

**SECTION 15100**

**VALVES, COCKS AND FAUCETS**

**PART 1: GENERAL**

**1.01 WORK INCLUDED**

- A. Gate Valves.
- B. Globe Valves.
- C. Strainers.
- D. Swing Check Valves.
- E. Variable Orifice Double Regulation Valves with metering station.
- F. Pressure Reducing Valves.
- G. Drain Valves.
- H. Ball Valves.
- I. Automatic air vents.
- J. Hose bibbs.

**1.02 RELATED WORK**

- A. Section15290: Air Conditioning & Ventilation HVAC.
- B. Section 15060: Pipe and Pipe Fittings.
- C. Section 15530: Fire Fighting System.

**1.03 REFERENCE STANDARDS**

- A. ASTM - American Society for Testing and Materials
  - A126 Gray iron castings for valves, flanges and pipe fittings
  - A182 Forged or rolled alloy steel pipe flanges, forged fittings and valves, and parts for high temperature service.
  - A216 Carbon steel castings.
  - A522 Fittings, valves and parts for low temperature services
  - B62 Composition bronze for metal castings.
  - B124 Copper and Copper Alloy Forging Rod, Bar and Shapes

- B. ANSI - American National Standards Institute
  - B16.1 Cast iron pipe flanges and flanged fittings
  - B16.5 Steel pipe flanges and flanged fittings
  - B16.24 Bronze flanges and flanged fittings
- C. AWWA - American Water Works Association
  - C504 Rubber Seated Butterfly Valves

#### 1.04 SUBMITTALS

- A. Copies of valve ordering schedule for approval before ordering valves.
- B. Detailed shop drawings. Clearly indicate make, model, location, type, size and pressure rating.
- C. Manufacturer's installation instructions.
- D. Manufacturer's recommended spare parts and tools list.
- E. Certificate of compliance and operation.

### PART 2: PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. Approval of the manufacturer or product must be obtained before proceeding with associated work.
- B. Units shall be products of a Manufacturer regularly engaged in the production of these units and issuing complete catalog data for same.
- C. Substitutions: Items of same function and performance are acceptable.
- D. Provide valves of same Manufacturer throughout where possible.
- E. Provide valves with Manufacturer's name and pressure rating clearly marked on outside of body.

#### 2.02 VALVE CONNECTIONS

- A. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.
- B. Use grooved body valves with mechanical grooved jointed piping.

## 2.03 VALVES FOR ISOLATING PURPOSES

### 1. Gate isolating valves for size 50mm and smaller:

- A. Body shall be made of cast bronze and shall be like all parts designed to withstand high internal pressures and line strainers and are proportional to assure a high safety factor under recommended working conditions.
- B. Bonnet shall be made of cast bronze and bonnet gasket shall be manufactured of high grade compressed non-asbestos fibre.
- C. Disk and stem shall be made from high grade materials especially selected for their purposes.
- D. Stem shall be non-rising type inside screw, double wedge disc.
- E. It shall be of threaded end type with manually handle rated to 850kPa.
- F. It shall be UL/FM approved.

### 2. Butterfly isolating valves for size 65mm and larger

- A. Body shall be cast of durable ductile iron with black alkyd enamel.
- B. Disc coating shall be of synthetic elastomers permanently bonded to metal body.
- C. Body coating shall be of polyphenylene sulfide blend.
- D. Dual seal disc shall be two molded in rings assure inner body wiping action.
- E. Drive hub shall be integrally cast with disc to provide accurate disc positioning.
- F. Bracket connections: Integral side wing brackets mounts permit connection.
- G. It shall be of grooved end with manually handle rated to 300 psi (2065 kPa).
- H. It shall be UL/FM approved.

## 2.04 VALVES FOR THROTTLING PURPOSES

### 1. Globe throttling valves for size 50mm and smaller:

- A. Body shall be made of cast bronze and shall be liked all parts designed to withstand high internal pressure and line strains and are proportional to assure a high safty factor under recommended working conditions.
- B. Bonnet shall be made of cast bronze and shall be provided with ample deep stuffing boxes and accurately machined threads for the stems.
- C. Disk and stem shall be made from high grade materials especially selected for their purpose, such as metallic material.
- D. Stem shall be rising.

- E. It shall be threaded and type with manually handle rated to 850 kPa.
- F. It shall be UL/FM approved.

## 2.05 STRAINER

- A. Body, rigid coupling and end cap shall be ductile iron conforming to ASTM A-536.
- B. Coating shall be orange enamel.
- C. Basket shall be stainless steel type perforated metal including mesh wire screen with end cap.
- D. Gasket shall be Grade "E" EPDM with temp range -30F° to 230F°.
- E. Bolts/nuts: Heat treated carbon steel zinc electroplated to ASTM.
- F. Blow Down Port: an tap shall be provided in the cap for a discharge valve connection allowing solids to be blown down while the system is in service.
- G. It shall have grooved-end T-type, rated to 300Psi (2068 kPa) working pressure.

## 2.06 SWING CHECK VALVES

- A. Body shall be rugged ductile iron conforming to ASTM A-536 with end cap.
- B. Cap shall be ductile iron.
- C. Closure coupling shall be provided for easy access for in-line service, with closure Gasket.
- D. Bonnet cap: Tapped and plugged, clapper and Pin shall be stainless steel.
- E. It shall be of grooved end rated to 300 Psi (2068 kPa) working pressure.
- F. It shall be UL/FM approved.

## 2.07 VARIABLE ORIFICE DOUBLE REGULATING VALVE

- A. It shall be Y-Pattern style design.
- B. It shall be connected with a portable differential pressure meter and each meter connection shall have pressure/temperature probes.
- C. Each valve shall be installed in any direction without affecting flow measurement and shall provide three functions:
  - 1. Precise flow measurement.
  - 2. Precise flow balancing.
  - 3. Positive shut-off with no drip seat.

