

## **SECTION V (3)**

### **TECHNICAL SPECIFICATIONS MECHANICAL SERVICES**

#### **Air Cooled Cassette type air conditioner shall consist of units:**

Evaporator Unit (Indoor Unit)

Condensing Unit (Outdoor Unit)

Refrigerant piping:

The evaporator unit comprises evaporator coil, evaporator fan assembly installed together in a single sheet metal casing and with inter-connecting refrigerant piping, refrigerant controls, safety devices etc, the unit shall be complete with electronic centre & control pad incorporating the thermostat & speed control

The condensing unit comprises compressor- motor unit, condenser coil, condenser fan, fan control, casing supporting stand etc.

Both the evaporator unit and the condensing units shall be factory manufactured.

The panel for casing shall be machine pressed and folded. The entire casing shall be factory manufactured; it shall be of robust construction and shall present a neat appearance. The renderers' shall also bring out in their tender clearly the manufacturing techniques, finishes employed to meet the service conditions involved, etc.

The units supplied with control panel incorporating switch fuse units, contractors, over load relays, single-phase preventers, push buttons, etc., compressor and condenser fans.

#### **CEILING MOUNTED CASSETTE TYPE UNIT (MULTI FLOW TYPE)**

The unit shall be ceiling mounted type. The unit shall include pre-filter, fan section and DX-coil section. The housing of the unit shall be powder coated galvanized steel. The body shall be light in weight and shall be able to suspend from four corners.

Fixing the indoor unit with M.S angle supports and with all accessories for indoor unit to above false ceiling, and the supports should be with 10mm down rods with all accessories for all units.

Unit shall have an external attractive panel for supply and return air. Unit shall have four way supply air grilles on sides and return air grille in center.

Each unit shall have high lift drain pump, fresh air intake provision (if specified)

Low gas detection system and very low operating sound.

All the indoor units regardless of their difference in capacity should have **same decorative panel size** for harmonious aesthetic point of view. It should have provision of connecting branch ducts.

**CONDENSING UNIT:**

The unit shall be factory manufactory manufactured and shall be suitable for out door unit installation. It shall comprise compressor unit, condenser coil, fan motor, drive casing, supporting stands etc,.

The compressor unit shall consist of direct driven Scroll compressor with compressor and motor housed in a common shell; it shall be either hermitic or semi-hermitic type. In case the compressor motor is semi-hermitic type, the end plate shall be bolted to the shell.

The compressor shall be suitable for use with R-22 refrigerant.

The Contractors are required to narrate in detailed all protective devices, controls and such other features provided for the compressor motor units offered by them, like high temperature protection and over current protection, high and low pressure cut-outs. Low oil pressure protection etc,

The condensing unit shall be installed on a pedestal on the terrace of the building as shown in the drawing. The fan shall be propeller type direct-driven by an electrical motor. The unit shall be mounted in such a manner as to minimize transmission of vibration to the structure using vibration isolation pads, if necessary to secure satisfaction results.

The casing and structure for the condensing unit shall be of robust construction. The panels shall be of heavy gauge hot dip galvanized steel and they shall be machine pressed and folded. All joints shall be folded joints. The supporting structure shall use only hot dip galvanized sections, i.e. angles channels etc,.

The Contractors shall bring out in any case clearly, (and in detail) the details of construction of the equipment offered by them, highlighting in particular, the thickness and kind of materials used, manufacturing techniques employed, finish provided for whether protection etc,.

Air-cooled condensing unit shall incorporate necessary number of propeller fans of adequate size to obtain the required airflow rate under operating conditions. The fan shall be balanced both statically and dynamically. The fan motor shall be of TEFC squirrel cage construction.

The fan motor sets shall be complete with protection guards.

The condenser coil shall be made of copper tubes and aluminium fans. The coils shall be sized so as to optimize performance with respect to air flow rate, pressure drop, condensing temperature, power consumption etc., thus the values furnish for the parameters of the coil in section III, schedule of equipment shall be regarded as suggested values rather than specified values.

The coils shall be pressure tested for not less than those indicated below.

Factory test	-	kg / sqcm (psi):	30(440)
Field test	-	kg / sqcm (psi):	30(440)

The coil shall be so positioned with respect to the floor level that, dust pick-up by entering air is Minimized.

As noted in clause the condensing units have to be installed out door on suitable pedestal or any other appropriate supporting arrangements. The owner shall provide masonry work, if any require for supporting units, but the tender's shall furnish all necessary information including drawings. Further any supports made of MS structural section if required should designed, supplied and installed by the air conditioning contractor himself. He shall show the details of such supports in appropriate drawings and shall obtain the approval of the owners / consultants before providing them. The charges for such works shall be including in the price quoted by the Contractors: in any case, no extra sum will be payable on that account.

#### **29.4 REFRIGERANT PIPING:**

The specification that following cover the requirement of piping.

Only copper piping / tubing of refrigerant quality shall be used. Soft copper tubing can be employed for sizes up to and including 22 mm (7/8') OD and 9.5 mm (3/8") OD shall have a minimum nominal thickness of 0.76mm (0.030") and 0.81 mm (0.032 ') respectively.

All piping / tubing shall be new fresh, clean and dry.

Fitting like bends, tees, sockets, etc, Shall be of copper or forged brass. Flare type fittings may used for copper tubing while hard drawn tubes up to and including 15mm size may be bent to from 90 Deg bends with throat radius beings not less than 3 times the tube diameter. For bigger sizes, bends should be used as noted already.

Valves for pipe sizes up to 15mm OD shall be all brass, hand well operated, Diaphragm pack less type, globe or angle valves, for sizes over 15mm OD valves shall be of bronze, globe or angle type, packed back sealed.

Liquid line strainers shall be made of brass shall incorporate bronze screen and permanent management. Strainers shall be provided with shut valves on either side.

Thermostatic expansion valve shall be complete with remote bulb and external equalizer and external super head adjustment. Solenoid valves shall have manual opening system to serve as by – pass in case of failure of solenoid valve. Liquid moisture indicator shall be provided in the liquid line.

Flare type joints may be used for copper tubing while for a hard drawn pipe only brazed joints shall be used. For small lines also such as equalizer lines, expansion valves connections, gauge connections, connecting pressure switches etc., flared fittings and joints shall be used.

Piping shall be insulated sufficient number of bends and turns to ensure sufficient fleetly and minimize vibration. Supports, clamps, saddles, hangers etc., of adequate strength should be provided as required to support the piping adequately and minimize the vibration.

Necessary isolating materials like rubber, felt, spring, etc, Should also be provided as an additional measure to limit transmission of noise and vibration.

Refrigerant piping shall be carried out giving due consideration to the need to ensure oil return and avoid liquid slope-over into the compressor, according, the piping shall include necessary loops, traps, slopes, etc., to achieve these objects.

While installing the piping adequate clearance between pipes should be provided for insulation is called for.

On completing the erection, the system shall be pressure tested with dry nitrogen or carbon de-oxide. The test pressure shall be a sunder for R-134A.

High pressure side – kg / sq.cm (psi) : 25 (365)

Low pressure side - kg / sq.cm (psi) : 110 (150)

The system shall hold the pressure for a minimum period of 24 hours without reverting leaks.

After the leak test has been complete successfully, the pressure due to Nitrogen or carbon – de – oxide in the system.

The system shall than be dehydrated by drawings a vacuum. The vacuum achieved shall be achieve shall be at least 24 hours after the vacuum pump has been shut off.

### **29.5 Insulation for refrigerant piping:**

All suction lines (insulated both indoors & out doors) and liquid lines laid outdoors shall be applied over a coat of bituminous primer applied on the pipes surface.

### **29.6 Condensate drain piping:**

PVC pipes (medium) shall be used for condensate drain piping.

Piping shall be supported suitably on walls / floors and all charges involved there to shall be applied in the prices quoted by the Contractors. While installing the piping the contractor shall keep in mind the requirement that it should not foul with the structural or architectural

features of the building. Further, all piping must be insulated in a neat and workman – like – manner.

**APPROVED MAKES FOR HVAC SYSTEM**

Cassette Unit	LG, Blue Star, Carrier, Voltas, Daikin
Hi – Wall Splits	LG, Blue Star, Carrier, Voltas, Daikin

**TECHNICAL SPECIFICATION FOR FIRE FIGHTING SYSTEM**

**GENERAL:**

All materials shall be of the best-approved quality obtainable and unless otherwise specified they shall confirm to the respective Bureau of Indian Standard specifications.

Samples of all materials shall be approved before placing order and the approved samples shall be deposited with the Employer.

In case of non – availability of materials in metric size, the nearest size in FPS units shall be provided with prior approval of the Employer / Consultants for which neither extra will be paid nor any rebate shall be recovered.

If directed / found necessary, materials shall be tested in any testing laboratory selected by the Employer and the Contractor shall produce the test results to the Consultant for his scrutiny and approval. The entire charges for original as well as repeated tests shall be borne by the Contractor. If required, the Contractor shall arrange to test portion of work at his own cost in order to prove the soundness of the same, to the Employer/Consultant or their representatives. The work or portion of work if found to be not satisfactory in the opinion of the Employer / Consultant or their representatives. Contractor shall pull down and re – do the same at his own cost. All defective materials shall be removed from the site immediately as ordered.

It shall be obligatory for the contractor to furnish certificates, if so demanded by the Employer / Consultant from manufacturer or the material supplier, that the work has been carried out by using their material and installed / fixed as per their recommendations.

