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Technical Advisory for Working Safely During Maintenance Of Electric Passenger And Goods Lifts

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1. Preface

Lifts have become an indispensable part of our lives as many of us are living, working, entertaining and shopping in high-rise buildings. The high concentration of high-rise buildings in Singapore has made lifts an essential mode of vertical transportation.

Lifts that are not maintained adequately will not only cause inconvenience to users but may expose persons who are working on them to unnecessary risks. Therefore, it is important for all parties involved in such work to ensure that lift maintenance is done safely.

2. Scope

This Technical Advisory (TA) aims to provide information and guidance to meet the requirements of relevant legislation and Code(s) of Practice in all workplaces where maintenance of permanently installed electric passenger and goods lift is required. It serves to equip stakeholders in the lift industry with useful practical knowledge and good practices on service and maintenance of such lifts in Singapore.

3. Definitions

3.1 Authorised Manager

An “Authorised Manager” is a person employed and appointed by the registered lift contractor to oversee and ensure that the maintenance work is done safely.

3.2 Car

A “car” is a load-carry unit including its platform, car frame, enclosure and car door or gate. In the industry, the word “car” also means “lift car” and “cab”.

3.3 Car Top

“Car top” refers to the top of the car that serves as a working platform or enclosure used for adjustment, maintenance, inspection and repair.

3.4 Competent Maintenance Person

A “competent maintenance person” (CMP) is a person who has sufficient skill, experience and training to perform lift maintenance work as appointed by the registered lift contractor.

3.5 Landing

“Landing” refers to the portion of the floor, balcony or platform of a building or structure used to receive and discharge passengers or goods or both into and from a lift car.

3.6 Registered Lift Contractor

“Registered Lift Contractor” refers to a contractor registered with the Building and Construction Authority (BCA) to maintain lifts. In this document, the use of the term “lift contractor” has the same meaning as “registered lift contractor”.

For details on the requirements of lift contractors, refer to Registration Requirement for Regulatory Workheads (RW02) from BCA.

3.7 Lift Owner

“Lift owner” refers to a person who has the legal power of disposal of the lift and takes the responsibility for its operation and use.

3.8 Lift pit

A “lift pit” is the space in the lift well below the lowest landing served.

3.9 Lift well (Hoist way)

A “lift well” or “hoist way” is the fixed structure consisting of a chamber or shaft way for the vertical travel of one or more lifts.

3.10 Machine room

A “machine room” is the room where machine or machines and/or the associated equipment are placed. It is any enclosed or partially enclosed space that:

- is not primarily designed or intended for human occupancy; and
- has a restricted entrance or exit by way of location, size or means.

3.11 Machinery space

A “machinery space” is the space inside or outside the well where the machinery as a whole or its parts (including controller) are placed.

3.12 Maintenance

“Maintenance” refers to all the necessary operations needed to ensure the safe and intended functioning of the installation and its components after the completion of the installation, and throughout its life cycle.

For additional information on periodic maintenance and examination, refer to Singapore Standard, SS550 : 2009 Code of Practice: Installation, operation and maintenance of electric passenger and goods lifts.

3.13 Manufacturer or Supplier

“Manufacturer or Supplier” refers to the natural or legal person who takes responsibility for the design, manufacture or supply, and placing on the market either the machinery and/or safety components for lifts.

3.14 Other Entrants

“Other entrants” refers to any other person(s) who is/are authorised to enter the machine room, machinery space or hoist way to carry out work.

3.15 Soffit

“Soffit” refers to the lowered portion of a ceiling.

3.16 Work Authorisation

“Work authorisation” means a job order issued by lift contractor to the competent maintenance person to perform designated routine or non-routine maintenance work by his employer or the principal.

4. Introduction

4.1 Background

4.1.1 Performing Lift Maintenance Work can be Hazardous

Performing maintenance work on permanently installed electric passenger and goods lift can be hazardous. The types of hazards generally faced by competent maintenance workers in their working environment when they carry out the maintenance work include:

- Mechanical hazards:
 - crushing, for example, hit by counterweight or rail brackets
 - shearing, for example, caught by moving or rotating machines
 - pinching, for example, caught in-between moving objects
- Electrical hazards
- Working at height, such as:
 - falling from car top
 - falling through temporary open sides or gaps
- Falling objects
- Fire hazards

4.1.2 Why Lift Maintenance Work is Necessary

It is necessary to perform lift maintenance work to ensure the safe and proper operations of the lift.

