlet hole for multi-core PVC insulated and PVC sheathed cable.

**4.5 Fans**

The fans shall comply with BS 380 as far as constructional requirements, range of fan speed, speed regulator starting, radio interference silent operation and temperature rise



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is concerned. For testing BS 848 as amended 1 960 shall be complied with.

**4.5.1 Ceiling Fans**

The ceiling fans shall be three blades capacitor type, mounted with ceiling by means of pre-installed fan hook. The fan shall be suitable for operation on 250V AC with  $\pm 10\%$  tolerance.

The sweep of the fan shall be as given in BOQ drawings. Fans shall be supplied complete with fan coil unit, capacitor, suitable fan rod, canopy etc.

**4.5.2 Bracket Type**

The bracket type fans shall be suitable for mounting on the wall and suitable for operation semi-horizontally. These shall operate satisfactorily on 250 volts, single phase, 50 Hz, A.C. supply with + 10 % tolerance.

The sweep of the fan shall be as given in BOQ/drawings.

**4.5.3 Exhaust Fan**

The exhaust fans shall be three blade types, mounted on the steel/plastic structure of its own, which will be fixed to the structure by means of suitable grouted foundation bolts. The fan shall be suitable for operation on 250 VAC with + 10 % tolerance.

The sweep of the fan shall be as given in Bill of Quantities/drawings. Fans shall be direct driven and supplied complete with electric motor, back draft dampers and anti-vermin screen. The bearings shall be ball, roller or sleeve type of permanently lubricated and sealed type. Wheels shall be heavily and rigidly constructed and accurately balanced both statically and dynamically and free from objectionable vibration or noises.



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SECTION - F  
LIGHT FIXTURES

**1. SCOPE OF WORK**

The job consists of supply, installation and commissioning of all light fixtures as specified herein and / or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact location/positions of light fixtures.

**2. GENERAL**

The Contractor shall submit samples of each and every light fixture specified and obtain approval of the Owner/Engineer before purchasing. The quality and finishes of local make light fixtures (if mentioned in BOQ) shall be same as that of standard manufacturer.

All fixtures shall be finished in standard color schemes as mentioned in the manufacturer's catalogue for respective fixtures, unless specifically stated in the Specifications, Drawings or Bill of Quantities or directed by the Engineer.

**3. STANDARDS**

The light fixtures shall confirm the following standards:

- IEC 81 Tubular fluorescent lamps.
- IEC 82 Ballast for tubular fluorescent lamps.
- IEC 155 Starters for fluorescent lamps.
- IEC 400 Lamp holders and starter holders for fluorescent lamps.
- IEC 566 Capacitors for use in TL, HP Mercury and LP sodium vapor.
- IEC 598 Luminaries.
- BS 3677 Discharge lamp circuits.



#### **4. MATERIAL**

##### **4.1 Fluorescent / LED Light Fixtures**

The fluorescent light fixtures shall have lamps and ballast of proper rating as shown on the drawings. Each lamp shall be provided with independent ballast.

The fluorescent lamps shall be tubular type and 36/18 watts. The fluorescent color shall be warm white characteristics with an average output of 3350 lumens (+5%) for 36 watts and 1350 lumens (+5%) for 18 watts after 100 burning hours. The ballast shall be polyester filled type, totally enclosed and suitable to operate up to 250 VAC. The power loss shall not be more than 9 / 6 watts for watts ballast. A wiring, diagram, wattage, voltage and current figures shall be printed on the body of the ballast.

The lamp holders shall be rotary lock-in type. The starters shall be glow type with radio interference suppressor / by-pass capacitor. The internal wiring of the fluorescent light fixtures shall be done with heat resistant wires at the manufacturer's factory. All light fixtures shall be provided with power factor improvement capacitor to give a minimum power factor of 0.90.

The body of the fluorescent light fixtures shall be minimum 22 SWG sheet steel, de-rusted, degreased, finished in heat resistant paint, stove enameled. Appropriate size bushed wire entry holes, fixing holes and earth terminals shall be provided. Connectors suitable for connecting 2.5 sq. mm cable connectors shall be provided for supply connections. An earth terminal for connection to 2.5mm sq. wire shall be provided.

The light fixtures shall be furnished with perspex diffusing panels " 040 opal acrylic" (minimum sheet thickness 3 mm), polystyrene louvers or metal grid louvers or mirror optic reflectors, etc. as specified on the drawings or in BOQ. The louvers shall be secured firmly and in level. The polystyrene louvers shall be white Egg Crate or as approved. The louvers shall be in one section and not in pieces.

The design of light fixture for recess mounting shall be coordinated with the design of false ceiling prior to commencement of manufacture.

##### **4.2 Water proof light fixtures**

The underwater lights shall be suitable for 24V, 80Hz Dc. The DC supply shall be



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available from a step down transformer. The fixture shall be completely water tight and shall have scaled reflector flat lamps.

## **5. INSTALLATION**

### **5.1 General**

The mounting heights of light fixtures are indicated on the drawings, and position of fixtures according to the mentioned scale.

The Contractor must ensure that the light fixtures are installed uniformly with respect to the dimensions of the area. Any modifications due to site conditions may be made with the approval of Engineer. All fixtures shall be carefully aligned before fixing in position. All fixing accessories such as ceiling rose, flexible cord, lamp holder, suspension rod; pipe or chain with suitable canopy, etc., shall be provided and installed.

The wiring between ceiling rose or terminal box of the fixture shall be carried out with 3 core 0.75 sq. mm, PVC / PVC cable. The wiring inside light fixture body shall be done with heat resistant cables or PVC insulated cable in heat resistant sleeves as approved by the Engineer.

Glasses, shades, reflectors, diffuses, etc., must be in a clear condition after installation.

All light fixtures shall be earthed by an earth wire connected to the earth terminal in the fitting.

### **5.2 Fluorescent Light Fixtures**

The fluorescent light fixtures on the surface of ceiling shall be installed with the back of the body flush with the ceiling surface, and in a manner so as to facilitate wiring. Nylon plugs and galvanized steel bolts or screws shall be used for fixing the light fixture to the ceiling. The recessed type shall be light fixtures installed on false ceiling, the installation method detail shall be coordinated with ceiling design and submitted for approval of Engineer. The installation shall include cutting and making of holes in false ceiling. Care shall be taken to prevent the weight of the fixture from being transferred to the false ceiling.



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Pendent light fixtures shall have two holes in the top of each casing by a 1/4" diameter galvanized pipe or any other standard method as approved by the Engineer. Wiring from ceiling rose to the fixture shall be installed through the pipe. Proper arrangements such as long threads with check nuts, etc. for minor adjustment in the mounting heights of the fixtures shall also be provided.

**5.3 Incandescent Light Fixtures**

The incandescent light fixture shall be installed on the surface of ceiling or wall by means of nylon plugs and galvanized steel screws, such that their back finish flush with the surface for exposed conduits and flush with outlet box for concealed conduit system. Wherever convenient, screws for fixing light fixtures shall be screwed into the holes of the outlet box. The light on false ceiling shall be installed in a manner as described for fluorescent light fixture.

**5.4 Outdoor Lighting**

For illumination around buildings during dark hours, light fittings in various arrangements shall be provided in accordance with these specifications. The items not shown on drawings or called for, but which are necessary for a complete working system as required, these shall also be provided and deemed to have been considered as such.

In case, the specified materials and equipment are not used, the Contractor shall then essentially use the standard products of a manufacturer, regularly engaged in the manufacturer of the product and shall meet the requirement of the specifications.

**5.5 Emergency lights:**

- The emergency light fixtures shall be IP 65 polycarbonate construction suitable for interior/exterior applications. The florescent lamps shall be 2x8Watt, T-5, and batteries shall be self contained version – sealed nickel cadmium.
- The fixtures shall be suitable for ceiling/wall mount.
- The duration for emergency lights shall be 3 hours, maintained and non-maintained operation.