**SCOPE OF WORK:**

Following are the different items of work, which have to be supplied, erected, tested and commissioned. The system to conform requirements as per local statutory bodies.

1. In general the work to be performed under this contract shall comprise of the following: -
  - a. All incidental jobs connected with Industrial piping work such as excavation in trenches and back filling, cutting chases in concrete and brick work and making good cutting/drilling holes through walls, floors and grouting for fixing of supports etc. complete.

- b. Co-operation with other crafts in putting the installation place. Any work done without regard or consultation with other trades shall be removed by the Contractor without additional cost to the Owner, to permit the proper installation of all other works as desired by the Architects.
- c. Repair all damages done to the premises as a result of this installation and remove of all debris left by those engaged for this installation to the satisfaction of the Owner.
- d. Cleaning of all the completed piping work, testing painting the vessels, tanks, equipments and piping with a coat of primer, two coats of approved enamel paint as per specifications/code requirements and identification of different utility pipe lines by colour band, markers for indicating direction of flow, stenciling etc., and showing the satisfactory performance of all the fittings at the time of handing over to the Owner.
- e. It is the responsibility of the contractor to take care of all the fixtures fitted until the time of handing over to the Owners.

**DRAWINGS:**

The drawings enclosed herewith are for the general guidance to the tenderers. The Contractor shall upon the award of the work, furnish detailed drawing necessary to carryout the work at site within 7 days or as directed by client or turnkey contractor. These shall be submitted for approval to the Architect/Consultants. The work shall be commenced only after the approval of drawing by the Architects/ Consultants/ Owners

**INSPECTION AND APPROVAL:**

The contractor shall arrange all necessary inspection by the Local authority. He shall also arrange for all the test, obtain and deliver to the Owner any approval required as per the local by-laws. It is the sole responsibility of the contractor to prepare & submit the drawings.

Technical Data:

The tenderers shall furnish data of their equipments as per the proforma under 'Technical Data'. The tenders without technical data is liable to be rejected.

**TECHNICAL SPECIFICATIONS**

**REGULATIONS AND STANDARDS:**

The installation shall conform in all respects to the following broad list of standards in general and in particular the materials used shall bear prevailing ISI marking:

IS: 901-1975 : Specification for coupling, double male and double female, instantaneous pattern for fire fighting.

IS: 902-1974 : Specifications for suction hose coupling for fighting purposes.

MSS SP 67 : Butterfly Valves.

API 609 : Butterfly valves, lug type and wafer type.

IS: 1239 : Mild steel tube, tubular and other wrought steel fittings.

IS: 8423-1977 : Controlled per collating hose for fire fighting.

IS: 5290-1983 : Landing valves.

IS: 3844-1966 : Code of practice for installation for internal fire hydrants in multistory buildings.

IS: 2871-1983 : Branch pipe, universal for fire fighting purposes.

IS: 884-1969 : First Aid hose reel for fire fighting.

IS: 5132-1968 : Hose reel tubing for fire protection system.

BS: 5155 : Cast iron and carbon steel butterfly valves for general purpose

IS: 8090-1992 : Specification for coupling branch pipe, nozzle used in hose reel tubing for fire fighting.

IS: 3582-1984 : Specification for basket strainer for fire fighting purpose.

IS: 908-1975 : Specification for fire hydrant, stand post type.

Latest edition of Fire Protection Manual of the Tariff Advisory Committee.

11.2 Data:

a) Type : Automatic Fire Hydrant system.

b) No. of Fire Pumps : Jockey Pump, Electrical Motor Driven Pump : & Diesel Engine (Standby).

c) Static Water Storage : Based on building in ltrs in 1 compartment i.e., ---125---cum in One tank the water is stored in a above ground storage tank i.e. The suction is of positive suction to all the pumps. Through the 200 dia puddle flange from storage Tank suction is taken to pump. The suction to Pump is controlled by an sluice valve.

STORAGE CAPACITY OF FIRE WATER TANKS @ GROUND FLOOR

TERRACE TANK : 10 cum

### **FIRE HYDRANT PIPES:**

All fire hydrant pipes, sprinkler etc., shall be of MS pipe ('C' class).

MS Pipes shall be mild steel hot finished seamless or ERW pipes screwed and socketed tubes confirming to the requirement of I.S 1239 – 1982 for high grade. They shall be of the diameter (Nominal bore) as specified in the item specification / as directed by the Consultant nominal bores of the pipes for which they are intended. The MS pipes shall be of MAKE as per the list of approved makes only. The pipes and sockets shall be clearly finished, well galvanised in and out and free from cracks, surface flaws, laminations and other defects. All screw threads shall be clean and well cut.

The ends shall be cut clean and square with the axis of the tube

All screwed tubes and sockets pipe to up to and including 40mm dia shall have pipe threads confirming to the requirements of IS-543 – 1955(or revised) screwed tubes shall have threads while the sockets shall have parallel threads. Pipe 50mm dia and above shall have welded / flanged joints. All welding shall be done by qualified welder and shall shortly confirm to India standard code of procedure for manual metal are welding of mild steel.

The weights of GI pipes for various classes and diameters shall be as reproduced below:

Weights in kg per meter of common GI pipe of various diameters (plain ends)

Dia in mm	( Light ) `A` Class	( Medium) `B` Class	( Heavy) `C` Class
15	0.952	1.22	1.45

20	1.410	1.58	1.90
25	2.010	2.44	2.97
32	2.580	3.14	3.84
40	3.250	3.61	4.43
50	4.110	5.10	6.17
65	5.800	6.51	7.90

**PIPE FITTINGS:**

The fittings shall be of malleable cast iron or galvanised mild steel tubes as called for complying with all the appropriate requirements given in para A.1.1 or as specified. The fitting shall be designated by the respective nominal bores of the pipes for which they are intended.

The fittings shall have screw threads at the ends and conforming to the requirement of IS-544 – 1955 (or revised). Female threads or fittings shall be parallel and male threads (except on running nipples and collars of unions) shall be tapered.

**CUTTING, LAYING AND JOINTING:**

The pipes and fitting shall be inspected at site before use to ascertain that they confirm to the specifications given in para A.1.1 above. The defective pipes shall be rejected. Where the pipes have to be cut or rethread, the ends shall be carefully filed out so that no obstruction to born is offered. The ends of the pipes shall then be threaded conforming to the requirements of IS: 544 – 1955 with pipe dies and taps carefully in such a manner as will not result in slackness of joints when two pipes are screwed together. The taps and dies shall be used only for the straightening screw threads which have become bent or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in a water tight joint. The screw threads of pipes and fittings shall be protected from damage until they are fitted.

The pipes shall be cleaned of all foreign matter before being laid. In joining the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of cotton thread spun yarn wrapped round the screwed in the socket, tee etc., with the pipe wrench. Care should be taken that all pipes and fittings are properly jointed so as to take the joints completely watertight and pipes are kept at all time free from dust and dirt during the fixing, the joint shall be removed after screwing. After lying, the open ends of the pipes shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

Any threads exposed after jointing shall be painted or in the case of underground piping thickly coated with approved anticorrosive paint to prevent corrosion.

External Works:

The galvanized iron mild steel pipes and fittings in external work for fire hydrant / yard hydrant piping shall be laid in neatly excavated trenches. The widths and depths of the trenches for different diameters of the pipes shall be as given in the table below, and shall be deep enough to have a clear cover of atleast 400mm above the top of pipes.

<u>Dia. Of pipe</u>	<u>Width of trench</u>	<u>Depth of trench</u>
80mm to 100mm	450cm	60cm
150mm to 100mm	600cm	75cm

At joints the trench, width shall be widened wherever it is necessary. The work of excavation and refilling shall be done true to line and gradient.

The pipes shall be painted with two coats of anticorrosive bitumastic paint of approved quality followed by wrapping with burlap or hessain based bitumen pipe kote of 4mm thickness with overlap of minimum 25mm. The pipes shall be laid on a layer of 7.5cm sand and filled with excavated earth. The supplies earth shall be disposed off as directed. The filling shall be done after testing & rectifying leakages and after final passing of work by the Consultant.

When the excavation is done in rock the bottom shall be cut deep enough to permit the pipes to be laid on a sand cushion of minimum 7.5cm. in case of bigger diameter pipes where the pressure is very high thrust blocks of cement concrete 1:2:4 (1 cement :2 coarse sand: 4graded stone aggregate of 20 nominal size) shall be constructed on all bends to transmit the hydraulic thrust without impairing the ground and spreading it over a sufficient area, as directed by the engineer – in – charge / Consultants.

**Testing the joints:**

After laying and jointing, the pipes and fittings shall be inspected under working conditions of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost to Owner. The pipes and fittings after they are laid shall be tested to hydraulic pressure of 15kg/ sq.cm. (100 meter or double the designed working pressures whichever is more). The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw off takes and stop coocks shall be then closed and specified hydraulic pressure shall be applied gradually. Pressure gauge observations shall be made for atleast 2hrs. The pipes and fittings should be tested in section as the work of laying proceeds, keeping the joints exposed for inspection during the testing.

**Measurements:**

The lengths shall be measured in running mater correct to a cm for the finished work, which shall include GI pipes and sockets, GI fittings such as bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts, but exclude brass or gunmetal taps (cocks), valves, lead connection pipes and shower rose. The length shall be taken along the central line of the pipefitting. All pipes and fittings shall be classified according to their diameter of the internal bore. The pipe shall be described as including all cuttings and wastage. In case of fittings of unequal bore, the largest

bore shall be measured. Digging and refilling of trenches shall be measured separately or clubbed with main item as called for in the item specification/tender bill of quantities.