- D. Each valve shall have one 360° adjustment turn of hand wheel with memory features for use with positive shut-off, and locking feature for tamper - proof setting.
- E. Variable orifice double regulating valve size up to and including 50mm shall have female threaded ends, body and all metal parts shall be a copper alloy, including drain connection with protective cap rated to 300 Psi (2065 kPa).
- F. Variable orifice double regulating valve size above 50mm shall have standard out grooved ends, body shall be cast-iron and all metal parts at non ferrous copper alloy rated to 300 Psi (2065 kPa) working pressure.

## 2.08 PRESSURE REDUCING VALVES

- A. Water pressure reducing valves shall deliver flow rates based on initial and final pressures as indicated. Valves shall be suitable for 1725 kPa operating pressure on the inlet side with outlet pressure range 34.5 to 862 kPa.
- B. Valves shall have easily adjustable low pressure setting and shall be designed to resist water shock pressures.
- C. Valves 50mm and smaller shall have bronze body and trim with screwed ends.
- D. Valves 65mm and larger shall have iron body ASTM A126 bronze trim and flanged ends.
- E. Valves shall have stainless steel stem ASTM A182, disc and diaphragm shall be synthetic rubber, seats shall be bronze.
- F. Valves shall be self-contained, single seated direct operated, diaphragm, spring loaded type with balanced operation suitable for continuous or dead end service.

## 2.09 Drain valve

- A. It shall be 850 kPa, bronze ASTM B62, globe valves threaded ends, screwed bonnets with nipple and cap or hose thread.

## 2.10 BALL VALVES

- A. It shall be end entry, Quarter-turn, lever operation and tight shut-off, threaded type.
- B. Body shall be bronze (chromium plated), seat retainer shall be bronze, and lever shall be mild steel (zinc plated), lever cover (PVC).

## 2.11 AUTOMATIC AIR VENTS

- A. Brass body with leak proof automatic slwt off.

## 2.12 HOSE BIBBS

- A. Bronze ASTM B62 or red brass ASTM B124, with coupling union elbow replaceable hexagonal disc, hose thread spout, vacuum breaker, charm plated.

## PART 3: EXECUTION

### 3.01 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install butterfly valves for shut-off and isolating service, to isolate equipment, part of systems or vertical risers.
- C. Install globe or angle valves for throttling service and control device or meter by-pass.
- D. Provide swing loaded check valves on discharge of pumps.
- E. Provide drain valves at main shut-off valves, low points of piping and apparatus.
- F. Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations, and shall be provided as indicated on CWS & HWS pipes feed toilets or group of fixtures, to limit maximum static pressure at plumbing fixtures.
- G. Variable orifice double regulating valve shall be used for regulation of chilled water entering system.
- H. A strainer shall be installed in piping immediately on suction water booster pump.

### 3.02 VALVES, CONTROLS, ETC., IDENTIFICATION MARKERS

- A. Tags shall be secured to components by brass bead chain in such manner that such identification cannot be removed without tools or partial disassembly of the component. Attachment shall not interfere with normal use, operation, or adjustment of component.
- B. Identification shall be readily observable from normal inspection observation position. On overhead piping, the center face of the identification label shall be normal to a line of sight inclined 45 degrees above the horizontal where practical. Labels shall read axially along the piping.
- C. Markers shall be Brass Tags, 500 mm square, with 6.4 mm radius corners with 5 mm diameter drilled hole at center of one side, 5.6 mm to centerline.
- D. Stamped letters or numbers shall be 5 mm high, filled in with black paint. Component number shall appear on upper line and specific category designations shall be stamped below in one to three lines.

- E. Tags shall be attached to components with 6.4 mm pitch brass bead chain with brass connectors or rings as required. Attachment shall be such that tag and chain cannot be removed from component without use of tools.

### 3.03 PAINTING

- A. All painting shall be in conformance with Engineerural and structural specification.

### 3.04 CLEANING

- A. Clean all systems in conformance with Engineerural and structural specification.

**End of Section**

## **SECTION 15171**

### **ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT**

#### **PART 1: GENERAL**

##### **1.01 SCOPE OF SECTION**

- A. This Technical Specification details the electrical requirements of the mechanical equipment and plant.
- B. All electrical materials, equipment, plant and installation procedures shall be in accordance with Division 16 of this Specification.

##### **1.02 WORK INCLUDED**

- A. The work includes the provision of all labor materials and the performance of all operations in connection with the electrical requirements for mechanical equipment.
- B. Co-ordination: The Contractor shall be responsible for the full co-ordination of the work of all trades.

##### **1.03 QUALITY ASSURANCE**

- A. The Contractor shall employ specialist electrical equipment installers and manufacturers that can demonstrate at least 5 years successful experience in the supply and installation of the type of equipment and systems specified.

##### **1.04 APPLICABLE CODES AND STANDARDS**

- A. The Electrical Requirements shall comply with the latest relevant British Standards in all respects.
- B. The following are some of the most commonly used British and other Standards associated with Electrical works. However, the Contractor shall ensure all applicable Standards are complied with, whether listed here or not.

- BS 1376 - Specification for colors of light signals.
- BS 2757 - Method for determining the thermal classification of electrical insulation.
- BS 4099 - Colors of indicator lights, push buttons, and digital readouts.
- BS 4794 - Special requirements for specific types of control Part 2 switches.
- BS 6231 - Specification for PVC insulated cable for switch gear and control gear wiring.



- IEC 144 - Degrees of protection of enclosures for low voltage switch gear & control gear.

#### 1.05 SUBMITTALS

- A. Drawings refer to 15010
- B. Product data - relating to each and every component and assembly.
- C. Systems information - full schematic and wiring diagrams including panel fascia layouts.

#### 1.06 OPERATION AND MAINTENANCE DATA

- A. Comply with 15010

#### 1.07 WARRANTY

- A. Provide 12 months warranty in accordance with contract conditions.

#### 1.08 EXTRA MATERIALS

- A. Comply Section 15010.