## SECTION - G EARTHING SYSTEM

### 1. SCOPE OF WORK

The job consists of supply, installation and commissioning of all material and services of the complete earthing system as specified herein and / or shown on the Drawings and given in the Bill of Quantities.

### 2. GENERAL

All exposed conductive non-current carrying parts of switchgear, boxes, trays, fixtures etc should be efficiently earthed. It should be separate with the earthing of transformer or generator. The earthing system consists of earth electrodes, earthing leads, earth connecting points, earth continuity conductors and all accessories necessary for the satisfactory operation of the associated electrical system.

### 3. STANDARDS

Following standards should be applicable:

BS 951	Earthing Clamps
BS 1433	Hard drawn bare copper conductor for earthing.
BS 2874	Nuts, Bolts, Washers and Rivets for use on copper.
BS 6346	PVC Insulated Cables.
CP 1013	Earthing

Any other standard referred to in above standards or these specifications.

### 4. MATERIAL

#### 4.1 Earth Rod Electrodes

Drive extensible rods of the same diameter into the ground, either manually or by power driven hammer, to a suitable depth to obtain low resistivity in the particular soil.



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Weld earth connectors to the top of the rods, in sufficient number to take all incoming cables.

**4.2 Earthing Lead**

The earthing lead shall connect the earth electrode to earth connecting point or equipment in the building. It shall be round hard drawn bare electrolytic copper of size shown on the drawings.

**4.3 Earth Continuity Conductor**

Earth continuity conductor (E.C.C) shall be hard drawn bare copper wire or single core PVC insulated copper conductor cable of sizes indicated on the drawings. All thimbles, lugs, sockets, nuts, washers and other accessories necessary for the complete installation of ECC shall be provided & installed.

The earth continuity conductor should form a continuous path from any point of installation to the earthing sets. When two earthing sets are provided for same mains, these shall be at least 6m apart. The earthing lead shall be taken up to the earthing electrodes in a 32mm of G.I. pipe irrespective of wiring system, and shall be efficiently bounded to the earth electrodes by means of sweating socket, brass nut, bolts, etc. to make a permanent and positive connection with the earthing electrodes. The other end of the earthing lead shall be sweated into a cable lug of a correct size for the wire for its connections to the main apparatus to be earthed.

**5. INSTALLATION**

The earthing system shall give earth resistance, including resistance of soil, earth leads and E.C.C. equal to less than one ohm, without ground pits water spraying.

The fastening of the earthing conductors shall be made on a sufficient length so as to prevent crushing or cross section weakening. The parts on which they are connected shall be conveniently cleansed and surface.

Leads sheaths or steel tape amours are not permitted as earthing conductors. The earthing system shall be installed to ensure that when any part of the earthing system is disconnected for the purpose of carrying out periodic testing an alternative path to earth is available.

At all connections of earth continuity conductor to any metallic body, proper size or brass sockets, thimbles or lugs shall be used to which the copper wire shall be connected by copper brazing. The soldering of copper wire at joints or termination shall not be allowed. All tee-off connections shall be by copper brazing using suitable socket and clamps. After brazing, the



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jointed surface shall be protected by oxide inhibiting compound of low electrical resistance. For connections to metallic body, the surface shall be thoroughly cleaned before bolting the lug or socket.

The earth continuity conductor shall be generally run in cable trench or in conduits / pipes or in cable trays as shown on the drawings. For under floor runs, these shall be installed in pipe / conduit of appropriate sizes. Where laid along underground cables, these shall be laid directly under ground in unpaved areas and in pipes under paved areas.

The electrode plate shall be installed at a minimum depth of 5 meters from finished ground level or 1 meter below permanent water level, whichever is less. The minimum horizontal distance between earth electrodes shall be 3 meters. Proper mixture of lime and charcoal in the ratio of 1:3 shall be made and buried along with the copper plate in the ground to increase the soil conductivity. The electrode shall be installed as per details shown on the drawings. The inspection chambers shall be constructed at locations approved by the Engineer.

A 50 mm diameter UPVC pipe shall be provided from inspection chamber to earth plate for watering purposes. The pipe shall have 10 mm diameter holes at 500 mm center to center all along the length. At the ground level an inspection chamber with cast iron cover shall be constructed having dimensions as shown on the drawings. The inspection chamber shall have a copper supported on angle iron frame. The cover shall be hinged type, as approved by the Engineer and shall finish flush with the ground level.

The earth connecting point shall be installed at locations shown on the drawings. It shall be fixed on wall surface by means of brass screws with nuts, washers and other insulating material as instructed by the Engineer.

The earth continuity conductor of sizes shown on the drawing shall be installed all along the cable runs and connected to the earthing bar / terminals provided in the equipment.

At any joint or termination, the E.C.C. shall be connected using proper accessories.

No connection shall be made by twisting of earth conductors.



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Section - H  
Cable Tray System:

- i. The cable trays shall be fabricated by prime quality 1.6mm MS sheet steel or GI sheet, solid or perforated and painted powder coated RAIL- 7032. Supply and install all accessories like tees, bands, elbows, risers, etc. to complete the cable tray system.
- ii. The length should be standard of 2.44 meters.
- iii. All fixing or supporting accessories shall also be provided & installed like hangers, brackets, clamps etc.
- iv. The cable trays shall be capable to support all type of wiring like high voltage, medium voltage, low voltage etc. it should be fabricated with the standards laid down by NEMA.  
For internal areas, it should be mill galvanized.

For external areas, the cable trays and accessories should be hot dip galvanized after fabrication.

After fabrication process, all trays, ladders and accessories (bands, elbows, risers etc like nut, bolts, washers, tees) shall be dipped into liquid zinc bath, the surface including all cut edges being coated with a homogenous zinc layer to provide better protection against low chemical stress, marine air, urban air & other low atmospheric influences which activate corrosion.



SECTION – I  
VOICE & DATA COMMUNICATION SYSTEM

**1. GENERAL**

The proposed cabling system for the UTP and Fiber network cabling and Fiber Links shall be an open system and application and vendor independent and shall be warranted by an International Vendor for a minimum of 20 years. The contractor Installers (labor) and engineers must be trained and certified by this vendor to design and install cabling system.

A Main Patch Panel (MPP) shall be provided at the server room of the Building. The Patch panels are located as marked in drawings. The cable run from the Patch Panel to the associated outlet is limited to 90m. The cable run must be free of bridges, taps and splices.

Wiring system used shall be star topology i.e. each data/voice outlet is connected directly to Patch Panel. Both ends of the cables shall be labeled to EIA/TIA 606 administration standards.

Transmission Media:

**For Data:**

Vertical runs between floors extending from the MDF to each Patch Panel in a star topology using fiber optic cables installed in cable trays.

Horizontal runs from a patch panel to the data outlets using CAT-6, 4 Pairs UTP twisted pair cables.

**For Voice:**

1. Vertical runs between floors extending from the MDF to each JTB using multi pair CAT 5 cables installed in cable tray.
2. Horizontal runs from a TJB to the telephone outlet using 2 Pair telephone cables.

Data & voice processing system shall be supplied installed and tested complete in place including but not in a way of limitation, cables, socket outlets, adapters, connectors, patch panels, 110 wiring blocks, patch cords, cable management, floor distributors (racks/cabinets).



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The Cabling System shall be designed using standard, proven equipment and materials with the latest technology version or model. If there is any problem during warranty period related to the shortage of Materials, the Contractor shall supply them with no extra cost.

The design shall fully comply with EIA/TIA 568B & ISO 11801 in a full star topology configuration collapsing in the MDF.

The network data cabling systems support at least 1000 Base-T (Gigabit) Ethernet or faster protocol.

The UTP (unshielded twisted pair) Category 6 cable's technical specifications shall be up to the highest industry standards and should have performance specifications better than 250 MHz and should exceed all proposed requirements for data, video & Gigabit applications.