**Butterfly / Ball Valves:**

Valves up to 40 mm dia and below shall be Nickel plated brass body heavy stainless steel ball, lever operated, tested to 20Kg/sq.cm with female screwed ends. All ball valves shall be of full-bore type and of RB make.

Valves from 50mm up to 150mm dia shall be of cast of iron body butterfly valves lever operated with flange ends. Valves shall carry IS certification mark. The valves shall be of INTERVALVE make.

All valves shall be approved by consultants before they are used on work.

All globe and check valves shall have working parts suitable for hot and cold water, as required. Valves shall be tagged with permanent label under hand wheel indicating type or duty.

**Air Release Valves:**

These are placed at every summit in the pipeline to permit the escape of air when the main is filled and afterwards, if any air carried out in to the mains. These are also placed on long stretches of nearly level main.

**Non-return Valves:**

These are fixed so as to open in the direction of flow but automatically close if the water flows back. They are used to diminish the damage done by the escape of water due to a burst or prevent damage to impellers of pumps.

**`Y' Strainers:**

Strainers shall be of approved make, equal `Y' type of pot strainers, with cast / MS fabricated bodies. Strainers shall have bronze screen with 3mm perforations. Screen shall be removable and replaceable without disconnection of the main pipes. All strainers shall be provided with equal size isolation valves, so that the strainer may be cleaned without draining the system. All `Y' type strainers wherever specified shall be MS fabricated type only.

All pipe supports shall be mild steel, thoroughly cleaned and given on primary coat of red oxide paint before being installed.

Controlled percolation / RRI, hose conforming to IS 8423 of 63mm dia. x 15 RMT long shall be provided with suitable

**Gun Metal Branch Pipe with Nozzle:**

Gun metal short branch pipe shall be of shall be of 63 mm dia. female instantaneous inlet, male threaded outlet complete with hexagonal nozzle of 19 mm dia heavy quality as per IS 903 shall be provided.

**Hose cabinet:**

MS hose cabinet to accommodate two nos. of hosepipes with coupling and 1no branch pipe shall be provided for each yard hydrant valve. This cabinet shall be glass fronted with hinged door and lock. The cabinet shall be powder coated to scarlet red colour.

**Fire Brigade Inlet Connection:**

Fire brigade connection shall be provided to the reservoir comprising of four instantaneous pattern 63 mm dia inlets with four nos. built – in non- return valve including cap with chair and 150 mm dia sluice valve. The manifold shall be mounted in a MS cabinet with glass fronted door.

**Gun metal Branch Pipe with Nozzle:**

Gunmetal short branch pipe shall be of 63 mm dia. Female instantaneous inlet, male threaded outlet complete with hexagonal nozzle of 19 mm dia. Heavy quality as per IS 903 shall be provided.

**Hose Reel:**

Hose reel of swing type with 19 mm dia and 36 RMT long hose and hand-controlled nozzle of 6.35 mm dia shall be provided on a drum with suitable bracket for fixing on the wall

**Hose and Extinguisher Cabinet:**

Where indicated on the plan installs the auxiliary hose stations within a fire hose cabinet.

Recessed Style – box shall be 18 gauge steel with 20 gauge hollow metal door and 16 gauge steel trim – door shall be due panel type with finish interior with trim – door shall be due panel type with finish interior with factory prime exterior set finished specified Croakers standard 5000 series.

**Above Ground Piping:**

All pipes inside and outside the building, laid above the ground shall be properly supported on, or suspended from, stands, clamps and hangers as specified and as required. The contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers, and be responsible for their section and usage. Approved type of anchor fastener shall be used along with standard pipe supports, like HITEC supports. The pipes shall be duly painted with one coat red oxide primer and two coats of synthetic enamel paint of fire red colour as per shade No 536 per IS 5. The pipes shall be supported a minimum interval of 3.5 Mts. between adjacent supports.

Vertical risers shall be parallel to walls and column lines and shall be straight and plump. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 15 mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage.

Pipe sleeves 50mm larger diameter than pipes shall be provided wherever pipes through walls and slabs and annular space filled with fibreglass and finished with retainer rings.

All pipe work shall be carried out in a workman like manner causing minimum disturbance to the existing services, buildings roads and structure. The entire piping work shall be organized in consultation with other agencies work so that laying of pipe supports pipe and pressure testing for each area shall be carried out in one stretch.

Cut outs in the floor slab for installing the various pipes are indicated in the drawings. Modification of these cut-outs / additional cut-outs if required shall be included in the offer.

The contractor shall make sure that the clamps, brackets, clamps saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

All pipes shall be accurately cut to the required sizes in accordance with relevant ISI codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In other location, concentric reducers may be used.

All welding of pipes shall be carried out by certified welding only. A welding procedure shall be prepared and qualified before any welding is done. The welding standard shall be as per AWS D11.1, level AR-3. All pipe works of 40 mm NB and below shall be of screwed constructions.

**Testing & Balancing:**

All piping shall be tested to hydrostatic test pressure of at least One and Half time the maximum operating pressure but not less than 10kg per sq.cm gage for a period of not less than 2 hours. All leaks and defects in joints revealed during the testing shall be rectified and got approved at site.

Piping repaired subsequent to the above pressure test shall be re-tested in the same manner till no leaks and pressure drops are found.

System may be tested in sections and such sections shall be securely capped then retested for entire system.

The contractor shall give sufficient notice to all other agencies at site of his intention to test a section or sections of piping and all testing shall be witnessed and recorded by owner's site representative.

**Measurements for piping:**

Unless otherwise specified measurements for piping for the project shall be on the basis of centreline measurements described herewith.

**Piping:**

Shall be measured in units of length along the center line of installed pipes including all pipe fittings, flanges (with gaskets and nuts and bolts for jointing) unions, bends, elbows, tees, concentric and / or eccentric reducers, inspection pieces, expansion loops etc., the above accessories shall be measured as a part of piping length along the center line of installed pipes and no special rates for these accessories shall be permitted.

The quoted unit rates for centre line linear measurements piping shall include all wastage allowance, pipe supports including hangers, MS channel, wooden haunches, nuts and check nuts, vibration isolator suspension where specified or required and any other item required to complete the piping installation as per the specification. None of these items will be separately measure NOR paid for.

However, all valves (gate / globe / check / balancing / butterfly / ball etc.,) strainers, orifice plates, thermometers, pressure gages shall be separately measured and paid as per their individual unit rates.

**LIST OF APPROVED MAKES FOR FIRE FIGHTING SYSTEM**

S.No	Name Of Item	Approved Makes
1	Fire pumps	Kirloskar / M&P / KSB / Grundfoss / EQULT

2	Motors	Kirloskar / Crompton / Siemens / NGEF / Grundfoss / EQU LT
3	Control Panel	Siemens / L&T, ABB
4	Pressure switch	Indfoss / Switzer /Donfoss / L&T / EQU LT
5	Pressure gauge	Guru / Fiebig / General Instruments /Warree
6	MS Pipes/Fittings	Jindal / Tata / Bharat/EQU LT
7	Air release valve	Elemes / Zoloto / Newage
8	Wrapping & Coating tape	WL / Rustech
9	Paint	Berger / Shalimar / J&N / Asian
10	Hose pipes	Newage / CRC / Jayashree / Eversafe

## **SPECIFICATION FOR CONVENTIONAL TYPE FIRE ALARM SYSTEM**

### **Manual Call Point (MCP)**

MCP's will be manually operated used to initiate an alarm signal.

The Manual Call Point will be Pull station type and the same will be constructed of durable molded polycarbonate material with red finishing on the body and white lettering for clear identification. The housing will accommodate a pull down lever, which, when operated, will lock in position indicating the manual pull station has been activated. The pull down lever will remain down and locked until the manual pull station is reset. Manual pull stations will contain the intelligence for reporting address, identity, alarm and trouble to the fire alarm control panel. The manual pull station communications will allow the station to provide alarm input to the system and alarm output from the system within less than four (4) seconds. All the MCP located in outdoor areas will be supplied with a suitable pedestal and canopy in order to allow the MCP to be free standing and accessible at height of 1.4 meters in the field where wall mounting is not possible. Manual call points will be installed near exit / entrance doors, stair cases or outdoor locations where automatic fire detectors cannot be installed.

### **FIRE EXIT BOARD**

Self illuminating "FIRE EXIT" sign boards will be provided indicating escape routes to escape under fire condition. The type of sign board will be as per site condition.

### **HOOTERS AND STROBE LIGHTS**

#### **Hooters**

The electronic sounder / loud speaker being located at vital places will have minimum 90 dB output. The Hooters will be of the same make as that of the detector, Panel.

**Strobe lights**

The electronic strobe light being located at vital places will have a high intensity flasher light for a visual alert from a distance. The Strobe Lights will be of the same make as that of the detector, Panel.

**CENTRAL PROCESSING UNIT (CPU) of FIRE ALARM PANEL.**

CPU will communicate with various microprocessor based fire alarm control panel /peripherals of the system and execute /receive FIRE & FAULT alarms, control the activation of outputs. CPU failure should be indicated by an LED on the front facial. The CPU will also communicate with printer and PC based Graphic workstation through RS-232C or equivalent connectivity. Indications / information received from detectors /field devices, switches etc to CPU will be available at the central graphic workstation.

The CPU will be a state-of-the-art 32 bit processor which will serve as central processor, system software will be designed specifically to monitor status; processing alarms according to priorities, controlling / processing communications with operator peripherals; and synchronizing all system activity.