### **PART 2: PRODUCTS**

#### 2.01 CONTROL PANEL ENCLOSURES

- A. Panels shall be constructed from 2 mm thick galvanized steel plate to IP54.
- B. Each composite panel shall include a main isolator interlocked with the door which shall be lockable. All panels shall be finished with stove enamel internally and externally. All panels shall be sealed against ingress of moisture, dust and vermin. All starters and controls shall be located in panels unless agreed otherwise by the Engineer. Anti-condensation heaters and ventilation fans shall be provided in each panel.
- C. An ear bar shall be provided throughout the entire length of the control panel.
- D. Ventilation fans and filters should be provided in control panels to limit interior temperatures. Plant room ambient air must be assumed to be at 45°C.
- E. A minimum of 2 doors shall be provided on any panels wider than 800 mm which shall be fabricated to form rigid trays with dust excluding gaskets around their perimeter.  
Doors shall be fitted with hinges to facilitate the removal of the door panels if required.  
All doors shall be interlocked or arranged such that the door that provides access to the main isolator must be opened first. All door locks shall be provided with common keys.

Panels shall be designed with the following limitations:-

Height	=	2200 mm max.
Length of single section	=	2400 mm max.

## 2.02 CONTROL PANEL METERS

- A. Ammeters and voltmeters shall be provided for each motor either of the moving coil or moving iron self-contained type to BS 89 (Industrial Grade).
- B. All instruments shall be flush mounted and those with moving coil or moving iron movements shall be center pivot type with circular scales unless otherwise specified or approved. They shall be of the dead-beat type and shall be capable of carrying their full scale currents continuously without undue heating or impairing their accuracy. The indicated reading shall be clearly defined and shown against indelibly marked scales engraved on enameled metal. The pointers shall be of clean outline. The pointers and scales shall be such that the scale is marked on a stepped section to avoid the casting of shadows on the scale, and parallax errors. The markings on the dials shall be restricted to the scale markings. Instrument transformer ratios and maker's name shall not appear prominently on the dials but may be marked in an unobtrusive position. The glass covers to dials shall be of non-reflecting glass.
- C. Means shall be provided for zero adjustment without dismantling the instrument or removing the instrument from the panel.
- D. Bus bar voltmeters shall be calibrated while hot. All voltage circuits to instruments shall be protected by a fuse on each pole of the circuit placed as close as possible to the instrument transformer terminal or, where instruments are direct connected, as close as possible to the mains connection in any one of three phases. All instruments and apparatus shall be back connected and all instruments shall be properly earth.

## 2.03 CONTROL SWITCHES AND ELECTRICAL ISOLATION

- A. Control switches shall comply with BS 4794.
- B. Switches shall be of the rotary type.
- C. All control switches shall be capable of being locked in the "off" position, unless stated otherwise.
- D. The contacts of all switches shall be strong and have a positive wiping action when operated.
- E. All control switches shall be provided with labels.
- F. All control panels shall be provided with a defeat proof door interlock isolator controlling the main incoming supply. The isolator shall be capable of making and breaking on full load without damage. Additionally the isolator shall have:-

- a) Auxiliary contacts to isolate any secondary supplies to the control panel.
- b) Manual override switch to enable the control system only to be energized whilst the incoming supplies are isolated.

All terminals of the isolator (incoming and outgoing) are to be shrouded to prevent accidental contact.

- G. The panel shall be constructed such that power (3 phase and single phase) equipment is located behind the interlocked isolator door.  
Control (extra low voltage) equipment shall be located behind the second or subsequent doors to ensure segregation from power equipment.  
The control system operating voltage shall not exceed 110V without prior authorization.  
All internal wiring shall be enclosed within wire way. Inter wiring that is required to pass between the power and control sections of the panel shall be enclosed within separate or segregated wire way to ensure electrical separation of the power and control systems.

#### 2.04 INDICATING LAMPS INSTRUMENTS AND FITTINGS

- A. Indicating lamps fitted into the face of switch and instrument cubicles or panels shall be adequately ventilated.
- B. A red warning light shall be provided to indicate "Main Supply On".
- C. The following must be included on all local HVAC control panels.
  - a) Run/trip lamps for all equipment
  - b) Panel live lamp
  - c) Rotary selector switches for duty/standby plant
  - d) Rotary switches for all single plant items
  - e) Ammeters for all motors.
  - f) Warning lamps
  - g) Gauges
  - h) Hours run meters
- D. Lamps shall be easily replaceable from the front of the panel by manual means without the use of extractors.
- E. The bezel of metal or other approved material holding the lamp glass shall be of an approved finish and easily removable from the body of the fitting so as to permit access to the lamp and lamp glass.
- F. The lamps shall be clear and shall fit into a standard form of lamp holder. The rated lamp voltage should be 10 percent in excess of the auxiliary supply voltage, whether ac or dc. For ac circuits, lamp units shall have an integral transformer providing a 6V supply to the lamp.
- G. The lamp glasses shall comply with BS 1376 and BS 4099 and shall be in standard colors, red, green, blue, white and amber. The color shall be in the glasses and not an applied coating and the different colored glasses shall not be interchangeable. Transparent synthetic materials may be used

instead of glass, provided such materials have fast colors and are completely suitable for use in tropical climates.

- H. All indicating 1 amp circuits shall have a "Test Lamp" switch.