The UTP Category 6 cable's technical specifications shall be up to the TIA/EIA-568B.2-1 industry standards and should have performance specifications better than 250 MHz and ample margin compared to the Category 6 Standard for performance in factors such as NEXT.

Data & Voice cables may be drawn through the same conduits and raceways & terminated in separate face plates.

## **2. SCOPE**

The contractor shall carefully examine the specifications to ensure that he is fully conversant therewith and has included for everything necessary therein, either expressly provided for or as would normally be expected to be provided for by a reputable contractor specializing in the type and nature of the Services described in the Contract.

The Contractor is advised that items or matters not specifically provided for, or partially described or otherwise missing from the specifications, but which are nevertheless necessary for the execution and completion of the Services, shall be deemed to have been included by the Contractor.

The Contractor shall ensure that all selected manufacturers of equipment and materials provide



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with appropriate warranties and guarantees for their products.

Authorized and certified installers registered with their respective manufacturers shall execute the installation of the Cabling system.

The Contractor shall also be required to submit, in their bid, a list of personnel along with their CV, certifying that the installers it intends to employ on the services have the necessary training and experience.

The LAN cabling system shall meet the emerging EIA/TIA 568A/B and ISO 11801 Category 6, Class E specifications and shall support Gigabit Ethernet, Sonnet/asynchronous transfer mode (ATM) at rates (minimum of) 1 GB/seconds and analog broadband video in addition to existing telecommunication and multimedia technologies.

The voice backbone cabling system shall meet the EIA/TIA 568A/B-5 and ISO 11801 Category 5E, Class D specifications.

The Contractor shall carry out all the necessary surveys, design and engineering so as to provide for the Services, a whole and complete system to ensure full compatibility of the Services with any of the existing facilities pertinent to Cabling System applications & operations.

The scope of the Services include the provision of all material, labor, supervision, construction, equipment, tools, temporary, test equipment, spares, consumable and all other things and services required to engineer, design, supply, install, test and commission the Cabling System.

It is the responsibility of the Contractor to make sure that the system works at the company environment.

The Vendor must provide a list of project Reference within the last three years.

The Vendor must have completed a project with a minimum of 1000 points or higher of Category 6

The Vendor must have experience with minimum 500 points of fiber installed and terminated.



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**3. SUBMITTALS**

Product Data: Submit manufacturer's data on signal transmission media and components.

Shop Drawings: Submit layout drawings of computer cable distribution system and accessories.

Wiring Diagrams: Submit data transmission wiring diagrams for computer system, including rack and terminal connections.

**4. QUALITY ASSURANCE:**

For Manufacturer:

Firms regularly engaged in manufacture of signal transmission media and accessories of types required, whose products have been in satisfactory use in similar service for not less than 5 years.

For Installer:

Firms with at least 5 years of successful installation experience with projects utilizing systems and equipment similar to that required for this project.

Coordinate with other electrical work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of data system with other work.

Sequence installation of data system with other work to minimize possibility of damage and soiling during remainder of construction.

**5. COPPER & FIBRE OPTIC CABLE AND CONNECTORS**

UTP Copper & fiber optic cables shall be approved & recommended by component manufacturer. This is to enable the component manufacturer to give the necessary product and application warranties for the system.

Provide UTP copper cable, fiber optic cable and connectors, in sizes and types as recommended by the active equipment manufacturer for indicated applications. Mate and match connector



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materials to factory installed equipment.

Cabling Accessories:

Provide computer accessories, including modular wall and floor jacks, junction boxes, connecting blocks and pre-wired boxes.

The selection and type of material required for the Services shall conform to the specifications given herein and items or matters not specified herein shall conform to ISO/IEC 11801, EN 50173 and EIA/TIA 568B Category 6 Standards as applicable. The Contractor shall also ensure that the materials utilized to complete the Cabling System installation are capable of supporting the minimum expected performance requirements for emerging applications such as ATM services (1.2 Gbps), including 10 GB Ethernet. The complete system shall guarantee a minimum of 250 MHz & 100 MHz bandwidth performance and the products shall be from an internationally reputable manufacturer. The selection of materials shall be subject to approval by The Company.

The cables that are used to complete the installation shall be Category 6 UTP, capable of carrying high bit rate signals for extended distances in building distribution systems over frequency ranges up to and potentially beyond 250 or 100 MHz, designed to work on an ISO 11801 Class “E” link.

The cable shall be composed of 23 or 24 AWG bare, solid-copper conductors. The insulated conductors shall be twisted into individual pairs and four such pairs twisted together.

The cables shall be fully color coded as provided hereunder, color contrast being such that each pair in the cable is easily distinguishable from every other pair.

<b>Conductor Identification</b>	<b>Colored Code</b>	<b>Abbreviation</b>
Pair 1	White – Blue Blue – (White)	WT – BL BL
Pair 2	White – Orange Orange – (White)	WT – OR OR
Pair 3	White – Green Green – (White)	WT – GN GN



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Pair 4	White – Brown Brown – (White)	WT – BR BR
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**6. TELEPHONE SYSTEM**

**6.1 General**

The work included under this section consists of furnishing of all labor, services and skilled supervision necessary for the construction, erection, installation and connection of all facilities specified herein and as shown on the drawings and/or normally required for the complete telephone system and its delivery to the owner on completion in all respects ready for use, except the main telephone exchange equipment (PABX) and telephone instruments which will be supplied and installed by the relevant authority in accordance with the requirements of the PTCL.

**6.2 Telephone Services**

The telephone service entrance location shall be coordinated with PTCL. For bringing in the service connection and underground UPVC pipe 75mm diameter shall be installed, a minimum 500mm below ground level and as shown on drawings. Pull wire shall be furnished and installed in the pipe line as recommended by PTCL.

**6.3 Telephone Conduit System**

The telephone conduit system, including telephone outlet boxes, rosettes, junction boxes, etc. shall be generally in conformity with the specifications of similar items given in BOQ and shall be in accordance with the recommendation of PTCL.

**6.4 Telephone Junction Boxes**

The telephone junction/terminal boxes shall be cubical design of 1.6mm sheet steel fabricated with a hinged door fixed flush with the wall and having built in concealed lock. The color of the box shall be powder coated RAIL 7032, and it shall be installed in such a manner so as to have easy access for service and repair. The TJB shall be vermin proof. It shall be made to accommodate tag blocks with indicating and marking arrangements.

**6.5 Telephone Wiring**

Wiring of telephone system will be done by multi-core PVC insulated and sheathed cables complying with BSS 2746. The conductor shall be of high conductivity tinned



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copper diameter 0.6mm. PVC insulated and PVC sheathed. All telephone cables shall be continuous between telephone outlets and junction boxes. All connections shall be made, marked and identified on tag blocks and socket outlets.

**7. SPECIFICATIONS OF UTP CABLES:**

Cable Type	Category 6 UTP
Conductor Size(mm)	23 or 24 AWG
Number of Pairs	4
Nominal Outer Diameter (mm)	6.0
Impedance(Ohm)	100+/-15
Velocity of propagation (% speed of light)	69
Frequency (MHz)	250
Max. Attenuation @ 250 MHz (dB)	32.1
Worst case NEXT @ 250 MHz (dB)	38.3

**8. FIBRE OPTIC & UTP CABLING**

The backbone cabling interconnecting distribution cabinets to the main Central distribution cabinet shall be of multimode fiber cable 50/125 microns; 12-core cable with color-coded fibers. All fiber optic cables shall be laid in straight run without intermediate splices and all fibers shall be terminated at either end using suitable fiber cable patch panels mounted on the wiring closets.

All fiber optic backbone links between the main cross connect and the Telecommunication rooms have a backup link using a different route from the main fiber optic link. Each of these links shall be 12-core fiber optic cable as described in this document.

The Contractor shall be responsible for the supply, installation, testing and commissioning of the complete fiber cable backbone interconnection/cross connection requirements of the “building/complex” LAN Cabling System.