For reasons of reliability and preventing inadvertent changes, the system will be maintained in non-volatile memory. The system will permit reprogramming by authorized personnel only via dedicated Laptop. The CPU will indicate post dates for carrying out detector pooling. Alternatively, the detector will report its proper functioning to the panel. The same will have a history logging in non-volatile memory which should also be available at the panel end. The CPU will derive power from panel Power supply. The looping scheme, scheme of detector connections will be software programmable.

**APPROVED MAKES FOR FIRE ALARM SYSTEM COMPONENTS FOR FAS :**

Fire Alarm Control Panel	Ravel/ Apollo/ GST
Manual Call Point	Ravel/ Apollo/ GST
Hooters	Ravel/ Apollo/ GST
2C x 1.5 Sq.mm & 4C x 2.5 Sq.mm Cable	Polycab/ Finolex/ Hawells/ Universal
CO2 4.5 Kg Fire Extinguisher	Safex/ Andex/ Kanex
Mechanical Foam 9 Ltrs Fire Extinguisher	Safex/ Andex/ Kanex
Water CO2 9 Ltrs fire extinguisher	Safex/ Andex/ Kanex
CO2 22.5 Kg Trolley Mounted Fire Extinguisher	Safex/ Andex/ Kanex

## TECHNICAL SPECIFICATION FOR 15 PASSENGER LIFTS

### GENERAL:

- 1.0 Scope
- 2.0 Drive Machinery
- 3.0 Type of controls
- 4.0 Installation aspects
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- 6.0 Lift Car
- 7.0 Car and landing entrances
- 8.0 Leveling
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- 12.0 Lift Ropes – IS 14665 (part 4/Sec 8) – 2001
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- 15.0 Controlling Equipment
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- 1.0 Scope
- 1.1 Scope

The scope of work includes Design, Supply, Storage, Installation, Testing and commissioning of 15 Passenger Lifts The equipment required is outlined broadly without attempting to cover the details of design and construction. Vendor shall provide all the equipment and accessories required for satisfactory operation of the lifts and shall include all allied and implied items, whether specially mentioned or not in the specification.

The scope of work shall include, but not limited to the following: -

- a) Detailed design and Engineering of Lift system.
- b) Submission of all drawings to Client for Approval
- c) Fabrication and supply of all equipment at site.
- d) Liaise with Lift inspector/ Electrical Inspector or relevant statutory authorities for approval
- e) Providing and removing all necessary scaffolding, miscellaneous civil works like breaking, grouting etc required for installing the lifts, erection, testing and commissioning of the system and training of Client's personnel.
- f) Handing over to the Client
- g) Maintaining the lift during the warranty period.
- h) All civil works like scaffolding, ISMB, brackets, beams in LMR, making of holes and closing of the same etc., all related civil works included in lift vendor scope.

## 1.2 Standards:

The following IS standards and Codes of Practice with the latest amendments as applicable to conventional traction type passenger and service lifts shall apply to the equipment and the works covered under this contract.

Electric Traction Lifts — Guide Line outline dimension - IS 14665(Part 1) — 2000

Electric Traction Lifts — Code of Practice for installation - IS 14665(Part 2) — 2000

Electric Traction Lifts — Safety rules - IS 14665(Part 3) — 2000

Electric Traction Lifts — Components - IS 14665(Part 4) — 2001

Electric Traction Lifts — Inspection manual - IS 14665(Part 5) — 1999

Code of practice for electrical wiring installations

(System voltage not exceeding 650 volts) - IS 732 — 1989

Lift manufacturing - IS 3534

## 1.3 CO-ORDINATION WITH OTHER AGENCIES:

The Vendor shall Co-ordinate and co-operate with other agencies responsible for:

- (a) Construction of the lift shaft.
- (b) Fixing of inserts
- (d) Fixing of door frames after erection
- (e) Forming of sill supports
- (g) Forming and making good of recesses at landings for car position indicators and call button
- (h) Guards to well opening
- (i) Signboard with “DANGER” notice as instructed on lift motor room doors.
- (J) Supply and installation of lift floor finish
- (I) Provision of a fire extinguisher to the satisfaction of the appropriate codes
- (m) Lightning protection to be provided as per UL standard 96A with Maintenance free earth pits.

The Vendor shall attend all related site meetings arranged by the Client, and abide by the decisions taken during the meeting while installing the lifts.

## 2.0 Drive Machinery:

### 2.1 Electric Supply:

Three phases, 50 c/s, 415 V electric supplies shall be made available. The entire lift equipment should be suitable for operation at +10% to –20% of the rated supply voltage.

### 2.2 Gearless Machine:

The gearless machine shall consist of a motor, traction sheave and break- drum or brake disc completely aligned on a single shaft. The gearless machine shall be A.C. gearless with VVVF drive.

### 2.3 Geared Machine:

The machine shall be of worm gear reduction type with motor, brake, worm gearing, driving sheave and suitable for type of control specified.

### 2.4 Sheaves:

Sheaves and pulleys shall be of hard alloy, cast iron, SG iron or steel and free from cracks, sand holes and other defects. They shall have machined rope grooves. The traction sheave shall be grooved to produce proper traction and shall be of sufficient dimension to provide for wear in the groove. The deflector sheave shall be grooved so as to provide a smooth bed for the rope. The deflector or secondary sheave assemblies where used shall be mounted in proper alignment with the traction sheave. Such deflector sheaves shall have grooves larger than rope diameter as specified in clause 8 of IS 14665 (Part-4-Sec 3): 2000. Wherever necessary suitable protective guards may be provided.

### 2.5 Shaft keys:

Shafts which support sheaves, gears, coupling and other members which transmit torque shall be provided with tight fitting keys of sufficient strength and quality.

### 2.6 Brake:

The lift drive machinery shall be provided with an electro-magnetic brake or motor operated brake normally applied by means of springs in compression when the operating device is in off position. The brake shall be suitably curved over the brake drum or brake disc and provided with fire proof friction lining. The operation of the brake shall be smooth, gradual and with minimum noise. The brake shall be designed to be of sufficient size and strength to stop and hold the car at rest with rated load.

The brake should be capable of operation automatically by the various safety devices, current failure and by the normal stopping of the car. The brake shall be released electrically. It shall also be possible to release the brake manually, such releases requiring the permanent application of manual force so as to move the lift car in short stops. For this purpose suitable brake release equipment wherever necessary shall be supplied with each lift installation and the same shall be kept in safe custody to prevent misuse.

#### 2.6.1 Hand Winding wheel or handle:

At times of lift stoppage due to any reasons, it shall be possible to move the lift car to the nearest landing manually. The manual operation shall be by means of a winding wheel or handle mounted on the end of the motor shaft. The up or down direction of the movement of the car should be clearly marked on the motor or

at suitable location. A warning plate written in bold signal red color advising the maintenance staff to switch off the mains supply before releasing the brake and operating the wheel list to be prominently displayed.

## 2.7 Bearings:

Bearings shall be either of the anti-friction metal sleeve type with oil reservoirs, self, lubrication, oil gauges, capped filler openings and drains of the ball roller or sintered type subject to oil flood lubrication or grease lubrication. Grease lubricated bearings shall have grease gun connections and drain plugs. The bearings and lubricant reservoirs shall be dust tight and shall incorporate effective seals to prevent leakage. The outer end of the bearings shall be closed with a removable oil tight plate. Thrust bearings shall be of the ball or roller type and shall have two sets of balls or rollers arranged to minimize backlash for efficient working.

## 3.0 Type of controls:

### 3.1.1 Single speed alternating current control:

A control for a driving machine induction motor which is arranged to run at a single speed.

### 3.2 Variable Voltage Variable Frequency:

Incoming mains ac power is first rectified to dc and then inverted to provide controlled ac current to the elevator drive. Precision monitoring of motor speed and car direction, position and load enable the pulse width of the ac power supplied to the motor to be adjusted to ensure that elevator speed is maintained very accurately to an ideal profile.

Thus in VVVF controls pulse width modulation control of ac motors has following advantages

compared with the older servo controlled elevators:-

- (a) Total control at all stages of the motion cycle.
- (b) A consistent fully adjustable smooth ride.
- (c) Better leveling accuracy under all conditions
- (d) A higher power factor
- (e) Lower starting currents
- (f) Energy saving through reduced power consumption.

## 4.0 Installation aspects:

Installation in machine room- Lift machine room to accommodate the drive machinery, controller, etc., shall as far as possible be located on top of the lift shaft. The layout of equipment there should be such as to allow free movement of maintenance personnel inside. The machine room shall not be used for storage purposes.

4.1.1 Ventilation of machine room- Machine room shall be provided with natural air and mechanical ventilation to avoid over heating of the electrical equipments and to ensure proper operation of the

controller. Entry of dust etc. shall also be suitably prevented.

4.1.2 Vibration, Isolation- Vibration and isolation arrangement shall be provided to prevent transmission of vibration to the building and structure.

#### 4.2 General Illumination of Lift well

Suitable light points shall be provided in the lift well at a spacing of not more than 10 meters in between, starting at the ground floor. All the points should be group controlled from the M/C room. The wiring shall be carried out in surface conduit as per CPWD General Specification. One socket outlet shall be provided in the shaft for use by maintenance personnel at a level slightly above the ground floor landing.