## 2.05 SMALL WIRING

- A. All control panel wiring shall be carried out in a neat and systematic manner with cable supported clear of the panels and other surfaces at all points to obtain free circulation of air.
- B. In all cases, the sequences of the wiring terminals shall be such that the junction between multi-core cables and the terminals is affected without crossover. Except where terminals are approved by the Engineer for use with bare conductors, crimped connectors of approved type shall be used to terminate all small wiring. Insulating bushes shall be provided where necessary to prevent chafing of wiring.
- C. All panel wiring shall comply with the requirements of BS 6231 Type A or B, as appropriate. Conductors shall be copper and have a minimum cross section equivalent to 50/0.25 mm (2.5 mm<sup>2</sup>), 7/0.67 mm (2.5 mm<sup>2</sup>) or 1/1.78 mm (2.5 mm<sup>2</sup>). 7/0.67 mm shall only be employed for rigid connections which are not subject to movement or vibration during shipment, operation or maintenance. Flexible conductors equivalent to 30/0.25 mm (1.5 mm<sup>2</sup>) or smaller sizes generally shall only be employed with written approval.
- D. All wires shall be color coded and fitted with numbered ferrules of approved type at each termination. At points of inter-connection between wiring, where a change of numbering cannot be avoided, double ferrules shall be provided. Such points shall be clearly indicated on the wiring diagram.
- E. No wires shall be teed or jointed between terminal points.
- F. Electrical wiring and instruments shall be located so that leakage of oil or water cannot affect them.
- G. All metallic cases of instruments, control switches, relays etc., mounted on control panels or in cubicles, steel, or otherwise, shall be connected by means of copper conductors of not less than 2.5 sq.mm section to the nearest earth bar. These conductors may be bare or have insulation colored green/ yellow stripes.

## 2.06 LINKS AND FUSES

- A. Provision shall be made for isolating links to enable circuits to be isolated for maintenance and testing items of plant on the panels without affecting other circuits. These links shall be clearly labeled.
- B. All incoming supply terminals above 110V shall be shrouded.
- C. Fuses of the appropriate rating shall be fitted to each outgoing circuit to provide both overload and short-circuit protection.

- D. All fuses shall be of the HRC cartridge type and comply with BS 88. Carriers and bases for fuses and links shall be colored in accordance with local practice. The labeling of links and fuses shall be in accordance with the schematic diagrams. A complete set of spare fuses shall be provided in each panel.
- E. If miniature circuit breakers and/or mould case circuit breakers are utilized in any circuit, and "back-up protection is required to afford adequate discrimination between these circuit breakers and any other protective device in the circuit, HRC fuses shall be used as "fault current limiters".
- F. The rating and characteristics of fault current limiters shall be such as to limit the fault current of the ultimate circuit breaker in the circuit to the fault current capacity of the circuit breaker. Fault current limiters shall be such that they will not operate under overload as distinct from short circuit conditions. Fault current limiters shall be labeled as such.
- G. Equipment fixed inside cubicles shall be required to give easy access to wiring and terminals. Resistance boxes shall be located so that the adjustment screws are on a vertical accessible face. Stud terminals shall be provided for all resistance.

## 2.07 TERMINAL BOARDS

- A. Grouped terminal boards of adequate capacity and fully numbered, with permanent labels, shall be provided for all wires leading to equipment outside a panel. Terminal numbers or markings shall correspond with those used on related apparatus and wiring diagrams. Removable plates or other facility shall be provided for the entry of incoming cables, conduits, trunk, etc. with means for effective earth to the cubicle chassis. Provision shall be made for the earth of all non current-carrying metalwork. For main power terminals incorporated within a panel, soldered socket type terminals shall be provided.
- B. All terminal boards shall be mounted in accessible positions and when in enclosed cubicles, are preferably to be inclined towards the doors. Spacing of adjacent terminal boards shall be not less than 100 mm and the bottom of each board shall be not less than 200 mm above the incoming cable gland plate. Separate terminations shall be provided on each terminal strip for the cores of incoming and outgoing cables including all spare cores. Barriers shall be provided between wires of different voltages on the same or adjacent terminals.
- C. Terminals that are "live" from other power sources when the cubicle isolator is open shall be shrouded and fitted with a danger label.
- D. Screw or stud type terminals shall only be used with crimped ring type wiring terminations. Plain steel screws and studs shall be not less than size M6 but stainless steel and bronze down to size M5 may be used provided that the current carrying capacity is adequate. All studs shall be provided with nuts, washers and lock washers.

- E. Insertion type terminals shall generally be employed for small circuit wiring whereby the stranded conductor or crimped termination is clamped between plates by a screw having a suitable locking device. Terminal entries shall be shrouded such that no current carrying metal is exposed. Tapped holes shall have not less than three full threads.
- F. Terminal assemblies are preferably to be of the unit form suitable for mounting collectively on a standard assembly rail, secured from the front and giving the required number of ways plus 10% spare.
- G. All connections shall be made at the front of the terminal boards and no live metal is to be exposed at the back.
- H. No more than two leads shall be taken to any common pair of terminals, unless specially approved by the Engineer.

#### 2.08 NUMBER PLATES AND LABELS

- A. Number plates and labels shall be provided and fixed to all items, including push buttons, operating levers, indicating lamps, etc. to show the purpose and function of each item and to ensure its safe and satisfactory operation. The type, size, inscription and position of labels shall be to the Engineer's approval.
- B. Adhesive die stamped or printed tapes shall not be permitted for labeling equipment.

#### 2.09 EARTHING

- A. All control panels shall be provided with a continuous copper earth bar having a sectional area of not less than  $75 \text{ mm}^2$  placed at a convenient position near the bottom of the panel. The area of the earth bar shall not be less than half the cross-sectional area of the phase bus bars and not less than the area of the incoming neutral conductor.
- B. All metal cases or earth terminals of the various instruments, relays, etc. on the panels shall be connected to this earth bar by copper connections of not less than  $2.5 \text{ mm}^2$ .
- C. All metal parts other than those forming part of any electrical circuit shall be earth in an approved manner and all earth terminals shall be of adequate dimensions.

#### 2.10 ANTI CONDENSATION HEATERS

- A. Anti-condensation heaters shall be provided in all control panels, switchboards and motors to prevent internal condensation due to atmospheric or load variations. The heaters shall be thermostatically controlled and of sufficient capacity to maintain  $5^{\circ}\text{C}$  temperature differential with the surrounding atmosphere. The heater circuit shall include an isolating switch and indicator lamp to show "Heater Circuit On". The heaters may be energized from a 127V or 220V, 60Hz supply, as applicable.