The Contractor shall install suitable fiber optic pigtails/connectors needed to complete the entire fiber cable installation as per the manufacturer’s recommendation and shall ensure that the backbone is capable to handle the traffic and provide error- free universal data transport for the foreseeable future.



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The backbone Fiber optic cable shall be run either vertically between floors or horizontally to connect wiring closets to the MDF.

The 12 core fiber optic cables shall be installed from the Main Cross-Connect to each Telecommunication rooms. The cable shall be tied down to the designated area at the rear side using cable ties around the outer jacket, leaving 2 to 3 meters of excess length of the cables, in addition to the length required to facilitate the termination process.

All of the fibers in the backbone shall be terminated with LC type connectors at the time of the installation. The Contractor shall ensure proper testing of the fibers and make them available whenever they are needed. No fibers shall leave un-terminated, all fibers must be terminated. A document with fiber cable test results for every fiber cable link shall be provided by the Contractor.

The Contractor shall observe the manufacturer's specifications for maximum tension and minimum bend radius for each fiber optic cable. The contractor shall provide a copy of the manufacturer's specifications to the owner prior to the commencement of the work.

Care must be taken when mechanical pulling devices are used, that maximum tension limits are not exceeded. Minimum bend radius specification shall not be violated when the cables are routed through walls or around corners. The contractor shall ensure that all installation personnel are aware of these limitations.

The Contractor shall follow an intelligent numbering system based upon the destination and channel number. The numbering system shall have a prefix 'F' to indicate it is a fiber optic cable, followed by the destination IDF, then a hyphen and the channel within the cable.

100 pairs UTP shall be installed between the Telephone MDF and the Voice/Data MDF. This cable shall be of category 5, 100 MHz and shall be terminated in a rack mounted patch panels installed in the telecommunication closet at the MDF.

Multi-pair, CAT 5, 100 MHz UTP cable shall be installed as backbone between the voice MDF to the IDF in each floor/location as indicated in the drawings.

Logical labeling should be as per ANSI/TIA/EIA-606. Labels should be ring and printed type. No labels should be written by hand.



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**9. OPTICAL FIBRE CABLE TECHNICAL SPECIFICATION**

Fiber optic cables within the premises shall use multimode, graded-index.

Fibers must comply with EIA/TIA 492 specifications and OM3 fiber specification as in IS 11801 standard.

Fibers will have dual wavelength capability; transmitting at 850 and 1300nm ranges.

All fibers shall be color coded to facilitate individual fiber identification. The coating shall be mechanically strippable.

Core	50 $\mu\text{m} \pm 3 \mu\text{m}$
Core Non-Circularity:	<6%
Core/Cladding Concentricity Error:	<3.0 $\mu\text{m}$
Numerical Aperture:	0.200 $\pm$ 0.015
Cladding diameter:	125 $\mu\text{m} \pm 1 \mu\text{m}$
Cladding Non-Circularity:	<2.0%
Colored Fiber Diameter:	250 $\mu\text{m} \pm 15 \mu\text{m}$
Buffering Diameter:	890 $\mu\text{m} \pm 50 \mu\text{m}$
Minimum Tensile Strength:	100,000 psi
Fiber Minimum Bending Radius:	.75 in. (1.91 cm)
Cable Minimum Bending Radius: During Installation: After Installation:	20 times cable diameter 10 times cable diameter

Operating Temp. Range:	32°F to 122°F (0°C to 50°C)
Storage Temp. Range:	-40°F to 149°F (-40°C to 65°C)
Maximum Fiber Loss:	3.5 dB/km at 850 NM 1.5 dB/km at 1300 NM
Minimum Bandwidth:	1500 MHz km at 850 nm (OFL) 500 MHz .km at 1300 nm (OFL) 2000 MHz km at 850 nm (DMD, laser) 500 MHz km at 1300 nm (DMD, laser)



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**10. DATA & VOICE OUTLETS**

The Contractor shall provide the identification labels at each and every information outlet with clear information of its connection. (TR, cabinet number, patch panel number and port number). The labeling shall be on the faceplate of the information outlet according to EIA/TIA 606 Administration Standard.

The contractor has to provide clear identification labels for data & voice.

In the process of installing the information outlets, if the Contractor envisages difficulty in mounting the outlet at planned location in the drawings. The contractor shall notify the Engineer/Owner, the contractor shall not make his own discretion in modifying or changing any information provided in the drawings.

The type of information outlets shall be of modular RJ45 of Matt Chrome/ metallic or any other approved finish, 8 position, 8 conductor designed for high speed networking applications that use data transmission rates over frequency ranges up to and potentially beyond 250 MHz & 100MHz. The outlets shall be of insulation displacement connectors type (IDC).

The 8 position/8 conductor outlet shall meet the category 6 transmission requirements for connecting hardware specified in ISO/IEC 11801 and EIA/TIA-568A/B and Class E design guidelines.

The modular outlet shall provide maximum versatility in designing a premise distribution system. It shall be designed to snap into modular faceplate. When the outlet is inserted into the faceplate or frame, it shall lock into place and shall only be released using the dual-purpose wire insertion tool. The mounting and removal system shall allow easy installation and modification. The faceplate jacks must be shutter protected and shall include a label window required to write circuit identification number. Each port must support a color icon to identify the port function. The plastic used to construct the modular data outlet shall be of high impact, flame-retardant, made of poly (phenylene oxide) with flammability rating meeting UL 94V-0UL, the jack wires shall be at least 50 micro-inch lubricated gold plating over 100 micro-inch nickel under plate. The connector shall be of copper alloy, at least 100 micro-inch bright solder over 100 micro-inch nickel under plate.

The insulation displacement connector shall accept 24/23 AWG solid copper wire conductors. The connector shall have multicolor labels marking wire terminals with numbers, assuring fast,



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accurate installation. The outlet must support wiring configuration as per T568A and T568B on the same RJ-45 jack

The connector shall be wired using the wire insertion tool (impact tool). The module shall be wired from the centre to the outside and shall not untwist paired conductors more than 12.7 mm. In the process of terminating the cables in patch panels/outlets the Contractor shall ensure ISO/IEC and TIA/EIA category 5E/6 transmission performance requirements.

## **11. PATCH CORDS**

The contractor shall supply patch cords for all the installed points on the network switch side as well on the workstation side. The cord length shall be of two different sizes, 1m on the network switches side and 3m on the workstation side.

The patch cable shall meet the requirements warranted to meet ISO/IEC 11801, EN 50173 and EIA/TIA 568A/B category 6 wiring standards capable of connecting high speed information terminal devices to information outlets, to interconnect information terminal devices and 8-position modular jack panel applications. The patch cord shall be designed to provide support for extended multimedia transmission distance over frequency ranges up to and potentially beyond 100/250MHz.

The patch cord shall support the computer networking applications over frequency ranges up to and potentially beyond 250 MHz and shall be compatible with voice and information applications.

The construction of the cord shall be of stranded type cordage tightly twisted, 24 AWG, 8 conductor. The cord shall be terminated to an 8-position RJ-45 modular plug on both ends. The cords shall support the transmission requirements warranted to meet ISO/IEC 11801 Class E, EN 50173 or TIA/EIA 568B Category 6, Class E component specifications and standards.

The Contractor supplied cord shall be of factory crimped modular plug at both ends.

Pre-wired patch cords, 110 to 8 position (RJ45), constructed of 24 gauge, stranded wire in PVC jacket shall be used to add modularity to 110 system.



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**12. PATCH CORD ORGANIZER**

The Contractor shall supply and install sufficient patch cord organizers/inter-bay patch cord organizers that are used for routing patch cords in 19-inch (48.3-cm) frames. The patch cord organizers shall support the requirements of routing patch cords both at the equipment side as well as the Category 6-patch panel cabling side at the wiring closets. These organizers shall be located in the 19-inch frame inside the wiring closet.