In general, there are two types of maintenance work:

- Routine maintenance:
 - lubrication;
 - cleaning; or
 - inspection.
- Non-routine maintenance:
 - troubleshooting and doing emergency repairs;
 - replacing worn or damage components (e.g., cables, parts of elevator doors, and machine bearings that do not affect the characteristics of the installation);
 - re-calibrating of load cell and re-adjustment of sensors and switches;
 - job that requires special tools (e.g., cutting equipment, rigging equipment and heat generating equipment); and
 - assisting in or performing rescue operations.

The following operations are considered as non-maintenance work:

- Cleaning the external part of the hoist way;
- Cleaning the interior of lift car;
- Changing major components such as the machine, the car, the control panel, and so on;
- Replacing the installation;
- Modernising the installation, including changing any characteristic of the installation such as speed or load; and
- Rescue operations carried out by the authorities (e.g., Singapore Civil Defence Force [SCDF]).

For additional information on periodic maintenance and examination, refer to Singapore Standard, SS550 : 2009 Code of Practice: Installation, operation and maintenance of electric passenger and goods lifts.

4.2 Responsibilities of Different Stakeholders

It is important for all stakeholders to comply with the relevant regulations and take reasonably practicable measures to ensure the safety and health of workers, visitors and public at workplaces.

4.2.1 Lift Owner's Responsibilities

The lift owner (LO) should ensure that the lift maintenance environment is safe for work. The areas for the LO to consider can include:

- Rendering any machinery or equipment within the maintenance environment safe;
- Providing a safe route of access and egress to the lift machine room, machinery space and hoist way without posing any safety risk to workers;
- Providing clear and visible warning signs at prominent locations along the route to the lift machine room, machinery space and hoist way;
- Providing sufficient and suitable lighting for entry into or working in the lift machine room and hoist way;
- Establishing protocol and control of entry to the lift maintenance environment;
- Ensuring that a fall protection plan is in place when lift landings are opened, for example, portable barriers for routine maintenance and barricades for major lift works;
- Ensuring that lift contractor has in place relevant safety and health training for workers and supervisors on lift maintenance;
- Ensuring that lift contractor has done risk assessment for the lift maintenance operation;
- Ensuring that the rescue plan established by the lift contractor can be properly coordinated with the facilities and equipment (e.g., emergency routes of egress and rescue equipment) of the building during an emergency; and
- Ensuring that the lift contractor is registered under local statutory laws and licensed to conduct maintenance operations on lifts.

Note

As lift maintenance is a regular feature, some of the common items, for example, portable barriers, temporary caution signs could be stored on-site for easy retrieval whenever needed.

4.2.2 Lift Contractor's Responsibilities

It is important for the lift contractor (LC) to protect the safety and health of his lift maintenance workers by:

- Conducting risk assessment to remove or control risks at the workplace;
- Maintaining a safe workplace and arrangement at work;
- Ensuring safety in machinery, equipment, plant, articles, substances and work processes at the workplace;
- Developing and putting into practice control measures for dealing with emergencies; and
- Providing workers with adequate instruction, information, training and supervision.

4.2.3 Authorised Manager's Responsibilities

An authorised manager (AM) is employed and appointed by the LC to oversee and ensure that maintenance work is done safely. It is critical for the AM to ensure that risk assessment and control measures are carried out to reduce the risks to acceptable levels. The recommended steps to put in place risk assessment are:

- Form a risk assessment team;
- Establish an inventory of work activities (refer to Annex 2 for an example);
- Identify hazards and evaluate risks;
- Develop control measures;
- Implement control measures to reduce or mitigate risk level;
- Update residual risks in the risk register; and
- Arrange for risk communication.

4.2.4 Manufacturer's or Supplier's Responsibilities

Besides ensuring that the lift is safe for public use, the manufacturer or supplier also needs to ensure that none of the provided machinery and lift equipment is posing any risk to the lift maintenance person. The manufacturer or supplier should evaluate the risk and implement control measures in the design for hazards such as:

- Mechanical hazards;
- Electrical hazards;
- Working at height;
- Falling object hazards; and
- Fire hazards.

4.2.5 Competent Maintenance Person's Responsibilities

The competent maintenance person (CMP) should follow safe work procedures strictly as specified by the lift contractor. The competent person should not endanger himself or others who are working around him through any unsafe behaviour or act. It is never safe to tamper with any safety device or undertake any wilful or reckless acts. The competent maintenance person should use the appropriate personal protective equipment (PPE) correctly while carrying out lift maintenance work.

5. Risk Management Approach

In line with Workplace Safety and Health (WSH) (Risk Management) Regulations 2006, risk assessment must be conducted to identify safety and health hazards associated with lift maintenance work so as to assess their risk levels and implement control measures to eliminate or mitigate the risks to the acceptable level.