- B. When maintaining equipment fitted with heaters it will be necessary to switch off both the main isolating switch and the switch for the heater. A warning notice of this danger shall be fitted near the terminal box of every remote heater and at every panel fitted with heaters.
- C. All equipment fitted with heaters shall be such that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the equipment is in operation and as such must be provided with suitable ventilation.
- D. All such equipment, whether fitted with a heater device or not, shall be provided with suitable drainage and be free from pockets in which moisture can collect.

## 2.11 MOTOR STARTERS

- A. Motor starter enclosures shall be at least to the standards specified for LV switch gear.
- B. Motor starters shall be of the following types and suitably rated for each application:-

MANUAL	= UNDER 0.34 K W MOTORS
DIRECT ON LINE	= UP TO 5 K W MOTORS
STAR DELTA	= ABOVE 5 K W MOTORS

AUTO TRANSFORMER WHEN SUPPLIED BY THE MOTOR MANUFACTURER.

- C. Auto-transformer type motor starters when supplied shall each comprise:
  - 1. Triple pole mechanically interlocked isolator with padlocking facilities in the 'off' position.
  - 2. H.R.C fuses in the power circuit.
  - 3. Adequately rated auto-transformer.
  - 4. Contractors rated at 15 starts per hour suitable for pushbutton operation, with magnetic blow outs and arc chutes on each pole, hard drawn copper main contacts of the removable type, and continuously rated operating coils.
  - 5. Under voltage release.
  - 6. Overload relays of the adjustable electro -magnetic type with oil dash pot time lags and reset facilities, calibrating plates shall be scaled in amperes or equivalent thermal compensated type.
  - 7. Control circuit fuses of the cartridge type.
  - 8. Single phase preventative device.
  - 9. Ammeter of the moving iron type.

10. Pilot lamp to indicate "motor-running".
  11. Removable neutral link of heavy section copper.
- D. The Star/Delta motor starters shall each comprise:
1. Triple pole mechanically interlocked isolator with padlocking facilities in the "off" position.
  2. H.R.C. fuses in the power circuit.
  3. Contractors rated at 15 starts per hour suitable for pushbutton operation, with magnetic blow-outs and arc chutes on each pole, hard drawn copper main contacts of the removable type and continuously rated operating coils.
  4. Under voltage release.
  5. Overload relay of the adjustable thermal type.
  6. Control circuit fuses of the cartridge type.
  7. Motor protection relay (unbalance and single phasing)
  8. Ammeter of the moving iron type.
  9. Pilot lamp to indicate "motor running".
  10. Removable neutral link of heavy section copper.
- E. Direct-on-line type motor starters shall each comprise:
1. Triple pole mechanically interlocked isolator with padlocking facilities in the "off" position.
  2. H.R.C. fuses in the power circuit.
  3. Contractor rated at 15 starts per hour suitable for pushbutton operation, with magnetic blow outs and arc chutes on each pole, hard drawn copper main contacts of the removable type, and continuously rated operating coils.
  4. Under voltage release.
  5. Overload relays of the adjustable thermal type.
  6. Control circuit fuses of the cartridge type.
  7. Motor protection relay (unbalance and single phasing).
  8. Ammeter of the moving iron type for motors in excess of 5 K W.
  9. Pilot lamp to indicate "motor running".



10. Removable neutral link of heavy section copper.

- F. For starters incorporating reduced voltage starting the change over shall be automatic. A lock-off switch shall be provided and located locally to each motor and connected into the starter control circuit so that the starter cannot be operated when the switch is in the "off" position.
- G. "Hand/off/Auto" switches shall be provided for all starters.

## 2.12 BELT DRIVES

- A. Centrifugal fans shall be driven by electric motors through V-belt drives unless specified otherwise. V-belt drives shall conform to BS 1440 and shall consist of endless V-belts capable of transmitting a power at least 75% in excess of the rated BHP of the motor. Not less than two belts per drive shall be used. Guards shall be provided for all V-Belt drives.

## 2.13 ELECTRIC MOTORS

- A. Motors shall be of the totally enclosed fan cooled (TEFC) design to BS 5000 and shall be fitted with axially locating type bearings and/or heavy duty thrust bearings at the non-driving end and roller type bearings at the drive end. All bearings shall be of adequate proportions and design suitable for the particular application.
- B. Motors shall be of the squirrel cage induction type. Motors shall be suitably finished to afford protection against any corrosive liquid or fumes.
- C. All motors shall be built of high grade components and materials and shall operate without undue vibration and with the minimum of noise.
- D. The insulation shall be Class 'F' to BS 2757 but the temperature rise shall be limited to 80°C measured by the resistance method, at an ambient temperature of 50°C. The motors shall be suitable in all respects for their operational duties taking into account such an ambient temperature within the building.
- E. All motors rated at 11 K W and above shall be fitted with thermostatic control elements actuating directly on the control circuit of the motor and disconnecting it from the supply in the event of a temperature rise exceeding the acceptable limits for its insulation class.
- F. The motors shall be fully tropicalised, and shall be fitted with anti-condensation heaters.
- G. The motors shall be capable of providing 10% in excess of the specified volume flow of their respective fans under all operating conditions. Selections must assume that resistance increases by the square law and absorbed power by the cube law.
- H. Motors are required to operate from a 220V, 3 phase or 127V single phase, 60Hz supply as applicable, and shall be continuously rated.

