Alpha
Consulting Engineers Pte Ltd

# FEEDBACK REPORT FORM

Ref No: 157 - 051010 (S)

To: LCT From: LFY

Job No./Project: LIFT MASTER SPECS *(where applicable)*
Section 2 – Lift Machinery

Source of feedback:

Scope of Feedback: * ☐ Quality ☐ Environmental ☐ Administrative ☐ Contractual
☐ Technical X Specification ☐ Others

**Section A : Problem & Cause**
DC Traction Machines - outdated, with the advent of Power Electronics, AC Traction Machines have replaced DC Traction Machines. AC Traction Machines can be 3 phase permanent magnet synchronous or 3 phase induction motor. Also clause 2-3-5

**Section B : Mitigating Action Taken, if any** should be deleted as it is meant for DC Traction machine.

**Section C : Suggested Corrective Action**
Update to reflect current technology.

**Section D : Approved Corrective Action**

Document Affected * : ☑ Yes ☐ No Affected Document : L/2-1 to L/2-9

Approved By : Date : 5/10/2010

**Section E : Action**

Action By : NA

Targeted Completion : Oct 2010

Actual Completion : 5 Oct 2010 Verified By :

** Mark [ X] where appropriate*

Distribution:

*Select one of the following headings*

**LIFT & ESCALATOR INSTALLATION**

**LIFT INSTALLATION**

**ESCALATOR INSTALLATION**

## SECTION 2 - LIFT MACHINERY

*Select Clause 2.1a for 'Lifts', Clause 2.1b for 'Dumbwaiters only'. For Contract which calls for double deck lifts, or a combination of single and double deck lifts add those clauses which state "For double deck lifts".*

*2.1a General - Lifts*

### 2.1 General

The machinery for lifts requiring machine rooms and machine roomless lifts shall comprise hoisting machines, drive systems, control equipment, all associated power and control wiring, and other necessary items for the safe and efficient operation of the lifts.

*2.1b General - Dumbwaiters Only*

### 2.1 General

The machinery in the respective machines rooms shall comprise hoisting machines, control equipment, all associated power and control wiring, and other necessary items for the safe and efficient operation of the dumbwaiters.

### 2.2 Hoisting Machines

*2.2.1 A.C. Traction Machines*

2.2.1 A.C Traction Machines

A.C. traction machines shall be designed for bi-direction traction and shall be suitable for 400 volt, 3 phase, 50 Hz supply complete with geared or gearless assembly as specified. The geared assembly where incorporated shall be of an appropriate design and no friction gearing shall be used. The A.C. motor shall be specifically designed for lift operation and shall be three phase permanent magnet synchronous or three phase induction type designed for use with variable voltage variable frequency drives. The hoisting motor shall be capable of being frequently started in either direction and stopped and shall have high starting torque and low starting current.

When operated under normal operation conditions, the maximum temperature rise of the winding shall be in accordance with IEC 60085. The size of the motor shall take into account the contract speed and load as well as the weight of the lift car itself (which shall include the weight of the specified finishes/materials), counterweights, etc.

The drive system shall be of solid state design.

*2.2.2 Select for Dumbwaiters Traction Machines*

2.2.2 Dumbwaiter Traction Machines

Dumbwaiters shall be driven by A.C. two speed induction motors suitable for operation on 400 volt, 3 phase, 50 Hz supplies.

2.2.3 Handwinding

Provisions shall be made in all the hoisting machines for manual raising and lowering of the lift cars in an emergency situation. The direction of raising and lowering of the

lift car shall be clearly indicated. The handwinding apparatus shall, where detachable, be mounted in an accessible position in the lift controller and one unit shall be provided in each lift controller. A notice shall be prominently displayed in the lift controller, listing a step by step procedure to operate the lift in an emergency and also a warning notice to state that the handwinding apparatus shall only be used by authorised persons only.

2.2.4 Brakes

Every lift machine shall be provided with a brake that is mechanically applied and electrically released and designed to apply instantly and automatically if there is an interruption of power supply to the motor for any cause. The brake shall comprise at least two brake shoes with non-combustible linings and shall be capable of bringing the lift car to rest smoothly, under maximum conditions of load and speed. The brake shall also be capable of sustaining a static load of 125% of the contract load. No brake shall be released in normal operation unless electrical power is applied to the lift motor. No earth fault, short circuit or residual magnetism shall prevent the brake from being applied when the power supply to the lift motor is interrupted. Means of releasing the brakes in an emergency shall be provided. Provisions should also be made to ensure immediate re-application of the brake as soon as hand pressure is released.

2.2.5 Insulation & Construction

All hoisting machines shall be electrically insulated to Class 'F' of IEC 60085. The construction of all lift machines shall conform generally with BS 5655: Part 1.