The Contractor supplied patch cord organizers/inter-bay patch cord organizers shall support the requirements of routing cords in both horizontal and vertical pathways.

**13. PATCH PANELS (JACK PANELS)**

The Contractor shall supply and install the modular patch panels to meet the full cabling system requirement of the “building/complex”. Every category 6 cables serving the information outlets at work areas shall be terminated at the patch panels. The Contractor shall ensure that the supplied patch panels meet the ISO/IEC 11801, EN 50173 and TIA/EIA 568 warranted component specifications and standards.

The patch panels shall be of 19-inch rack-mounted panels. The rear of the panel shall feature connecting blocks mounted on a printed wiring board. These connecting blocks shall be capable for use in terminating category 6 station wires, equipment, or tie cables. The modular patch panel shall be capable of supporting up to 24 jack positions (ports) as required by the design drawings of the voice and data system and shall have the facility to write the circuit designation details at the front side of each jack. The contractor shall provide 20% spare capacity for both voice and data.

The insulating displacement connector field in the patch panel shall be made continuous to the 8-pin modular jack field on front of the panel through printed wiring board connections to enhance the features to confirm to EIA/TIA 568A/B cabling recommendations.

The construction of the modular jack panel shall be of category 6 – compliant and shall have the stringent requirements of connecting hardware as specified in EIA/TIA 568A/B commercial/residential building Cabling System standards.



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When the patch panels are tested in accordance with the appropriate test methods described in EIA/TIA 568 A/B and ISO/IEC 11801, EN 50173 Category 6 specifications. The modular patch panels shall meet the worst-pair near-end cross talk (NEXT) requirements over the entire frequency ranges up to and potentially beyond 100/250 MHz on all pair combinations.

Care must be taken to ensure that the cables are terminated correctly at category 6 cross connect hardware (patch panels).

The pair twist of the cables must be maintained as close to the termination at the patch panel IDC Modular outlet as possible. Cables shall not be untwisted for more than 12.7 mm. The cable conductor's entry shall be at the center of the IDC module and the module shall be wired from the center to the outside.

The cable conductors shall be terminated as described in EIA/TIA 568A/B and ISO/IEC 11801, EN 50173 Category 6, Class E wiring sequence by using the proper insertion tool (impact tool).

When terminating the cables in the insulating displacement connector field, care must be taken to ensure that the strip – back is limited only as much cable jacket as is required to perform connecting hardware terminations. The cables shall be properly secure terminations. The cables shall be properly secured to the 19 – inch rack with cable ties as well as at the patch panels.

The IDC connectors must be color coded to meet both T568A and T568B wiring Configuration.

Each port of the patch panel must support color Icon to identify the port function.

Each port must be numbered in sequence with white printing on black background or other high contrast colors.

Each port on the patch panel must have a label place holder and for the patch panel number.

The IDC connector on the back of the patch panel shall support 22 to 25 AWG solid conductors cables.

The package must include frame mounting screws, labels, cable ties and instruction sheet.



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**14. IDC WIRING SYSTEM**

The IDC blocks shall be used for the voice cross connect and should be 19” rack mountable type.

The IDC blocks shall be capable of terminating up to 336 pairs.

Shall be capable to terminate 22-26 AWG solid conductors or 22-26 AWG stranded conductors.

Shall be made of high-impact UL 94V-0 rated thermoplastic.

Maximum insulated conductor outside diameter 0.05”

Complete kit include connecting blocks, labels and label holders shall be used.

Jumper troughs shall be used to route cable horizontally and vertically.

**15. CABLING CABINET (Racks)**

The Contractor shall supply and install cabling System Cabinets to house the passive and active network equipment. The cabinets shall be free/standing or wall mounting types.

The Cabling System cabinets shall meet the requirements of accommodating the high volume of cabling 19” 24-port patch panels & LAN Equipment fully assembled with the following items.(Cabinet dimension 42U 600 mm x 800 mm nominal width & depth). The cabinets must meet the following specifications:

42U 800 x 800 Ready Rack

500 KG load rating

42U 600 4mm Safety Glass Door (On the front).

42U 600 1.6 mm steel Door (On the rear).

600 x 800 side vented top cover.

Castors heavy duty braked.

42U Panel mounting angle kit.

800 X 800 thermostat controlled Low Noise Fan Tray.

A power outlet strip shall have a 2 meter flying lead, (3-wire extension cord) with a 3 prong British plug with fuse and shall have 13 amp. 250 volt 3 prong British outlets with individual



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on/off switch and indicator light with mounting brackets. The AC Mains distribution integral at the rear pillar of the cabinet should have at least 10 of 13 amp. Power Outlets. Cable management panel inclusive of other accessories such as earthing kits, screws, washers, grip-nuts and a removable shelf, able to resist a weight of 50 to 60 kgs. The cabinets shall be rugged and strong and all steel shall be finished scratch proof in a durable enamel Grey paint on both sides.

The cabinets must include Low Noise Thermostat controlled fans and shall automatically switch on and off according to the temperature inside the cabinets, the temperature range shall be from 10 to 60 degrees centigrade. The dimensions of the tray shall be of 600 mm x 800 mm. The fan tray shall have minimum of four fans 250 Volts AC + 6% 50 Hz. The low noise top mounted fan tray shall aid the cooling requirement of the LAN equipment installed inside the cabinets, and in the process of installing the fan tray on top of the cabinet it shall not occupy any of the usable U height in the cabinet.

The front glass door shall have at least 4 mm toughened & 50 percent light transmission smoked safety glass able to resist a weight of 80 to 100 Kgs. Placed within 200 mm of the door center. The door shall be lockable and shall have a swing handle supplied with 2 keys.

The rear door shall be the same as the front except the construction of the door shall be of rugged and strong 1.6mm steel finished in a durable enamel Grey paint on both sides, and without glass.

The internal panel mounting angles shall be supplied in pairs to provide 19" mounting positions with hole patterns to accept captive nuts on universal centers. In the design of the panel mounts the centers of each U height shall be notched, to make the positioning of cage nuts much simpler. The panel mounting shall be fitted onto panel mount angle supports to allow infinite adjustment throughout the depth of the track.

The cabinets shall be supplied at least with one shelf kit. The shelf should carry a load rating of 50 Kgs. And shall be manufactured with holes/slots providing sufficient airflow to LAN equipment when installed inside the cabinets.

Four steel castors with rubber wheels at least 40 mm high. These castors shall be mounted at the corners of the cabinet and be able to support the total weight of the cabinet and all options.

The cabinets must support the installation of fire protection units and all 19" equipment including frames for 110-punch block.



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The supplied cabinets must meet the following standards:

IEC 297-2

D/N 4/494 Part 7

D/N 4/491 Part 1

Load rating 500 Kg

Rust proof coating

EN 60950

VDE 0100

Material 1.6mm steel

Paint finish according to RAL 7035

For the 25U freestanding cabinets the specifications is as follows:

The 19" 6U, 350 x 600, rack mounted type. Tempered glass front & rear door with key lock for maximum protection.

A power outlet strip shall have a 2 meter flying lead, (3-wire extension cord) with a 3 prong British plug with fuse and shall have 13 amp. 250 volt 3 prong British outlets with individual on/off switch and indicator light. The AC Mains distribution Integral at the rear pillar of the cabinet should have at least 6 of 13 amp. Power Outlets.

The cabinet shall be fitted with at least a 2 way low Noise Fan Tray and medium duty castors.