- I. The motors shall be capable of satisfactory operation with a voltage variation of 10% above or below the supply voltage. They shall also be capable of operating satisfactorily with a frequency variation of 2.5% above or below the normal frequency of 50 or 60 Hz, as applicable.
  - 1. No motor shall run faster than 1500 rpm. unless otherwise approved by the Engineer.
  - 2. Motors shall be designed to operate at a power factor not less than 0.85.
  - 3. Motors shall be suitable for the starting methods specified.
  - 4. Motor starting currents shall not exceed the following values:-
    - Auto-transformer starting - 1.5 times the full load current.
    - Star/Delta starting - 3.5 times the full load current.
    - Direct-on-line starting - 6 times the full load current.
- J. The connections of the motors shall be brought out to easily accessible terminals of the stud type, totally enclosed. They shall be substantially designed and thoroughly insulated from the frame. Cambric or equal insulation shall be used for the connections from the windings to the terminals. Terminal boxes shall be fitted with glands to accept the specified type of cable.
- K. The cable glands shall be downwards pointing at such an angle as is necessary to clear the motor base plate and plinth.
- L. Motors shall have visible nameplates indicating:-
  - Motor power--- K W
  - Voltage
  - Phase
  - Cycles
  - RPM
  - Full load amps,
  - Locked Rotar amps
  - Frame size
  - manufacturers name and model
  - Power factor

### **PART 3: EXECUTION**

#### **3.01 INSTALLATION**

- A. Installation of all the equipment, plant and material included in this Section of the Specification shall additionally be in accordance with the requirements of Division 16.

**End of Section**

## **SECTION 15190**

### **MECHANICAL IDENTIFICATION**

#### **PART 1: GENERAL**

##### **1.01 SCOPE OF SECTION**

- A. This Technical Specification establishes the type and quality of materials and the standard of workmanship to be used in the supply and installation of Mechanical Identification systems.

##### **1.02 WORK INCLUDED**

- A. The work includes the provision of all labour, materials and the performance of all operations in connection with the supply and installation of Mechanical Identification systems as specified herein and where referred to on the Drawings.
- B. Coordination: The Contractor shall be responsible for the full coordination of the work of all trades.

##### **1.03 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in the manufacture of Mechanical Identification systems whose products have been in satisfactory use for a similar application and not less than 10 years.
- B. Installer: Firms regularly engaged and qualified in the installation of Mechanical Identification systems with at least 5 years successful installation experiences on projects of a similar nature.

##### **1.04 APPLICABLE CODES AND STANDARDS**

- A. Mechanical Identification systems and all associated materials and workmanship shall comply fully with the latest relevant British Standards in all respects.

The following are the most commonly used and relevant British Standards associated with pipe work products and associated materials. However, the Contractor shall ensure that all applicable British Standards are complied with whether listed here or not.

BS 1710 - Specification for Identification of Pipelines and Services.

BS 4800 - Specification for Paint Colors for Building Purposes.

##### **1.05 SUBMITTALS**

- A. Drawings refer to 15010
- B. Products: Full manufacturers color data for each product.

- C. Samples - Full - size color sample of pipe work and ductwork identification.

#### 1.06 OPERATION AND MAINTENANCE DATA

- A. Comply with 15010
- B. Mechanical identification system shall correspond totally to "As Built" data.

#### 1.07 WARRANTY

- A. Provide 12 months warranty in accordance with contract conditions.

### PART 2: PRODUCTS

#### 2.01 PLANT AND PIPEWORK IDENTIFICATION

- A. All pipe work shall be color coded in accordance with BS 1710 as detailed in Table 1.

TABLE I  
IDENTIFICATION OF PIPE LINES

Pipe contents	Color code indication (approx 100mm)	Basic color (approx 150mm)
Drinking Water	To BS 1710	Blue
Cold water down service	To BS 1710	Green
Hot water supply	To BS 1710	Green
Drainage	To BS 1710	Black

- B. Identification to pipe work shall consist of 100mm PVC adhesive bands over the basic color and shall include flow direction arrows together with the abbreviation of the service name. All coding requirements are to be agreed with the Engineer.
- C. Code indication for safety conditions shall be as follows:-

Safety Color	BS color reference BS 4800
Red	04 E 53
Yellow	08 E 51
Auxiliary Blue	18 E 53

Safety color references are as follows:-

1. Red for fighting equipment.
2. Yellow with black diagonal stripes for warning of danger.
3. Yellow with trefoil symbol for organizing radiation (as defined in BS 3510).
4. Auxiliary blue in connection with green basic colors, to denote pipes carrying fresh water, either potable or non-potable.

Safety color references shall be applied using 100mm wide sections of PVC adhesive band in all permanent locations, to be agreed with the Engineer.

Color references shall include notation as follows:-

1. FIRE
2. DANGER
3. RADIATION
4. POTABLE OR NON-POTABLE

In the case of fire service, all equipment, i.e. valves, suction tanks, etc., shall also be painted red.

- D. Un insulated pipe work shall be painted with one coat of undercoat and one coat of gloss finish to the relevant BS color.
- E. Valve identification shall be by means of 40mm diameter battered discs of white/black/white composition. Letters and figures of 8mm minimum height, identifying the service and valve number shall be engraved into the material. A 3mm diameter hole shall be drilled through the disc for the purpose of securing the disc to the valve.
- F. Plant identification shall be by means of traffalyte labels of white/black/white composition. Letters and figures of 8mm minimum height identifying the plant shall be of a size to be agreed with the Engineer. A minimum of two 3mm diameter holes shall be drilled through the label to the plant.
- G. All plants shall carry the manufacturer's identification plate which shall incorporate all details of electrical and mechanical duties.

## 2.02 DUCTWORK IDENTIFICATION

- A. Ductwork shall be color coded in accordance with HVAC Specification DW142 to the colors indicated in Table 2. For conditioned air, identification shall comprise either of two symbols (one red, one blue) or a single symbol colored, part red, part blue.

TABLE 2  
DUCT IDENTIFICATION COLOURS

Type	Color	BS 4800
Conditioned Air	Red and Blue	04353 / 18E53
Warm Air	Yellow	10E53
Fresh Air	Green	14E53
Exhaust / extract recirculated air	Grey	AA009
Foul Air	Brown	06C39

- B. Direction of flow shall be by PVC self adhesive equilateral triangles with one apex pointing in the direction of flow. The minimum length of side of the triangle shall be 150mm.