*Include this Clause for double deck lifts*

2.2.6 Machine Sheaves of Double Deck Lifts

The machine sheaves of all double deck lifts shall have a Brinell hardness of at least 230.

2.2.7 Vibration Isolation

All hoisting machinery, including motors, transmissions, brakes and pullies shall be isolated from the supporting structure with neoprene type bearing pads (or neoprene impregnated duct pads, compressed fibre-glass pads) of 4mm static deflection, sized to accommodate the loads at the various support points.

Any restraints or anchoring bolts, if provided, shall be isolated from the mounting base and/or structure with neoprene inserts of min. 10mm thickness.
The entire mounting system shall be totally captive and in event of failure of the pad mounts, shall not allow equipment/base to move more than the thickness of the pads.

## 2.3 Speed Governors

The overspeed governor shall be of the centrifugal type with a trip speed which shall be set in accordance with the current edition of Singapore Standard SS 550: Code of Practice for Installation, Operation and Maintenance of Electric Passengers and Good Lifts. The electrical contacts actuated by the overspeed action of the governor shall cut off electricity supply to the traction equipment prior to the mechanical tripping of the governor.

## 2.4 Safety Gears

The safety gears shall be of flexible guide clamp type and to be mounted on the bottom member of the car frame. This gear shall be arranged to stop the car gradually whenever excessive descending speed is attained, and means shall be provided to cut off electrical supply to the traction equipment, and apply the brake prior to the application of the safety gear. The maximum and minimum stopping distances for the flexible guide clamp safety gear for the various contract lift speeds shall be in accordance to Singapore Standard SS 550.

For lifts of speed 45 mpm and below, instantaneous type of safety gears may be used.

*Insert the following sentence where there are double deck lifts.*

For double deck lifts, the safety gear shall be provided for both the upper and lower cars.

## 2.5 AC Variable Voltage & Variable Frequency (VVVF) Drive System

The VVVF drive system shall comprise a 3-phase rectifier using IGBTs as the switching device to convert the AC power source to DC and an inverter to invert the DC voltage into a 3-phase variable voltage variable frequency AC source. The inverter control unit regulates the output frequency and voltage through sine wave pulse width modulation techniques.

This drive system shall provide quiet, smooth acceleration and deceleration of the lift with a high degree of levelling accuracy, high efficiency and high power factor under all load conditions and direction of travel.

*Select this clause where hydraulic lifts have been specified.*

## 2.6 Hydraulic Drive System

### 2.6.1 Hydraulic Pumping Unit

Hydraulic pumping unit shall be of integral design and shall comprise an A.C. poly-phase squirrel cage induction motor, an oil pump, an oil cooler, a hydraulic controlling valve system, oil storage tank etc., all compactly designed to form a self-contained unit.

The oil pumps shall be of positive displacement screw type, specially designed and manufactured for lift operations. The oil pump shall be driven by a 3 phase 400 volt A.C. squirrel cage induction motor which is designed for a minimum of forty-five motor starts per hour.

The speed control system shall be close loop electronic type to provide smoothness of ride with good levelling accuracy.

### 2.6.2 Oil Storage Tanks

The oil storage tanks shall be steel reinforced rigid construction designed with a factor of safety of at least 4, based on the ultimate strength of the material. Each tank shall be supplied with all necessary fittings and connection including the following:

* Roof manhole and hinged cover.

* Visual level indicators with the minimum permissible fluid level clearly marked.

* A vent complete with breather.

* A permanent plate indicating the storage capacity, type and grade of oil to be used.

* Earthing terminal near the base of tank.

* Drain & isolating valves and piping.

* Removable oil filter.

Fluid level shall be clearly marked. Such means shall be accessible without the removal of any cover or other parts of the marked equipment.

The storage tank shall be filled with the working fluid during testing and commissioning and for the operation of the system during the Maintenance Period.

2.6.3 Vibration

The pumps shall be mounted on double neoprene pad (DNP) isolators formed by two layers of minimum 8 mm thick ribbed or waffles neoprene, separated by a metal plate. Neoprenes shall be 40 to 50 durometer and shall be selected for loadings between 280 KN/sq m and 350 KN/sq m. DPN isolators shall be of Type Korpad from Korfund Dynamics or Type WSW from Mason Industries or equivalent.

2.6.4 Pipings & Fittings

Seamless steel pipes with knife-edge-ring screw joints shall be used for the hydraulic system. The pipes and fittings shall be designed for a minimum pressure equal to at least 2 times the maximum operating pressure.

The diameter of the pipes shall be selected to prevent cavitation, starvation, turbulence or temperature rise.