The supplied cabinets must meet the following standards:

IEC 297-2

D/N 4/494 Part 7

D/N 4/491 Part 1

Load rating 500 Kg

Rust proof coating

EN 60950

VDE 0100

Material 1.6mm steel

Paint finish according to RAL 7035

18 42 U free standing open frame



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Integrated cable and cord management  
allows for more efficient and effective cable management  
Focused on accessibility  
Extruded aluminum construction  
Modular open frame design (no doors and side panels to remove)  
Pre-threaded mounting holes  
42U with 270 holes per vertical channel meets EIA/TIA RMU rack mounting unit dimension  
Mounting screws with pilot point  
Cable guides provide an effortless solution to transitioning cables  
Flexible cable guides allow cable to snap-in easily for quick cable routing  
Spacing of cable guides aligns exactly with the standard ISO 1101 rack  
Unique switch gate Door / Cover provides easy access to the door  
Edge protected pass through holes for transition of cables to rear side

**SECTION - J**

**CONVENTIONAL FIRE ALARM SYSTEM**

**1. SCOPE**

The work consists of supply, installation and commissioning of all material and services of the complete Addressable Fire Alarm system as specified herein and / or shown on the Drawings and given in the Bill of Quantities.

**2. STANDARDS**

Following standards/codes shall be applicable:

BS 5839

NFPA 72

Any other international standard

**3. OPERATION**

The Fire Alarm System shall be pre-signal non-coded type complete with battery backup.



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As per drawings the break glass type fire alarm stations and automatic detectors shall be installed at site. In case of any Fire, the manual station shall be operated by pulling down the handle or breaking the glass. The actuation of this station shall cause an audio as well as visual alarm at the fire alarm control and indication unit, duly indicating the location of the respective station/zone.

An authorized person shall immediately visit the affected area and if after investigating, it is deemed necessary, alarm in the whole building shall be initiated from either the alarm switch located beside the fire alarm control panel by inserting a special key or the actuation of any indication at the Main Fire Alarm Control Panel. The general alarm shall be initiated by an authorized person after inspecting the affected location.

#### **4. MATERIAL**

##### **4.1 Wiring**

Fire Alarm Cable shall be 2core, fire resistant, PVC/PVC insulated, 250/440 volts grade cable to be laid in concealed PVC conduit.

##### **4.2 Power Supply**

The supply and operating voltages shall be 220 volts, 50 c/s and 24 volts D.C. respectively. The control stations shall be provided with sufficient capacity nickel cadmium battery with charger to operate the complete system for the least 15 hours in case of mains failure. A 20 Amp SPN switch socket shall be provided near the central fire alarm panel to feed the mains supply.

##### **4.4 Manual Call Point**

It shall be re-settable (non-breaking) glass type, electronically addressed and suitable for semi finish and surface amount installation as per drawing. The break-glass manual station shall be operated by pulling down the handle. When operated, the handle shall remain down with the pre-signal alarm contacts closed until the station is reset. The general alarm contacts shall remain open until after investigation. The general alarm switch shall be operated by an authorized person with a special key.

##### **4.5 Fire Alarm Bell**

Fire alarm (bell) shall be of red color surface mounted installed where indicated on the drawings. Sound intensity shall be such that an audible signal will be heard clearly throughout the structure when all the bell ring. The bell shall be connected in multiple cross loop conductors.



**4.6 Smoke Detector**

The detector shall use the light scattering principal to measure smoke density & shall send data to FACP indicating analog level of smoke density. It should be low profile design, electronically addressed, twin LED's for 360 degree vision and removable optical chamber for cleaning & maintenance. The operating voltage shall be 24V DC and surface mounted ceiling and shall include a separate twist-lock base that includes a temper proof feature.

**4.7 Heat Detector**

It should be low profile design with fixed temperature and rate of rise heat detection type. Electronically addressed and twin LED's for 360 degree vision. The operating voltage shall be 24V DC and surface mounted as per drawing.

**4.8 Fire Alarm Sounder**

It shall be of red color surface mounted installed as per drawing. It should be electronically addressed and strobe provided by high intensity LED cluster. The operating voltage shall be 24V DC.

**4.9 Function of Conventional Fire Alarm Control Panel (FACP)**

**i. Design**

The FACP shall be solid state, modular design highly reliable & functional type with integral static protection. All indicating lamps shall be long life, low maintenance solid state light emitting diodes (LED). It shall have graphically LCD display, programmable from PC built-in gas extinguishing control and integrated security alarm facilities. It should be designed to receive signals emitted by manual call points & fire detectors, producing sound & light indications. It should provide options for integration of external sound units & executive devices.

**ii. Enclosure**

The FACP enclosure shall be semi flush mounted. The enclosure shall be hinged from the left and the cover shall have clear windows and locking mechanism to keep the system operating and status switches from being tampered keys shall be made available to fire department and other authorized operating personnel. Finish shall be "FIRE ALARM RED" and "BLACK".



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**iii. Functions**

The functions of conventional fire alarm systems shall be as follows:

- a. Control over fire alarm lines & controllable output for fault conditions (short circuit & interruption) and automatic reset.
- b. Detection of removed fire detector and automatic reset.
- c. Ability to identify automatic fire detectors and manual call points.
- d. LED indication for fire & fault conditions.
- e. Built-in sound signalization for fire condition (one-tonal continuous) that can be switched off.
- f. Built-in sound signalization for fault condition (one-tonal continuous) that can be switched off.
- g. Test mode of fire alarm lines.
- h. Disable of fire alarm lines.
- i. Disable of output for fire condition.

**iv. Components of Fire Alarm Control Panel**

- a. All hardware and software to allow the panel configuration and operation to be changed at the panel. Systems that require off-site programming are not acceptable.

The memory data for panel configuration and operation shall reside in non-volatile, memory provided by battery backed RAM. Removal of the board shall not cause loss of memory contents.

Switches for panel setup, set reset, manual, evacuation alarm, silence and acknowledge. Individual supervisory LEDs shall be provided for power, run, alarm, trouble, disconnect, low battery and ground fault.

- b. Indicating zones: As indicated on the drawings, each zone containing smoke detectors shall provide power and monitoring for up to only 50% detectors. (All hardware and software shall be provided to facilitate selection of circuit performance to provide alarm verification for smoke detector circuits with field false alarms. When a detector signals an alarm, the panel shall automatically reset the detector, wait and their double checks to verify the alarm. Each zone shall have a red LED to



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indicate alarm and yellow or amber LED to indicate a trouble condition.

**v. Manual Functions**

At any time, even without an alarm condition on an indicating circuit, the operator shall provide the following manual capabilities in the FACP by means of switches located behind a key locked cover:

- a. In case of fire if a general evacuation is needed all bells shall sound. These signals can be initiated from the main panel and secondary switch at manual fire alarm initiating device (break glass unit).
- b. Silence the local audible signal. This shall also cause the LED(s) to cease flashing and to be continuously 'ON'.
- c. Silence the alarm signals.
- d. Reset the FACP, after all initiating devices have been restored to normal.
- e. Disconnect any individual initiating or indicating circuit from the alarm sequence. This action shall light a disconnect LED and cause a trouble condition.
- f. Perform a complete operational test of the system microprocessor with a visual indication of satisfactory communication with each board.
- g. Test all panel LEDs for proper operation without causing a change in the condition on any zone.

**vi. System Supervision**

- a. Upon application of primary power, or reapplication following power failure, the FACP shall automatically be in a normal supervisory condition.



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- b. In the normal supervisory condition, a green "POWER" LED shall be illuminated, indicating the presence of primary power.
- c. A green "RUN" LED shall be illuminated indicating that the microprocessor is communicating with the system and the memory contents are satisfactory.
- d. The following shall be electrically supervised:

All initiating and indicating device circuits.

All plug-in circuit board shall have proper board type in the position. System that use electrical continuity to supervise the presence of plug boards, but that do not assure that board position have been exchanged, shall provide equivalent means for specified supervision, beyond that provided by the locked cover.

**4.11 Test**

Upon completion, the Contractor shall conduct a total system test where line supervision and each device shall be tested. All the tests shall demonstrate that the system meets the tests shall operating requirements of this specification, that individual conductors of all circuits are free of grounds, shorts and breaks, and that no grounds exist between any piece of equipment in the control unit and the cabinet. All final connections, testing, adjusting and calibrating shall be made under the direct supervision of a factory trained technician of the system supplier.