### PART 3: EXECUTION

#### 3.01 STORAGE

- A. All identification materials shall be stored within a well lit container or purpose made compartment racks or shelving. The material shall be adequately covered to prevent damage and ingress of dirt.
- B. Refer to 01600

#### 3.02 GENERAL

- A. Identification shall be placed where it can be easily seen and at positions where identification will be required. To ensure that the symbols are seen, the following points shall be considered:-
1. The symbols shall be on the surface which faces the positions of normal access to the completed installation.
  2. The symbols shall not be hidden from view by structural members, other ducts, plant or other services distribution systems.
  3. The symbols shall be placed where there is adequate natural or artificial light.
- B. Symbols shall occur frequently enough to avoid the need for ducts and pipes to be traced back. Symbols should be placed at any service and access points to the distribution system.
- C. Identification shall be applied to pipe work and ductwork at every entry and exit point to a room but in no case of intervals of less than 12m.

### 3.03 PLANT AND PIPEWORK IDENTIFICATION

- A. In addition to the color bands, all pipe work in plant rooms and service areas, whether insulated or not, shall be legibly marked with black or white letters to indicate the type of service and the direction of flow. Services shall be identified as follows:

Chilled Water:		CHW
Refrigerant:		RFG
Cold Water:	Raw	RW
	Sweet	SW
Domestic Hot Water:	Raw	RW
	Sweet	SW
Fire Main:		FM
Gas:		GAS

- B. The basic identification color shall be applied using a PVC adhesive band either applied to pipe work insulation or pipe when u n n insulate. Identification shall be placed at all junctions, at both sides of valves, services appliances, bulkheads, wall penetrations and at any other places where identification is necessary or advantageous.
- C. Where pipes are run in pairs, the letters F and R shall be added to indicate flow and return respectively.

### 3.04 DUCTWORK IDENTIFICATION

- A. All ductwork in plant rooms and services areas, whether insulated or not, shall be legibly marked with black or white letters to indicated the type of service and the direction of flow. Services shall be identified as follows:-

Supply Air	-	S
Return Air	-	R
Fresh Air	-	F
Exhaust	-	E

- B. Ductwork identification shall be applied to ductwork whether insulated or not, at all branches, plant connections, wall penetrations and at any other place where identification is necessary or advantageous.

**End of Section**

**SECTION 15290**

**HEATING, AIR-CONDITIONING AND VENTILATION (H V A C)**

**PART 1: GENERAL**

**1.01 WORK INCLUDED**

- A. Internal environmental designs conditions and external ambient conditions.
- B. System Design Criteria

**1.02 REFERENCE STANDARDS**

- A. The air conditioning system has been designed in accordance with the following standards:

ASHRAE      American Society of Heating Refrigeration and Air conditioning Engineers.

SMACNA      Sheet Metal and Air Conditioning Contractor's National Association Inc.

UMC          Uniform Mechanical Code.

- B. All mechanical equipment used in the air conditioning system shall be in accordance with the following codes and standards.

A.R.I          Air Conditioning and Refrigeration Institute

ANSI          American National Standards Institute.

ASHRAE      American Society of Heating Refrigerating and Air Conditioning Engineers

ASME          American Society of Mechanical Engineers.

UL            Underwriters Laboratories.

**1.03 SCOPE OF WORKS**

- A. The work covered under this section shall include all the supply, installation, testing, commissioning, maintenance and delivering in good operating conditions of complete heating, air conditioning and ventilation systems as described in these specifications and shown on drawings and bill of quantities.
- B. The Contractor shall provide all the necessary components and accessories as well as materials, manpower, equipment, tools, scaffolding, painting, testing facilities, supervision and overhead, etc., at his own expense to execute a complete operable system.
- C. The Contractor shall obtain the necessary information and instruction for the execution of the works only from the Engineer and not from third parties.



- D. The Contractor shall program his work such that it will not interfere with other trades and to suit site requirements.
- E. Schedules and specifications including but not limited to the following:
  - 1. To check the design and to undertake the responsibility of giving the design conditions in the occupied areas.
  - 2. To supply, install and commission the air-conditioning plant to the satisfaction of the Engineer.
  - 3. To connect air handling units/fan coil units drains to the nearest drain point.
  - 4. To provide power supply to the individual air handling unit/s, fan coil units, chillers and pumps.
- F. Electrical power supply terminating in an isolating switch located within 3 meters of the unit shall be provided.

1.04 DESCRIPTION OF THE WORKS

- A. The HVAC works shall consists of ventilation, cooling heating system.  
  
All as per specifications, drawings and bill of quantities.
- B. All Toilets and Kitchens should be ventilated with independent extract fans, capacities and type as shown on drawings.
- C. Fire dampers according to Civil defense requirements.

1.05 DESIGN CONDITIONS

- A. General: The installation is based on the following design conditions, capacities and dimensions given in the specifications and drawings will be considered as the minimum to be accepted and it is the responsibility of the contractor to select all unspecified equipment to attain the required design and guarantee conditions.
- B. External Conditions
  - 1. Dry Bulb Temperature (summer) 35C°
  - 2. Wet Bulb Temperature (summer) 22C°
  - 3. Dry Bulb Temperature (winter) 0C°

C. Internal Environmental Conditions

No.	Description	Summer	Relative Humidity	Ventilation
1.	Guest room, Suites	22°C	50% RH	25 I/s/person
2.	Restaurant & coffee Shop	22°C	50% RH	7.5 I/s/person
3.	Offices, shops, reception, staff lounge	22°C	50% RH	7.5 I/s/person
4.	Kitchen	28.00°C	50% RH	7.5 I/s/person
5.	Meeting	24°C	50% RH	7.5 I/s/person
6.	Auditorium (Cinemas)	24°C	50% RH	7.5 I/s/person
7.	Dining	24°C	50% RH	7.5 I/s/person

**PART 2: COMMISSIONING**

5.1 GENERAL

- A. The Contractor shall allow for all water and air distribution services to be balanced and commissioned in accordance with the relevant commissioning codes published by the Chartered Institution of the Building Services Engineers.
- B. The balancing and commissioning of all air-conditioning circuits shall be carried out by the contractor.
- C. The Contractor shall supply and install on all air distribution systems all test points required in order to commission the systems completely. Testing and commissioning results shall be submitted to the Engineer for approval by the Engineer.
- D. The Contractor will be particularly required to show, in distribution systems, that the correct design static pressure will be available at the most remote diffusers.