#### 5.0 Guide rails:

Guide rails shall be in accordance with clause 3 of IS 14665 (Part 4 – Sec 2) 2000. Only machined guide rails shall be permitted for cars for passengers and hospital lifts. Formed sheet metal rails shall be used up to speeds of 1.75 mps for counter weight applications. In the case of goods lifts, unmachined guides rails shall be permitted for the counterweight for all speeds and for the cars only up to a speed of 0.5m/sec. The guide rails shall be continues throughout the entire travel and shall withstand without any deformation the action of safety gear with a fully loaded car.

Generally the guide rails shall be supported by brackets secured to the hoist way frame at each floor. The rails shall be securely fastened to the brackets or other supports by approved heavy rail clamps. All necessary guide rails packing or additional supports shall be provided to prevent guide rail deflection and stresses exceeding the prescribed limits. The stresses on the guide rail due to the horizontal forces imposed on it during loading, unloading and running calculated without impact, shall not exceed 1100 kg/sq.cm based upon the class of loading and the deflection shall not exceed 5mm. The guide rail brackets, their fastenings and supports shall be capable of resisting the horizontal forces mentioned above, with the total deflection at the point of support not in excess of 3mm. Guide rails shall extend from pit floor to the underside of concrete slabs or grouting top of the lift well. They shall be erected in plumb and parallel with a maximum deviation of 3mm. All shimming required shall be of metal securely held in place. Jointing plates shall be so located as not to interfere with supporting clamps and brackets. The bolts shall be used with spring lock washers.

The guide rail anchorage at pit floor must be made without puncturing the water proofing. The expansion joints in the guide rails shall be so designed as to avoid jerks in the lift car. Machined guide rails shall have finished surfaces which shall be coated with corrosion preventive compound which shall be maintained till the commissioning of the installation. Before the car is placed in operation, the preventive coating shall be removed and the guide rails thoroughly cleaned and smoothed.

#### 6.0 Lift Car:

##### 6.1 Car Frame:

The car frame shall be in accordance with clause-4 of IS 14665 (Part 4-Sec 3): 2001 made of sheet steel of rigid construction to withstand without permanent deformation the operation of safety gear. The car shall be so mounted on the frame that vibration and noise transmitted to the passengers

inside is minimized.

#### 6.2 Car platform:

6.2.1 The car platform shall be of framed construction and designed on the basis of rated load evenly distributed. The dimensions shall conform to IS: 14665 (part 1) 2000 unless otherwise specified.

The flooring shall be smooth and of anti-skid surface. The flooring for goods lift shall be strong enough to take the rated load without any deformation or damage.

6.2.2 A load plate along with an overload alarm, giving the rated load and permissible maximum number of passengers should be fitted in each lift car in a conspicuous position.

#### 6.3 Car body :

The car shall be enclosed on all sides by a metallic enclosure. The enclosure including the door shall withstand without deformation a thrust of 35kg applied normally at any point and as per IS 14665 (part 4/Sec 3) 2001. Ventilation openings if specified shall be as per IS 14665 (part 4/Sec 3)-2001.

6.3.1 Stretcher guards/trolley guards made of PVC/Rubber extrusion housed in a stainless steel beading shall be fitted at suitable level (s) to rear/ side panels for bed lifts/goods lifts.

6.3.2 Lift Car door shall have a fire resistance rating of one hour.

6.3.3 Grounding switch (as), at ground floor level, shall be provided on all the lifts to enable the fire service to ground the lifts.

#### 6.4 Car roof:

Car entrance shall be provided with metal thresholds having a grooved surface. Thresholds for lifts having horizontally sliding car doors or gates shall have machined or extruded guide grooves.

#### 6.5 Car Thresholds

Car entrance shall be provided with metal thresholds having a grooved surface. Thresholds for lifts having horizontally sliding car doors or gates shall have machined or extruded guide grooves.

#### 6.6 Toe Guard Aprons:

The toe guard apron of gauge not less than 1.6mm sheet steel may be provided extending at least 15mm beyond entrance jambs at each side. The guards shall have a straight vertical face extending below the level of the finished car floor and not less than the depth of the leveling zone plus 7.5mm. The bottom of guard shall extend 700mm for lifts up to speed of 1.5mps & 1000 mm for lifts above speed of 1.5mps below vertical face and beveled at 15 degrees angle from the vertical. It shall be seamed to car platform construction and be reinforced and braced.

#### 6.7 Clearance:

The clearance between the top of the car and the soffit of the lift shaft roof, bottom of the car and the pit floor, the buffers etc., and the clearance between the car and the lift well, between the car and the landing sill, between two lift cars in the same shaft etc., shall be provided as per IS 14665 (Part 1,2 & 4) and relevant lift rules mentioned in Appendix-I.

#### 6.8 Car Apron, Landing Thresholds and Sills:

An apron shall be fitted to the car platform such that no dangerous gap exists at any time when the landing door is opening. Thresholds and sill plates shall be provided at the landings also. The distance between landing sill and the sill on the car platform shall not be more than 30mm.

#### 6.9 Inter-Communication system:

6.9.1.1 Though Para 8.4.3 of IS 14665 (part 2/sec 1): 2000 recommends for provision of either an emergency signal or a telephone inside the car but as a general experience, it is seen that over a

For a period of time these devices become inoperative due to one reason or the other. Therefore, in order to have at least one device of communication functioning at all the times, as an alternative arrangement, provision of both i.e. telephone with minimum two connections-one at the operator's room and other at guard room and the emergency signal with re-chargeable batteries as source of supply shall be made in the lift cars.

6.9.1.2 The device used for emergency signals should incorporate a feature that gives immediate feedback to the car passengers that the device has worked properly and the signal has been passed on to the intended agency. This shall be achieved by pressing of button from the control room which shall give audio signal to the passengers in the car.

6.9.1.3 Provision of group indicator panel in the control room shall be made to indicate working of lifts.

#### 6.9.2 Emergency Power Supply for lift car:

This shall include a suitable secondary battery with trickle/boost charge arrangement and inverter power pack with necessary contractors for supplying the light fixtures in the lift car. The same battery shall also feed the alarm bell and communication equipment.

#### 6.10 Ratings and Instructions:

Inside the lift car, the lift supplier shall also provide a stainless steel metallic plate indicating the rated load and detailed instructions for the passengers. This shall be mounted at a suitable place.

#### 6.11 Lift Car Interior Finish:

The side, rear and fascia panel shall be of scratch free stainless steel sheet. The flooring shall be with 3mm thick PVC tiles for passenger lifts and cherub red aluminium sheet for goods lifts and goods-cum-passenger lifts. The False ceiling in the lift car shall be crafted from mild steel powder coated to suitable colour with CFL lamps and fan diffuser (s) in different colour.

#### 6.11.1 Operating panel Inside the Car:

The car operating panel shall be of metal, flush mounted and duly finished to match the car interior décor and shall contain all the devices as may be specified depending upon the type of operation required. In addition separate illuminated panels for indicating the floor and direction may be provided on the top or the door way. All switches shall be fade proof and the devices shall be of suitable quality. Each device and its operating position shall be legible fade proof and marked.

#### 7.0 Car and landing entrances:

The car and landing doors shall be of flush type sheet steel only for power operation. The flush type may further be of single sliding, center opening or two speed construction. Power operated car and landing doors shall be so designed as not to injure any person during their closure by means of provision of a safety pressure switch which shall cause the doors to reopen on the slightest pressure. In case of power operated doors, it shall be possible on power failure, to open them from the car side. All the openings for passenger lifts shall be 2000mm clear in height. For goods lift vertical by- parting doors or collapsible gates as specified shall be used. The door opening and closing shall be accomplished smoothly and quickly without undue noise, vibration and shock and their movements shall be cushioned and checked at both limits.

#### 7.1 Car doors:

7.1.1.1 The car doors shall be hung from the top M.S. fabricated track and means shall be provided to prevent the door from jumping off the track. The doors shall be provided with two point suspension sheave type hangers suitable for the type of door operation specified. The hangers shall be securely fastened on bearings mounted on a malleable iron or steel bracket. Arrangements shall be provided for vertical and lateral adjustments of car doors. The sheaves shall move on a M.S. fabricated track so shaped as to permit free movement of sheaves with regard to vertical adjustment of sheave bracket or housing. The car door shall be center opening horizontal sliding stainless steel scratch proof (moon rock finish) or office, residential & goods lift applications whereas telescopic horizontal sliding stainless scratch proof surface (moon rock finish) for hospitals.

7.1.1.2 A potential cause of accidents could be the attempts made to open the landing door lock of the lower floor in case the car stops away from floor level due to power failure. Since the car door can be opened in case of power failure so as to improve the ventilation and avoid claustrophobic situations etc. as outlined in IS 14665 (part 2/sec 1): 2000 Para 10.9.1, there is a tendency among trapped passengers to make attempts to open any accessible landing door which can be opened by a electromechanical latch in the landing doors as the lock is accessible through open car doors. This attempt in panic may result in accidental fall into the lift pit. In order to ensure that the trapped passenger does not attempt opening the landing door, the electromechanical latch should be designed so that it is inaccessible or invisible to the passengers in the car.

7.1.1.3 In order to avoid accidental closure of doors while boarding or alighting the car, a tamper proof infrared curtain covering almost the entire height of the door should be provided in the lift doors.

#### 7.2 Provisions as per Barrier Free requirements

7.2.1 Wherever lift is required as per by-laws, provision of at least one lift shall be made for the wheel chair use with the following cage dimensions of lift recommended for passenger lift of 13 persons capacity by Bureau of Indian Standards.

7.2.2 A hand rail not less than 600mm long at 900mm above floor level shall be fixed adjacent to the control panel.

7.2.3 The time of an automatically closing door should be minimum 5 seconds and the closing speed should not exceed 0.25 M/Sec.