Pipe hangers shall be provided with vibration isolation hangers consisting of a neoprene-in-shear of glass fibre element contained in a steel housing similar to Type H from Korfund Dynamics or Type HD from Mason Industries or equivalent. Where the hanger rod passes through the hanger housing, a neoprene neck bushing (or other means) shall be provided. Flexible pipes and coupling shall be designed to withstand a minimum pressure equal to 2 times the maximum operating pressure. All pipes shall be supported to the floor, wall or ceiling by means of rubber insulated pipe clamps or equivalent method to reduce the undue stresses at joints and bends. If pipes (either rigid or flexible) pass through walls or floors, they shall be protected by means of ferrules.

2.6.5 Valves

The main controlling valves shall be of electro-magnetic positive restrained type so constructed to remain close to the supply when pressure is shut off and shall fail to safety in the event of power failure. The main controlling valves shall have a sub-valve for car levelling.

Check valves shall be provided in ascending, descending and manual descending lines and shall be designed to hold the lift car and platform with the contract load at any point when the pump stops or the mains pressure drops below the minimum operating pressure.

The relief valves shall be provided to by-pass the oil when pressure exceeds a pre-determined value. The relief valves located between the pump and the check valves shall be so installed that it cannot be shut off from the associated hydraulic

pump. The return from the relief valve shall be passed directly to the tank concerned and not to the suction side of the pump. The relief valve shall be pre-set to open out a pressure not greater than 125% of the working pressure of the pump. The size of the relief valve and by-pass shall be sufficient to pass the maximum rated capacity of the pumps without raising the pressure more than 20% above that at which the valves opens. Two or more relief valves may be needed for each lift to obtain the required capacity.

Check relief and other auxiliary valves shall be designed to withstand a static pressure equal to 2 times the normal operating pressure.
A manual operated emergency valve shall be provided in the main line of each lift to allow lowering of the lift car at slow speed in the event of power failure or for adjustment purpose. The manual valve shall reset automatically when hand pressure is removed. A prominent warning notice shall be displayed in the lift machine room stating that the hand lowering shall only be undertaken by authorised persons and only after the driver motor has been disconnected from the main supply.

An anti-creep device shall be provided to limit automatically the car movement within 75 mm of the landing from any point irrespective of the hoistway door when leakage in the hydraulic system arises.

2.6.6 Jack Units

The jack unit which comprises a plunger and cylinder and located in the hoistway, shall form part of the hoisting mechanism of the hydraulic lift.

The plunger shall be constructed of steel with a highly polished cylindrical surface. For hollow tube construction, the plunger's width shall have an appropriate uniform thickness. Solid metal stops shall be provided at the bottom of the plunges to prevent the plunger from travelling beyond the limit of the cylinder at the maximum speed and maximum operating pressure. For lift speeds exceeding 30 mpm, terminal slow-down devices shall be provided to retard the car to 30 mpm or lower before striking the stop at a retardation rate not in excess of 9.81 metre per second squared. Plunger shall be so constructed that a normal working stress of 1/5 the ultimate is not exceeded.

The cylinder and plunger shall be designed to withstand a static pressure equal to 2 times the maximum operating pressure. The cylinder shall be equipped with a cylinder head with bearing and drip ring to prevent siphoning of oil from cylinders. Also, a wiper shall be incorporated on the cylinder head to prevent impurities from getting into the cylinder when the plunger is lowering down and a circular chamber to collect the wiped off oil film.

A mechanically operated leakage-oil pump which is operated by the car shall be incorporated to drain the leakage-oil from the circular chamber into the tank.

Sufficient clearance shall be maintained between the bottoms of the plunger and cylinder when the lift car is resting on the fully compressed buffer.

The jack unit shall be so installed that except at the supporting points, the cylinder shall be surrounded by air space.

*Select only Clause 2.7.4 for contracts which call for dumbwaiters only.*

**2.7 Control Systems**

2.7.1 Micro-processor based systems

The lift control systems shall be fully solid state employing high performance micro-processors and software programming to indicate the flight pattern of the cars, control door motion, despatch cars in accordance with varying traffic demands, co-ordinate activities of the traction motors, brakes and doors, etc. Suitable solid state transducers for measurement of velocity, position, passenger load, etc. shall be provided to form part of the feedback loop in the control system.

The lift control systems shall include speed regulators, acceleration control, selector and loading control as appropriate, which shall be entirely automatic and shall ensure smoothness in starting, acceleration, running, deceleration and stopping of each car.

An automatic stopping device shall be incorporated in every lift to bring the car to rest at the terminal landings. Final limit switches shall be provided in the lift hoistways to stop the car and to prevent normal operation should it travel beyond the operational zone.

2.7.2 Automatic Self Levelling Device

An automatic self-levelling device shall be provided for each lift to bring the cars to the floor landings to within the following accuracy, where applicable:

(a) For DC gearless & AC variable voltage variable frequency lifts +/-6mm

(b) For hydraulic lifts +/-12mm

This device shall correct for over-travel and rope stretch and shall keep the car level to within the above tolerance and at the correct landing position irrespective of the loadings of the car. Under no circumstances should jerking in any feature of the normal car operation be tolerated.