**End of Section**

**SECTION 15430**

**PLUMBING SPECIALTIES**

**PART 1: GENERAL**

**1.01 SCOPE OF SECTION**

- A. This technical specification establishes the type and quality of materials, and the standard of workmanship to be used in the supply and installation of piping specialties.

**1.02 WORK INCLUDED**

- A. The work includes the provision of all labour, materials and the performance of all operations in connection with the supply and installation of piping specialties as specified herein and where referred to on the Drawings.
- B. Coordination: The Contractor shall be responsible for the full coordination of the work of all trades.

**1.03 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in the manufacturer of piping specialties whose products have been in satisfactory use for a similar application for not less than 10 years.
- B. Installer: Firms regularly engaged and qualified in the installation of piping specialties with at least 5 years successful installation experience on projects of a similar nature.

**1.04 APPLICABLE CODES AND STANDARDS**

- A. The piping specialties and all associated materials shall comply fully with the latest relevant British Standards in all respects.
- B. The following are the most commonly used and relevant British Standards associated with piping specialties and associated materials. However the Contractor shall ensure that all applicable British Standards are complied with whether listed here or not.

BS. 21 : Specification for Pipe Threads for Tubes and Fittings where Pressure Tight Joints are made on the Threads.

BS 4504 Part 1 : Specification for Ferrous Flanges and Bolting for Pipes, Valves and Fittings.

#### 1.05 SUBMITTALS

- A. Drawings - refer to Section 15010
- B. Products - submit full manufacturers data for every item.

#### 1.06 OPERATION AND MAINTENANCE DATA

- A. Comply with Section 15010.

#### 1.07 WARRANTY

- A. Provide 12 month warranty in accordance with contract conditions.

### **PART 2: PRODUCTS**

#### 2.01 PIPE SLEEVES

- A. Pipework sleeves shall be of the same materials as the pipework.
- B. The inside diameter of sleeves shall be such as to allow an 8 mm minimum gap between the finished surface of an insulated pipe and the internal surface of the sleeve. The length of the sleeve shall be limited to prevent the sleeve protruding beyond the finished building surface. Mastic of an approved type shall be inserted between pipe and sleeve as necessary.

#### 2.02 FLOOR, CEILING AND WALL COVER PLATES

- A. Floor, ceiling and wall plates shall be plastic and selected to suit the pipework size and material with which they are to be used.

#### 2.03 PIPE CLEANOUTS

- A. Shall be the same size as the pipe except that cleanout plugs larger than 4 inches (100 mm) will not be required. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs of the same size as the pipe up to and including 4 inches (100 mm). Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches (45 cm) of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium-plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs, and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall

not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron (or plastic).

#### 2.04 FLASHINGS

- A. A sheet-lead flashing shield shall be provided for drains and pipe sleeves with integral clamping devices that penetrate a membrane. Flashing shield shall be made from sheet lead not lighter than 4 pounds (20 kg/m<sup>2</sup>), and extend not less than 8 inches (20 cm) from the drain or sleeve in all direction. Flashing shall be inserted into the clamping device and made watertight. Lean flashing shields, and roof flanges of lead or copper flashing with integral flange, shall be set over membrane in a solid coat of a bituminous cement and strip-flashed as specified by the manufacturer. Pipes passing through pitches roofs shall be flashed using lead or copper flashing with an adjustable integral flange of adequate size to extend not less than 8 inches (20 cm) from the pipe in all directions and lapped into the roofing to provide a watertight seal.

#### 2.05 FLOOR AND SHOWER DRAINS

- A. Shall generally consist of body, integral seepage pan and adjustable perforated or slotted strainer consisting of grate and threaded collar. Drains shall be of double drainage pattern suitable for embedding in the floor construction. The seepage pan shall have weep holes or channels which will provide drainage from the pan to the drainpipe. The strainer shall be adjustable to varying floor thickness. A suitable clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing of waterproofing membrane shall be provided when required. Cast-iron floor drains shall be installed in all locations except where metallic waterproofing membrane is installed. Where metallic shower pan membrane is installed, polyethylene drain with corrosion resistant screws for securing the clamping device shall be provided. Cast-iron floor drains shall have a heavy cast-iron body and seepage pan and a chromium-plated bronze, nickel bronze, or nickel brass strainer. In lieu of a caulked joint between the drain outlet and waste pipe, a neoprene rubber gasket may be installed provided that the drain is specifically designed for the rubber-gasket mechanical joint. Certified independent laboratory tests indicating that the rubber gasket compression joint will not leak when tested with not less than 5 feet (1.5 meters) head of water for not less than one hour shall be provided. The rubber gasket joint shall be installed as recommended by the drain manufacturer. Drains shall be provided with separate cast iron "P" traps unless otherwise indicated. Drains shall have circular body, seepage pan, and strainer, unless otherwise indicated. Cast-iron floor and shower drains shall be as manufactured by Frost Ltd. Wade International or equal & approved.

#### 2.06 ROOF AND BALCONY DRAINS

Roof and balcony drains shall be suitable for the type of roof finish they are to be installed into. They shall have a cast iron body with membrane flange and gravel stop and be fitted with a domical or flat grating as detailed on the drawings.

**End of Section**