7.2.4 The interior of the cage shall be provided with a device that audibly indicate the floor the cage has reached and indicate that the door of the cage for entrance/exit is either open or closed.

### 7.3 Landing doors:

Each landing door shall be complete with locks, headers, sills, frames, rims, hanger supports with cover plates, fascia plates etc. The finished work shall be strong, rigid and neat in appearance. Plan surfaces shall be smooth and free from warp or buckle. Moulded surfaces shall be clean out, straight and true. Fastenings shall be concealed from the face side of the material. Steel Sills shall be provided with a suitable nosing of approximately 25mm depth on the shaft side. The opening for the landing gates or doors shall not be wider than that of the lift car. In the case of bi-parting type steel doors, the locking of the two leafs locking of the doors should be positive.

### 7.4 Car landings:

7.4.1 All the lift car landings shall be well lit to an illumination level of 150 lux and shall be free from obstructions. The control for landing lights and the sign lights shall be tamper proof. Wherever stand by power supply is available, these lights shall be connected to standby circuits also.

7.4.2 For the purpose of identification, the lift number should be displayed outside the landing door inside the car and in the machine room. This numbering may be used as reference for the purpose of routine/preventive maintenance, for operating from machine rooms and reporting of any incidents etc.

### 7.4.3 Instructions

Detailed instructions as specified or guidance of passengers shall be prominently displayed inside the car by the contractor and outside the car at all landings by the department. The Braille signage will be posted by the department outside lift lobby at all landings for the lift meant for barrier free requirements as per Appendix VII.

7.4.4 It is seen generally, that though the instructions on DO's and Don'ts, as per provision of the relevant IS, are displayed in lift cars but the same are either displayed in inconspicuous locations, or are very small in size or are in one language only. To make these instructions serve the intended purpose, and not a mere compliance of relevant IS clause; that these instructions should be displayed at a conspicuous location with larger and understandable script and should be written in Hindi, English and regional language (where official regional language is notified).

#### 8.0 leveling:

All lift (s) shall be incorporated with suitable floor leveling devices. In case of lifts with automatic power operated doors and with A.C.VVVF controller a separate level device for automatic leveling the leveling accuracy of +5mm or –5mm shall be incorporated

#### 9.0 Counter Weight:

The counter weight for lift cars shall be in accordance with clause 6 of IS 14665 (part 4-Sec-3); 2001 and shall be designed to balance the weight of empty lift cars plus approximately 50 per cent of the rated load. It shall consist of cast sections firmly secured in relative movement by at least two numbers of steel tie rods having lock nuts/split pins at each end and passing through each section and housed in a rigid steel frame work. Cracked and broken sub weights shall not be accepted.

#### 10.0 Counter Weight Guards

Guards of wire metal/mesh shall be provided in the lift pit to a suitable height above the pit floor to eliminate the possibility of injuries to the maintenance personnel.

#### 11.0 Guide shoes

Two numbers of guide shoes at the top and two numbers at the bottom shall be provided on the lift car and counter-weight.

#### 11.1 Type of shoes

##### 11.1.1 For passenger lifts and bed-cum-passenger lifts

(a) For speed up to 1.5 mps sliding guide shoes shall be used. Sliding guide shoes for car shall be always flexible and for counterweight solid guide shoes can be used up to 1.0 mps.

(b) For speeds more than 1.5 mps roller guide shoes shall be used for car and counter weight.

##### 11.1.2 For goods lifts solid shoes can be used.

11.2 Flexible type/solid type sliding guide shoes: The car shall be provided with solid or spring loaded swiveling guide shoes with renewable liners, where the lift car speeds are up to and including 1 MPS. The cars with speeds beyond 1 MPS shall be provided with spring loaded guide shoes with renewable liners or the guide shoes shall be of roller type.

#### 11.3 Roller type guide shoes

Each roller type shoe shall be of an approved type consisting of rollers assembled on a substantial metal base and mounted as to provide continuous contact of all rollers with the corresponding guide rail surfaces under all conditions of load and operation. The rollers shall run on the three finished guide rail surfaces and shall operate quietly.

##### 11.3.1 Mounting of guide shoes

Guide shoes shall be provided with adjustable mountings & shall be rigidly secured in accurate alignment at the top and bottom on each side of the car sling and counter weight frame construction. When oil buffers

attached to the bottom of counter weight are used, additional guide shoe shall be provided on each side of the buffer frame. The design of guide shoes and car safety devices shall be coordinated so as to ensure the provision and installation of equipment with clearance specified in clause 5.7 of this Chapter.

#### 12.0 Lift Ropes – IS 14665 (part 4/Sec 8) – 2001

Round strand steel wires ropes made from steel wire ropes having a tensile strength not less than 12.5 tones Cm 2 of good flexibility shall be used for lift. Lubrications between the strands shall be achieved by providing an impregnated hemp core. The lift ropes shall conform to IS 14665 – (part-4- Sec-\*): 2001 and the following factor of safety shall be adhered to. The minimum diameter of rope of cars and counter weight of passenger and goods lift shall be 8 mm

Rope speed of passenger & goods lifts (m/s) F Factor of safeties

0.5 or less

Exceeding 0.5 to 1.0

Exceeding 1.0 to 2.0

Exceeding 2.0 to 3.5

Exceeding 3.5

#### 12.1 Rope

fastenings

The ends of lift ropes shall be properly secured to the car and counter weight hitch plates as the case may be with adjustable rope shackles having individual tapers, Babbitt sockets, or any other suitable arrangement. Each lift rope shackle shall be fitted with a suitable shackle spring, seat washer, shackle nut & lock & shackle nut split pin.

#### 12.2 Guards for lift ropes

Where lift ropes run round a sheave or sheaves on the car and /or counterweight of geared/ gearless machine suitable guards shall be provided to prevent injury to maintenance personnel.

#### 12.3 Number & size of ropes

The contractor must indicate the number and size of lift ropes and governor ropes proposed to be used, their origin, type, ultimate strength and factor of safety. The contractor should furnish a certificate of rope manufacturers issued by competent authority.

#### 13.0 Safety Equipments:

Every lift installation shall necessarily be provided with the following safety features:

13.1 The safety gear shall be provided in accordance with IS 14665 (Part -4-Sec.4):2001, each type of car safety shall be actuated by a speed governor.

13.2 Governor – the car safety shall be operated by speed governor located overhead and driven by governor rope suitably connected to the car and mounted on its own pulleys. The rope shall be maintained in tension

by means of weighted or spring loaded tension sheaves located in the pit. Governor shall be provided for lifts with a travel of more than 5.5 meters. The governor rope shall be not less than 6mm in dia and shall be made of steel or phosphor bronze. These shall be in accordance with IS 14665 (part4/sec-4):2001. governor for car safety gears shall be adjusted to actuate the safety gear at the following speeds:-

(a) For rated speeds up to 1m/s maximum governor tripping speed shall be either 140 percent of rated speed or 0.88 ms, whichever is higher. For rated speed above 1m/s maximum governor tripping speed shall be 115 per cent of the rated speed plus 0.25 m/s.

(b) Minimum governor tripping speed shall be 115 per cent of the rated speed.

(c) The governor shall be of "V" groove wheel design and only the wheel is stopped to actuate the car safety upon a pre-determined over speed downward without damaging the rope.

13.3 The governor, rope and sheave shall be so located so as to minimize danger of accidental injury to the equipment.

13.3.1 The governor sheave and tension sheave shall be according to clause 2.4 and the sheave bearing shall be according to clause 2.7 of this Chapter.

13.3.2 The requirements for tests on car safety and governor and for drop tests to sliding type car safeties shall be as specified in section IV of this specifications.

#### 13.4 Terminal limit switches

##### 13.4.1 Terminal switches

These shall stop the car automatically at terminal floors within the top and bottom permissible over travel. They shall act independently of the operating devices, the ultimate limits switches and the buffers. They shall be in accordance with clause 8 of IS: 14665 (part 3-Sec 1): 2000.

13.4.2 Terminal stopping devices located in shaft or in the car and operated by cams shall be fitted with rollers having a rubber or other approved composition to provide silent operation when actuated by the cam. When the lift car cross head is 60cm from the nearest obstruction above it, no projection on the car shall strike any part of the overhead structure.

13.4.3 Lifts with speeds over 1.25 meters/second shall have the normal terminal stopping device located on the car or on the guide rails or in the machine room.

##### 13.5 Ultimate Terminal Switches:

These shall be provided in accordance with the statutory requirements and standing practices. When provided these shall arrange to stop the car automatically within top and bottom clearances independently of the normal terminal switches but with the buffers operative. These shall be in accordance with clause 8 of IS: 14665(part 3/sec 1)-2000.

13.6 Buffers- (IS 14665(part 4/Sec 1)-2001):

Buffers shall be oil resistant rubber pad type for speeds up to 0.25 mps and spring/oil type for speeds up to 1.5 mps and only oil type for speeds higher than 1.5 mps.

Buffers shall be suitable for installation in the space available. Buffer anchorage at pit floors shall be installed avoiding puncturing of water proofing. Oil buffers of the car and counter weight shall be of the spring return type or of gravity type.

The partial compression of spring return oil buffers when the car is in level with terminal landing will not be acceptable. All buffers shall be tested at manufacturer's works and a copy of the test report shall be submitted. When the lift car rests on fully compressed buffers there shall be at least 60 cm clearance between the lowest point in its car frame and any obstruction in the pit exclusive of buffers and their supports. Similarly when the lift car shall strike any part of the overhead structure. The contractor must indicate the name of buffer manufacturers, buffer stroke & certified maximum loads.