2.7.3 Floor-To-Floor Times

The floor-to-floor times shall not exceed 4.4 seconds based on the floor-to-floor height of 3300mm. The floor-to-floor time shall be measured from the time the car doors are fully closed to the time the lift stops to within the specified accuracy at the next successive floor under any loading condition and travel direction. The acceleration, deceleration and jerk (i.e. rate of acceleration) of each lift shall be controlled at the optimum level to ensure riding comfort.

2.7.4 Dumbwaiters

*(Specifications to be written for this clause)*

## 2.8 Equipment Panels

2.8.1 Construction

All equipment panels in the lift controller shall be self-supporting, floor mounted, fabricated from sheet steel of adequate thickness, robust, vermin, insect and dust-proof with double full length swing doors of metal construction complete with hinges, and locking devices. The rear of all cabinets shall be provided with adequate heat dissipation louvres and ease of access to the equipment located therein. All cabinets shall be thoroughly cleaned, anti-rust treated and painted as described in the relevant Clause elsewhere in this Specification.

Each equipment panel shall comprise all the necessary isolating switches or circuit breakers, contactors, indicating lamps, meters, busbars, sealing glands, protection devices, solid state devices and components, and other items of equipment whether specified herein or not shall be suitable for indoor service in an ambient temperature of up to 40 degrees Centigrade with 100% R.H. at maximum temperature permitted by the relevant Singapore and BS Specification.

Special attention shall be given to insulation and finish of all items. All components shall be fully tropicalised including electro-tinning of non-ferrous parts and vacuum impregnation of operating coils.

2.8.2 Contactors

The contactors shall comply with BS 5424: Part 1 with uninterrupted ratings (U.R.) mechanical duty Class III and appropriate making and breaking category.

Contacts shall be of the renewable butt type, solid copper hard silver faced and fully shrouded. Auxiliary contacts shall be provided as required. Contactor coils shall be fully tropicalised and wound for continuous operation with Class 'B' insulation to BS 5000 Part 99.

Magnets shall be fabricated from silicon alloy rivetted electrical steel sheet with shaded pole and magnet/armature assemblies which shall be fully floating and self-aligning.

Arc chutes and magnetic blow out coils shall be fitted to the larger sizes contactors as necessary.

2.8.3 Relays

Relays where used shall be electro-mechanical multi-contact D.C. type of robust construction, designed especially for lift control circuits and shall be able to handle a minimum 180 starts per hour. The relays shall comprise silver-to-silver contacts fitted to nickel silver leaf springs. The D.C control supply shall be derived from a full- wave silicon rectifier fed from a vacuum impregnated, double would transformer with proper circuit protection using HRC fuses or circuit breakers.

2.8.4 Electronic Components

Electronic devices and components shall be of highly stable and reliable type specifically for lift application and for the indoor service conditions as stated elsewhere in this specification. The electronic devices and components shall be mounted on printed circuit cards and shall be fully interchangeable and easily replaced without affecting the wiring and cabling in the cabinets or panels. The arrangement of the cards shall be such that it facilitates the routine checking, maintenance and installation. Sufficient test points shall be provided on the printed cards for routine checking and fault finding. All settings required for the proper function of the circuitry and/or system shall be carried out at the manufacturer's works.

2.8.5 Control Wiring

All control wirings within the control panels shall be PVC insulated, multi-strand, high conductivity tinned copper conductor of cross-section area not less than 1.5 sq. mm to BS 6004 and BS 6500. Wiring shall be run in a neat and systematic manner with cables supported clear of panels and without crossovers, to be fixed securely at close intervals using cleats of the compression types. For identification, different insulant

colours shall be used to distinguish the various circuits and each connection shall terminate at a terminal block placed in an easily accessible position with coded ferrules at both ends of each cable. Bushes shall be provided where cables penetrate the casings to prevent chafing of cables.

All panels shall be properly labelled to indicate the services. Labels shall also be provided to identify all items of equipment, circuits and where applicable ratings of fuses and circuit breakers, in the equipment panels. Labels shall be of the clear perspex, reverse engraved, filled flush with black (or red as suitable) filling and the back painted the same colour as the equipment. Labels shall be attached by means of machine screws and nuts or machine screws driven into drilled and tapped holes.

The panels shall be factory assembled and tested before delivery to site in suitable sizes for installation in the respective lift machine rooms.

2.8.6 Radio Interference Suppression

Radio and television interference suppression devices suitable to meet the levels specified in BS 800 'Limits of Radio Interference' shall be provided in all the equipment panels including those of the solid state drives. Interference suppression devices shall not be used in any part of the circuit when their failure may cause an unsafe condition.