**4.12 Installation**

The Fire alarm system shall be installed as mentioned in the drawings. The system shall be connected, tested and commissioned as per manufacturer's instructions and in the presence of Engineer In-charge. The wall recessed mounting Fire alarm manual stations shall be installed at a height of 4.5' feet above finished floor level. The connections of the appropriate Contactors of the Fire alarm system shall be made as per manufacturer's instructions.

The Fire alarm system conduit shall be laid 15cms (6") from the electrical conduits and cross the electrical conduit at 90 degree only. The Fire alarm system conduit shall be



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marked with red color at terminations in order to distinguish it from other conduit system.

SECTION – K  
CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM

**1. GENERAL**

- A. All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer's system.
- B. All systems and components shall have been thoroughly tested and proven in actual use.
- C. All systems and components shall be provided with the availability of a toll-free, 24-hour technical assistance program (TAP) from the manufacturer. The TAP shall allow for immediate technical assistance for either the dealer/installer or the end user at no charge for as long as the product is installed.
- D. All systems and components shall be provided with a one-day turnaround repair express and 24-hour parts replacement. The repair and parts express shall be guaranteed by the manufacturer on warranty and non warranty items.

**2. GENERAL SPECIFICATIONS**

**Indoor/Outdoor CCTV Camera Dome System**

- A. The indoor/outdoor CCTV camera dome system shall be a discreet, miniature camera dome system consisting of a dome drive with a variable speed/high speed pan and tilt drive unit with continuous 360° rotation, 1/4-inch high resolution color (or monochrome or color/black-white) CCD camera, motorized zoom lens with optical and digital zoom and auto focus; and an enclosure consisting of a back box, lower dome, and a quick-install mounting.
- B. The indoor/outdoor CCTV camera dome system shall meet or exceed the following



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design and performance specifications:

**3. DOME DRIVE**

A. The variable speed/high speed pan and tilt drive unit shall meet or exceed the following design and performance specifications:

- |    |                               |   |
|----|-------------------------------|---|
| 1. | Pan Speed                     | Variable between 360° per second continuous pan to 0.1° per second  |
| 2. | Vertical Tilt                 | Unobstructed tilt of +2° to -92°  |
| 3. | Manual Control Speed          | 0.1° to 80° per second, and pan at 150° per second in turbo mode. Tilt operation shall range from 0.1° to 40° per second  |
| 4. | Automatic Preset Speed        | Pan speed of 360° and a tilt speed of 200° per second   |
| 5. | Presets                       | Eighty preset positions with a 20-character label available for each position; programmable camera settings, including selectable autofocus modes, iris level, Low Light™ limit, and backlight compensation, for each preset; command to copy camera settings from one preset to another; preset programming through control keyboard or through dome system on-screen menu |
| 6. | Preset Accuracy               | +/- 0.1°  |
| 7. | Proportional Pan / Tilt Speed | Speed decreases in proportion to the increasing depth of zoom   |



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8.	Automatic Power-Up	User-selectable to the mode of operation the dome will assume when power is cycled, including automatically returning to position or function occurring before power outage
9.	Zones	Eight zones with up to 20-character labeling for each, with ability to blank the video in the zone
10.	Motor Drive	Cogged belt with 0.9° stepper motor
11.	Motor Operating Mode	Micro step to 0.015° steps
12.	Motor	Continuous duty, variable speed, operating at 18 to 30 VAC, 24 VAC nominal
13.	Limit Stops	Programmable for manual panning, auto/random scanning, and frame scanning
14.	Inner Liner	Rotating black ABS liner inside sealed lower dome
15.	Alarm Inputs	Seven N.O./N.C. dry contacts
16.	Alarm Outputs	One auxiliary Form C relay output and one open collector auxiliary output
17.	Alarm Output Programming	Auxiliary outputs can be alternately programmed to operate on alarm
18.	Alarm Action	Individually programmed for three priority levels, initiating a stored pattern or going to a pre-assigned preset position
19.	Resume after Alarm	After completion of alarm, dome returns to



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- previous programmed state or its previous position
20. Window Blanking Eight four-sided, user-defined shapes, with each side being of different lengths; window blanking setting to turn off at user-defined zoom ratio; window blanking set to opaque gray or translucent smear; blank all video above user-defined tilt angle; blank all video below user-defined tilt angle
21. Patterns Four user-defined programmable patterns including pan, tilt, zoom, and preset functions; pattern programming through control keyboard or through dome system on-screen menu
22. Pattern Length Four patterns of user-defined length, based on dome memory
23. Autosensing Automatically sense and respond to protocol utilized for controlling unit whether Coaxitron® or RS-422 P or D protocols; accept competitors' control protocols with the use of optional translator cards
24. Menu System Built-in for setup of programmable functions; multilingual, including English, French, Italian, Spanish, Portuguese, and German, and alternative languages in Russian, Turkish, Polish, and Czechoslovakian
25. Auto Flip Rotates dome 180° at bottom of tilt travel
26. Password Protection Programmable settings with optional password protection



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27.	Clear	Clear individual, grouped, or all programmed settings
28.	Diagnostics	On-screen diagnostic system information
29.	Freeze Frame	Freeze current scene of video during preset movement
30.	Display Setup	User-definable locations of all labels and displays; user-selectable time duration of each display
31.	Azimuth/Elevation / Zoom	On-screen display of pan and tilt locations and zoom ratio
32.	Compass Display	On-screen display of compass heading; user-definable compass setup
33.	Video Output Level	User-selectable: normal, or high to compensate for long video wire runs
34.	Dome Drive Compatibility	All dome drives are compatible with all back box configurations
35.	RJ-45 Jack	Plug-in jack on dome drive for control and setup of unit and for uploading new operating code and language file updates. Compatible with personal computers and PDAs such as Palm and iPAQ
36.	Remote Data Port Compatibility	Ability to control and setup unit and to upload new operating code and language file updates through optional remote data port that is located in area with easy access. Compatible with personal computers and PDAs such as Palm and iPAQ



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37.	UTP Compatibility	Ability to plug into back box an optional board that converts video output to passive, unshielded twisted pair transmission
38.	Fiber Optic Compatibility	Ability to plug into back box an optional third-party board that converts video output and control input to fiber optic transmission
39.	Third-Party Control Systems	Ability to plug in optional board that converts control signals from selected third-party controllers
40.	Power Consumption	Maximum 70 VA

**4. BACK BOX AND LOWER DOME**

The back box and lower dome shall meet or exceed the following design and performance specifications:

**A. In-Ceiling Environmental**

1. Connection to Dome Drive  
Quick, positive mechanical and electrical disconnect without the use of any tools
2. Trap Door  
Easy-access trap door that allows complete access to the installation wiring and, when closed, provides complete separation of the wiring from the dome drive mechanics



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3.	Terminal Strips	Removable terminal strips with screw-type terminals for use with a wide range of wire gauge sizes
4.	Auxiliary Connections	One Form-C relay output at <40 V, 2 A maximum, and a second open collector output at 32 VDC maximum at 150 mA
5.	Alarm Inputs	Seven alarm inputs
6.	Installation	Quick-mount spring clips
7.	Cable Entry	Through a 0.75-inch conduit hole
8.	Environmental Features	Factory-installed heaters and blowers
9.	Operating Temperatures	Maximum temperature range of -60° to 140°F (-51.1° to 60°C) for two hours, and a continuous operating range of -50° to 122°F (-51.1° to 50°C) continuous operation
10.	Memory	Built-in memory storage of camera and location-specific dome settings such as presets and patterns. If new dome drive is installed in back box, all settings to download automatically into new dome drive
11.	Color	Black, baked-on enamel powder coat
12.	Construction	Aluminum
13.	Lower Dome Material Acrylic, optically clear, with no distortion in any portion of the dome up to +2° above the horizontal	
14.	Dome Color	Clear and smoked versions