13.7 Door Locks:

Electro-mechanical door locks shall be provided for all the landing doors and they shall be such that the doors cannot open unless the car is at rest at the particular landing. It shall not be possible to move the car unless all the landing doors and the car door are closed and locked. This requirement however does not apply when the lift car is provided with automatic leveling devices and in such cases, it shall be permitted to move the car with both the doors open in the leveling zone for the purpose of leveling. All the locks and contacts shall conform to IS: 14665 (Part 1/Sec-6)-2001 shall be positive and pass the prescribed endurance and reliability test from a recognized testing laboratory. They shall be so located as to be inaccessible to un-authorized personnel. The electromechanical latch should be so designed that it is inaccessible or invisible to the passengers in the car.

13.8 Other safeties:

Besides these safety devices mentioned above, motor operated electro-mechanical brake (Clause

1.6) counter-weight guards (Clause 8.1) alarm bell, emergency door lock release operating key and associated safety and other safety requirements shall also be included.

14 Lift operations

14.2 Automatic-cum-attendant operation:

14.2.1 Single Automatic Push Button with/without attendant – The operating devices for this operation shall incorporate in the car control panel, car buttons corresponding to the various landings served and single landing button at each landing, all electrically connected to controller governing floor selection, direction of travel, acceleration, retardation etc. This system shall be so arranged that when the car is not in use, on pressing a landing call button the car shall start automatically provided all the doors are closed. During the movement of the car and also when the car stops at floor landing, other landing call buttons are in-operative for a predetermined time. The pressing of a car button shall automatically start the car and send it to the desired landing. In all the cases, the starting of the car is contingent on the establishment of landing

door and car inter-lock circuits. To indicate the availability, or 'in use' light shall be placed in the landing call button panel. When the light shall be 'OFF' the passenger shall be able to call the car. In case of manual operated door if the lift is standing at any landing with doors open (when not in use), the pressing of the landing call button shall ring a bell, fitted at the top of car to attract the attention of the people soliciting their help for closing the lift door if any one of the them happens to be near the lift.

In case of power operated doors, the landing and car doors shall be arranged to open automatically when the car is parked at landing after all the calls are served and the lift is parked at any landing. The doors can remain open or alternatively if desired the car shall be arranged to close after a pre-determined time unless closing is prevented or interpreted by the car doors re-opening device or the door open button. The lift shall be suitable for dual operation with or without attendant by the provision of key operated transfer switch indicating 'attendant' and 'automatic' positions. During 'attendant' operations the landing call shall be disconnected from the control system and shall be connected to an annunciator in the lift car. The attendant shall then operate the car to answer the registered calls. This operation is recommended for single speed control lift for low rising buildings having a single lift installation.

#### 14.2.2 Simplex Selective-Collective operation with/without attendant:

Automatic operation by means of one button in the car for each landing level served and by up-and-down buttons at the landings, wherein all stops registered by the momentary actuation of the car made as defined under non-selective Automatic Operation but where in the stops registered by the momentary actuation of the landing buttons are made in the order in which the landings are reached in each direction of travel (irrespective of the sequence in which the buttons have been actuated). With this type of operation, all 'up' landing calls are answered when the car is traveling in the up direction and all 'down' landing calls are answered when the car is traveling in the down direction, except in the case of the uppermost or lowermost calls which are answered as soon as they are reached in-respective of the direction of travel of the car.

#### 14.2.3 Duplex Collective Selective Operation with/without attendant

The control system for this operation shall be similar to the one described under simplex selective-collective operation except that in this system there shall be two lift cars in adjacent wells. It shall be arranged to coordinate both cars for efficient service and prevent them from answering the same calls by the provisions of only one set of landing call button fixtures. It shall automatically assign each call to the car that will be in the best position to answer promptly. The system shall be so arranged that when the cars are idle, normally one car will be parked at the lower main landing with its doors closed or open and the other car shall be free car parked with the doors closed or open to the landing where it answered its last call, and shall be the one to attend to the nearest call. Each car shall always respond to calls registered by its own car call buttons. When either car is parked out of service for any reason the other car shall function as a single car (simplex) selective collective. Besides, the control system shall also be arranged for independent service from inside the car.

A by-pass button (non-stop button) shall be provided inside the car to enable the attendant to by-pass any landing if the car is full or if otherwise so required. The two lifts shall be arranged with or without attendant operation and shall function as described using single car selective-collective operation. When the transfer switch is in the attendant position the operation of the cars shall be identical with that described for automatic operations except that:

(a) Closing of doors and starting of cars shall be initiated by the car buttons only;

- (b) Buzzers and directional lights in the car are operative, and
- (c) Landing by-pass shall be effective.

The pressing of an up or down landing call shall illuminate the appropriate direction indicator in the car panel, which is to answer that call and if the doors are open shall also sound buzzers as a signal to the attendant. If both cars are parked at the lower landing the above signals shall be given to the car which has been at the floor for the longest time.

#### 14.3 Automatic group supervisory control

##### 14.3.1 General operating principle:

The calls registered inside the car as well as the landings are answered in the sequence in which the floors are reached irrespective of the sequence in which the buttons have been pressed. Only one car will stop in response to any one landing call and will be the nearest car traveling in the corresponding direction of the call. While this car is stopping at this landing, the call will be automatically cancelled to prevent other cars stopping against the same call.

14.3.2 Automatic selection of traffic programmes. The group supervisory control continuously examines traffic conditions in the building and automatically puts into operation the programme which can best cope with the demand at any particular time. This is fully automatic and requires no supervision or attendant. To suit the traffic demand in the building, suitable traffic programmers can be selected for inclusion in this control. The following are the traffic programmers available:

- (a) Up Peak Programme,
- (b) Down Peak Programme,
- (c) Up down Inter floor Programme, and
- (d) Night Programme

(a) Up Peak Programme: - The group supervisory control responds to the increasing influx of passengers at the main landing in the morning hours, at the start of work, by automatically switching on the up peak programme. The cars are dispatched from the main landing automatically at a pre-determined interval after the previous dispatched car. The 'Leaves First' signal is transferred instantaneously from the car dispatched to another car at the main landing. The car answers the registered calls in the natural sequence of the floors and returns directly to the main landing after the last passenger has been discharged. At the main landing they are kept for a predetermined time for taking new passengers. However, a car starts its up travel the moment it becomes fully loaded, without waiting for the dispatch interval to lapse.

(b) Down Peak Programme: - An intense traffic flow from the upper floors towards main landing will automatically switch on the down peak programme. The cars, when fully loaded at upper floors, travel directly to the main landing and after discharging the passenger, immediately start up to answer further down landing calls. The down landing call which has been by-passed gets a priority over other down calls, which ensures equal service to all floors.

(c) Up-down Inter floor Programme: - A steady traffic between main floor and upper floor, and between floor to floor causes automatic switching on of the Inter floor Programme. Specific cars are assigned

to answer specific calls by traffic analyzer so that the calls are handled most efficiently. The cars are so well distributed that every call gets equal service with short waiting intervals. As soon as the number of calls drops to occasional calls only such as at night, the cars get automatically parked in their assigned zones to give personalized service with minimum lift travel. If no calls are registered for some time the motor generator sets are automatically switched off.

(d) Night Programme: - When the traffic ceases to occasional calls only, the supervisory control automatically switches over to Night Programme. All cars remain parked at the main landing with doors closed, but are at all times ready for operation. One of the lifts has its 'Leaves first' signal lighted. On pressing the call button at the main landing, the doors of this particular lift open and the passenger can travel with the lift. The same lift also responds to landing calls from above. The moment this car leaves the main landing the 'Leave First' signal is transferred to a second lift. Further passengers entering the main lobby will take this second lift. This second lift also responds to landing calls from above if one lift can no longer cope with the demand. After these lifts have answered their calls, the one reaching the main landing last will retain the 'Leave First' signal. Thereby, the service is practically confined to one lift alone and motor generator sets of the remaining lifts remain switched off. If no calls are registered for some time, the motor generator of the stand by lift also automatically is switched off. The motor generator will start up again, the moment the call is received. The number of lifts going into action is automatically regulated to just so many as are necessary to cope with the occasional traffic surge. In case where more than 6 lifts are installed in a building, a better utilization of these lifts can be obtained by two additional programmers to deal with heavier traffic in each direction in difficult times. These are

(1) Heavier 'Up' programme (ii) Heavier ('DOWN' programme).

(e) Heavier 'Up' programme: - This shall require the cars to make more stops in the up direction, necessitating more time for the up travel. For this purpose the automatic traffic analyzer shall dispatch cars from both terminal at automatically adjusted time intervals so that the cars are equally spaced, thus reducing passenger waiting interval (this programme caters for the traffic which is likely to be in both directions but predominantly in the up direction e.g. immediately after the morning peak or after lunch).

(f) Heavier 'DOWN' programme: - This shall require the cars to make more stops in the down direction and the dispatch times shall be adjusted accordingly by the traffic analyzer. In the event of failure of the automatic dispatch system the lifts shall function by auxiliary means to avoid any disruption of service. Audio visual indication shall be provided to bring such failures to notice. The lifts shall be designed for attendant operation as described under single (simplex) selective collective operation car except as follow:-

- a. The indicated lights in the car shall be operative to inform the attendant when to start loading a car at a terminal and when to leave the terminal.
- b. Landing call by pass switch and car reversal switch and switches shall be effective and load weighing devices shall be inoperative.
- c. Call above signal shall be illuminated whenever a call is registered at a landing above the car location indicating to the attendant that the car is to proceed upwards. When the highest call has been answered the light shall be extinguished indicating to the attendant that when the car is started it will proceed downward.