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15.	Trim Ring Connection	Two captivated screws
<b>B. In-Ceiling Interior</b>		
1.	Connection to Dome Drive	Quick, positive mechanical and electrical disconnect without the use of any tools
2.	Trap Door	Easy-access trap door that allows complete access to the installation wiring and, when closed, provides complete separation of the wiring from the dome drive mechanics
3.	Terminal Strips	Removable terminal strips with screw-type terminals for use with a wide range of wire gauge sizes
4.	Auxiliary Connections	One Form-C relay output at <40 V, 2 A maximum, and a second open collector output at 32 VDC maximum at 150 mA
5.	Alarm Inputs	Seven alarm inputs
6.	Installation	Quick-mount spring clips
7.	Cable Entry	Through a 0.75-inch conduit hole
8.	Operating Temperatures	Maximum temperature range of 32° to 122°F (0° to 50°C)
9.	Memory	Built-in memory storage of camera and location-specific dome settings such as presets and patterns. If new dome drive is installed in back box, all settings to download automatically into new dome drive



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10.	Color	Black back box, baked-on enamel powder coat; white trim ring
11.	Construction	Aluminum
12.	Lower Dome Material	Acrylic, optically clear, with no distortion in any portion of the dome up to +2° above the horizontal
13.	Dome Color	Clear, smoked, chrome, and gold versions
14.	Trim Ring Connection	Snaps in place
15.	Safety Cable	Plastic tether

**5. DIGITAL VIDEO RECORDER**

A. The digital video recorder (DVR) shall provide a high-quality recorder capable of storage and playback of images from 1 to 16 camera inputs at a simultaneous refreshing recording rate of up to 480 images per second (NTSC) at CIF resolution with a CD-RW as standard equipment. Refer to paragraph B.8. for total frame rates at 2 CIF and 4 CIF resolutions. The DVR shall possess a watchdog system, triplex operation, Windows® 2000 operating system with Service Pack 4 with the latest security updates from Microsoft, watermarking of each frame, inputs for external alarms, video motion detection, and scheduled event recording. Remote software shall be provided for operation via PC, web, and Pocket PC handheld devices.

B. The DVR shall meet or exceed the following design and performance specifications:

**PROCESSOR:**

1. Processing Unit: Pentium® 4, 2.8 GHz processor with 256 MB of RAM
2. Recording Modes: Continuous, motion detection, alarm activation, or scheduled recording



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3. Storage: Hard drive with 80, 250, 500, 750, or 1,000 GB of storage
4. Operating Software: Windows 2000, Service Pack 4
5. Signal Format: NTSC/PAL
6. Resolution:
 

NTSC	320 x 240, 640 x 240, 640 x 480, 720 x 240, or 720 x 480 pixels, depending on model
PAL	352 x 288, 704 x 288, 704 x 576, 720 x 288, or 720 x 576 pixels, depending on model
7. Compression: Pelco proprietary
 

Frame Rate:	NTSC	PAL	
	CIF	480 ips	400 ips
	2CIF	112 ips	96 ips
	4CIF	80 ips	64 ips
8. Functions: Operate as a recorder and a full-duplex multiplexer
9. PTZ Control: Pan, tilt, and zoom functions via RS-422 communications (D, P, and Coaxitron® protocols)
10. Viewing / Recording: Configurations of full screen, 4, 9, 12, or 16 cameras, or custom-designed display views
11. Full-Triplex Operation: Simultaneous playback and live viewing while recording live images
12. Programmable Schedules: 24 individual schedules



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13. Program Modes: Motion event, alarm input, or continuous recording
14. Hardware Watchdog System: A hardware device to monitor the system clock for Windows lockup; upon lockup of the system the recorder shall automatically reboot without losing any of the programmed settings
15. Password Protection: Four user levels of protection for setup functions, operation, and system exiting
16. Motion Detection: Built-in motion detection for each camera to start recording or to increase the recording rate of the system
17. Motion Areas: Selectable detection area and sensitivity for each camera
18. Alarm/Motion Activation: Alarm input will start the unit recording, or if already recording, increase the recording rate and image quality
19. Pre-Alarm or Pre-Motion Recording: Record images for up to 60 seconds before the alarm sensor has been activated
20. Bandwidth Throttling: Network throttling of transmitted video
21. Alarm History Log: Available through a query
22. Alarm Outputs: Sixteen dry contact alarm outputs to activate external devices
23. Motion Activation: When a unit is in scheduled time recording and a camera detects motion or an alarm is activated, the system shall begin recording the event
24. Remote Control: Full remote control operation of pan, tilts, and zoom functions via TCP/IP protocol and RS-422 interface
25. LAN/WAN Connection: Software and hardware provided for viewing and controlling DVR over the network



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|-----|-------------------|---|
| 26. | Video Quality:    | High-quality video recording of at least VHS grade compared to the original video; supports NTSC or PAL video   |
| 27. | Color Palettes:   | Minimum of 16 million color palettes  |
| 28. | Gray Scale:       | 256 shades  |
| 29. | Backup:           | A backup management system is to be provided to back up data to external devices (CD or other storage devices) without interrupting hard disk recording |
| 30. | Hard Disk Drives: | From 80 GB up to 1TB  |
| 31. | Programming:      | On-screen programming and operation through a PC keyboard or PS/2 mouse.  |
| 32. | Digital Zoom:     | Digital zoom of the image on the screen during playback modes   |
| 33. | Authentication:   | Software provided for image verification of each image recorded   |

**MECHANICAL:**

Mounting: Capable of being mounted in an EIA-standard 19-inch rack or placed on a shelf or desktop  
Connectors:

- a. Depending on model, eight or sixteen BNC video inputs plus eight or sixteen looping video outputs with automatic termination
- b. Two 9-pin, D-type connectors for COM 1 and COM 2 ports (disabled)
- c. Two 6-pin, mini-DIN connectors for a PS/2 mouse and keyboard
- d. One 15-pin, D-type port for a PC monitors connection
- e. One 25-pin D-type port for Printer connection
- f. One S-video jack for analog monitor output (disabled)
- g. Two multiplexed analog video outputs (optional)
- h. One RJ-45 connector for network connection



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- i. Four RJ-45 ports for RS485/RS422 support
  - j. Depending on model, eight or sixteen push-in connectors for alarm inputs and eight or sixteen push-in connectors for relay outputs
  - k. Six high-speed USB 2.0 ports
- Dimensions:
- a. Desk Mount  
7.0 (H) x 17 (W) x 19.9 (D) inches  
(17.78 x 43.18 x 50.55 cm)
  - b. Rack Mount  
7.0 (H) x 19.0 (W) x 22.0 (D) inches  
(17.78 x 48.26 x 55.88 cm)

Operating Temperature: 50°F to 95°F (10° to 35°C)

Relative Humidity: Maximum 80% non condensing

Optical Drive: CD-RW

**ELECTRICAL:**

Input Voltage 100-240 VAC, 50/60Hz, auto ranging

**7. GENERAL SPECIFICATIONS**

- A. The DSP color CCTV camera shall consist of a 1/3-inch format CCD imaging chip.
- B. The DSP color CCTV camera shall meet or exceed the following design and performance specifications:

**8. VARI-FOCAL LENGTH, DC-DRIVE, AUTO IRIS LENS**

The lens shall be a 1/3" format, variable focal length, auto iris lens, along with any accessories that may be required for a complete lens system.

The lens shall meet or exceed the following design and performance specifications:

The lens shall be a "CS" mount.

The lens shall be used with 1/3" or smaller format cameras.

The lens shall provide DC-drive auto iris, manual zoom and manual focus adjustments.

The lens shall provide high resolution optics in a compact body.

The lens shall automatically compensate for changing light conditions utilizing DC-drive voltages from the amplifier circuitry resident in the camera.



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The lens shall be equipped with a 4-pin “square” connector for auto iris functions.

END OF SECTION