### 15 Controlling Equipment:

The movement of the car shall be electrically controlled by means of a controller located in the machine room.

#### 15.1 Control Circuits:

The control circuit shall be designed to the type of lift specified for safety operation. It shall not be possible to start the car unless all the car and landing doors are fully closed and landing doors locked. The circuit shall have an independent fuse protection for fault and over loads and be arranged so that earth fault or an open circuit shall not create unsafe conditions. The circuit shall be so arranged that for the stoppage of the car at specified landing or for actuation of a contactor by

emergency switches or operation of safety gears the system shall not depend upon the completion or maintenance of an electrical circuit to cut off power supply and apply the brakes. This requirement is not applicable to dynamic braking and speed control devices.

#### 15.2 Terminal Boards:

All wiring for external control circuits shall be brought to a terminal board with means of identification of each wire. Metallic/plastic identification tags shall invariably be provided. All connections of wires to terminal boards shall be adequately or screwed.

#### 15.3 Auxiliary Switches:

##### 15.3.1 Emergency stop switches:

On top of the lift car an emergency stop switch shall be provided for use by maintenance personnel. Stop switches shall be provided in the machine room. Operation of these switches/buttons shall cancel all the registered calls and landing calls for that particular fit.

15.3.2 Maintenance switch on top of the car : For the purpose of inspection and maintenance, maintenance switch shall be provided on top of the car. The control circuitry shall be so arranged that in the event of the operation of this switch:

(a) The car speed shall be less than the rated speed not exceeding 0.85metres/sec.

(b) The car movement shall be possible only on the application of the continuous pressure on a button; it shall be so mounted to prevent any inadvertent operation.

##### 15.3.3 Fireman Switch:

Fireman switch with glass to break for access shall be provided at ground or main floor for all the lifts. The operation of this switch shall isolate/or cancel all calls to all the lifts and the lifts will stop at the next nearest landing if traveling to ground floor. If these were already traveling down, they would go straight to ground floor directly without stopping enroot.

##### 15.3.4 Inspection facility:

An Inspector's change over switch and set of test buttons shall be provided in the controller. Operation of the Inspector's change over switch shall make both the car and landing buttons inoperative and permit the lift to be worked in either direction from the machine room for test purposes by pressing corresponding test buttons

in the controller. It shall not however interfere with the emergency stop switches inside the car or on the top of the car.

#### 15.3.5 Safety line indicators:

If specified, visual tell tale lights may be provided to monitor the conditions of faults in the safety line of the lift for easier fault finding. These indicators will remain lit when safety circuits are normal. One indicator shall be provided for each safety on the controller. If any indicators fail to light up as the lift process in its sequence of operation, there shall be visual indication of the safety line open circuit and also its location for easier fault finding.

#### 15.4 Control Wiring:

##### 15.4.1 Wiring in machine room:

Power wiring between the controller and main board controller to various landings shall be done in heavy gauge conduit or metal duct & shall conform to I.E. Rules 1956 and CPWD. Specifications for electrical works. Following general principles shall be followed in wiring:

(a) Control cables carrying DC and power cable carrying AC shall not be run in the same conduit or metal duct and they shall be laid as per I.E. rules.

(b) Metal duct with removable inspection cover shall be preferred.

(c) In case of control cables also the harness shall be separate as far as feasible for separated functions and laid separately in suitably dimensioned metal duct or in a separate conduit such as the signaling, locking, lamp indication and safeties. Control cables for different voltages in the lift installation works should be laid as per IE. Rules.

(d) At least 5 percent with a minimum of 5 unconnected spare wires shall be available out of all the lines to be provided in the wiring harness from the midway junction box to the machine room.

(e) There shall be a master isolating switch Fuse associated with the controller heavy duty load break, quick break type TP&N preferably interlocked with controller cabinet door. The isolator handle shall have provision for external locking in off position. All relays shall be suitable for lift service and shall incorporate adequate contact wipe for reliable operation. Relays shall operate satisfactorily between 80 percent to 110 percent of their voltage. Main motor contactors shall be suitable for A.C. duty. Tenderer shall be required to furnish full details of make, type, applicable standard, voltage and current rating, duty class, type and routine tests done etc., on contractors and relays. Copies of type test certificates and other test certificates shall also be furnished by the successful tenderer.

All cables shall be with copper conductors and flame retardant or PVC insulated of appropriate size. The cables feeding the motor and heavy current flow paths shall be so selected that the size matches the protecting fuses and will not result in more than 2 percent voltage drop from the main board to the terminals of the motor. Control cables shall not be less than 0.5 sq mm. or equivalent if stranded; where installation of heavy gauge conduits present difficulties, short lengths of flexible conduits will be permitted but effective

electrical continuity and earth bonding shall be ensured. Ferrules shall be slipped at the ends of all cables as per standard control wiring practice. All terminal blocks shall be suitably marked.

#### 15.4.2 Trailing cables:

A single trailing cable for lighting control and signal circuit is permitted, if all the conductors of this trailing cable are insulated for maximum voltage running through any one conductor of this cable. The lengths of the cables shall be adequate to prevent any strain due to movement of the car. All cables shall be properly tagged by metallic/plastic tags for identification. Trailing cables shall run from a junction box on the top of the car to a junction box located in the shaft near the midpoint of travel and from these junction boxes conductors shall be run to the various locations. Trailing cables exceeding 30 meters in length shall run so that the strain on individual cable conductors will be reduced to a minimum and the cables are free from contact with the car counter weight, shaft walls or other equipment. Trailing cables exceeding 30 meters in length shall have steel supporting fillers and shall be suspended directly by them without rubbing over other supports. Cables less than 30 meters in length shall have no-metallic fillers and shall be suspended by looping cables around supports of porcelain spools type or equivalent. 5 per cent of the total capacity subject to a minimum of 5 wires shall be available unutilized in the trailing cable everywhere suitably distributed between various functions.

#### 15.4.3 Earthing:

Metal frames and all metal work of the lift controller frame etc. shall be earthed with double earth leads taken to the earth bar. Looping shall be permitted if such routing is feasible. All other individual metallic frame work of components etc., shall be loop earthed.

#### Miscellaneous:

Principle of segregation function wise shall be accepted as far as possible in the general arrangement of components. All terminal blocks shall be of 650 V grade.

#### Controller casing:

The controller unit comprising of the main circuit breaker adjustable overload and phase reversal and phase failure protection all the circuit elements transformer, rectifier for D.C.control supply, inverter power pack, terminal blocks et., shall be enclosed in an insect proof, sheet steel floor or wall mounted cabinet with hinged doors at front or at both front and rear. Proper warning boards and danger plates shall be provided on both sides of the controller casing. Sheet steel used for controller cabinet shall not be less than 18 gauges and shall be properly braced where necessary. Suitable gland plate shall be provided for cable entry. The battery for the charger unit shall be suitably placed in the machine room.

All sheet steel work shall be painted with two coats of synthetic enamel paint of suitable shade both inside and outside over two coats of zinc primer.

#### 16.0 Lift Rope Compensation:

The lift rope compensation for lift travel shall be provided for lift travels beyond 40m in all cases.

#### 16.1 Automatic Rescue Devices (ARD)

The Automatic Rescue Devices (ARD) meant for the purpose of bringing the lift car to the nearest landing doors, is being used selectively and is generally restricted to commercial buildings having heavy traffic.

However, frequent power failures being the common phenomenon, the provision of ARD shall be made in all the lifts in public buildings. The ARD shall have the following specifications.

16.2 ARD should move the elevator to the nearest landing in case of power failure during normal operation of the elevator.

16.3 ARD should monitor the normal power supply in the main controller and shall activate rescue operation within 10 seconds of normal power supply failure. It should bring the elevator to the nearest floor at a slower speed than the normal run. While proceeding to the nearest floor the elevator will detect the zone and stop. After the elevator has stopped, it automatically opens the doors and parks with the door open. After the operation is completed by the ARD the elevator is automatically switched over to normal operation as soon as normal power supply resumes.

16.4 In case the normal supply resumes during ARD in operation the elevator will continue to run in ARD mode until it reaches the nearest landing and the doors are fully opened. If normal power supply resumes when the elevator is at the landing, it will automatically be switched to normal power operation.

16.5 All the lift safeties shall remain active during ARD mode of operation.

The battery capacity should be adequate so as to operate the ARD at least seven times a day provided the duration between usages is at least 30 minutes

#### 17.0 ANNUAL MAINTENANCE CONTRACT:

16 Passenger 4 No's

The 5 years of Annual maintenance contract will be applicable after warranty of each item and Defect Liability Period (DLP).

#### 17.1 Spectrum of services:

Electro Mechanical Equipments for which Maintenance Services are needed are detailed below. However, this list is only indicative and under each item, any other services which may be relevant and necessary shall be provided by the contractor. The contractor would assess the actual quantum of work by visiting the site and bid accordingly. The contractor, apart from executing the scope of services detailed hereunder shall also arrange required clearances, licenses sanctions etc. on behalf of TS Secretariat from various Govt. departments. However, Govt. fee if any shall be borne by TS Secretariat.

#### LIST OF APPROVED MAKES:

**SCHINDLER / OTIS / JOHNSON / KONE**