5.1 Key Elements of Risk Assessment

Conducting risk assessment is the key to reducing risks related to lift maintenance work. Everyone, from lift owner to competent lift maintenance person, must work together to ensure that the risk assessment process identifies any foreseeable risk and adopt all reasonably practicable measures to make the lift maintenance environment safe for routine and non-routine work. The risk assessment should be conducted by a team of knowledgeable and experienced personnel.

5.1.1 Hazards Identification and Evaluation

It is critical to identify hazards and manage all risks associated with lift maintenance work. During the hazards identification process, it is advisable to take these factors into consideration:

- Method of work (e.g., repeated tasks and unsafe work practices);
- Manual material handling (e.g., lifting, pulling and pushing);
- Material used (e.g., corrosive substances);
- Machinery (e.g., traction machine, pulley and governor machine); and
- Environmental conditions (e.g., slippery surfaces, lighting level, working on car-top, overhead clearance and pit depth).

5.1.2 Control of Hazards

The hierarchy of control measures to manage the identified risks should be adopted (see Figure 1).

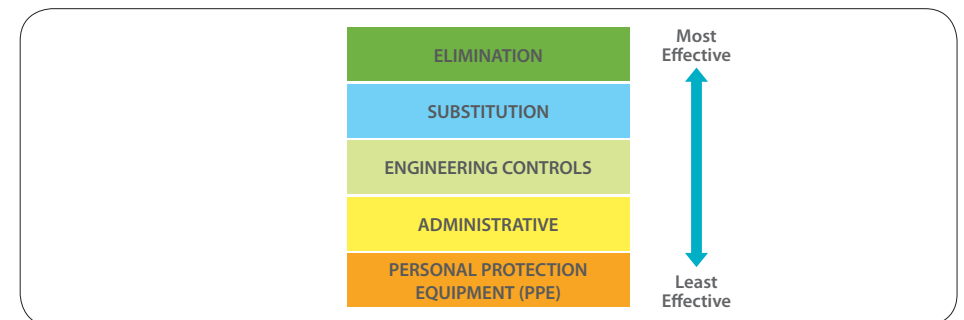


Figure 1: Hierarchy of control.

Elimination

Eliminate all hazards in the lift maintenance environment or control the hazards so that competent maintenance persons are able to carry out their maintenance work safely. For example, to trip an overspeed governor located in a hoist way, a remote tripping device can be installed to activate the governor outside the hoist way.

Substitution

This involves replacing the hazard by one that presents a lower risk. For example, to bring the batteries up to the machine room by a lifting basket instead of carrying them by hand and climbing up the cat ladder at the same time.

Engineering Control

Engineering controls are physical means that limit the hazard. One example would be to design safety railings along passageway to the roof-top machine room if the passageway is less than 1.5 metre away from the edge of the roof.

Administrative Control

This reduces or eliminates exposure to a hazard by following procedures or instructions strictly. Documentation should emphasise all the steps to be taken and the controls to be used in carrying out the activity safely. An example of administrative control is to put up necessary and appropriate safety signs.

For examples on safety signs, refer to Code of Practice for Safe working on lifts, BS7255 : 2001.

PPE

If reasonably practicable control measures are not available to mitigate the risks, the use of PPE may be considered as the last line of defence. For example, wearing safety boots can help to protect the toes from small falling objects or injury from slips and falls when the floor is wet and slippery.



Figure 2: An example of tripping the overspeed governor through a remote device outside the hoist way.

5.2 Communication

The outcome of the risk assessment should be communicated to all competent maintenance persons who may be exposed to the risks in lift maintenance work. It is necessary for authorised managers/ supervisors to inform the competent maintenance persons of:

- The work activities to be carried out;
- Associated safety and health hazards affecting them and the nature of the risks involved;
- Types of control measures implemented to protect them;
- Their responsibilities and expectations to comply with all work requirements including:
 - Obeying general safety rules and regulations;
 - The use of PPE;
 - Complying with safe work procedures; and
 - Instructions as required under Work Authorisation.
- Changes to the work conditions and risks control measures, if any.

5.3 Risk Assessment

It is essential to review or revise the risk assessment at least once every three years. However, a review of the risk assessment should also be done when these happen:

- When there is significant change to work practices or procedures including implementation of additional risk control measures; or
- After an incident arising from lift maintenance work.

5.4 Documentation

It is important to maintain duly approved record and current risk assessment. The record can include:

- Results or findings recorded in the risk assessment;
- Risk control measures taken or to be taken within an agreed and reasonable time frame; and
- Any method statement on safe work procedures.

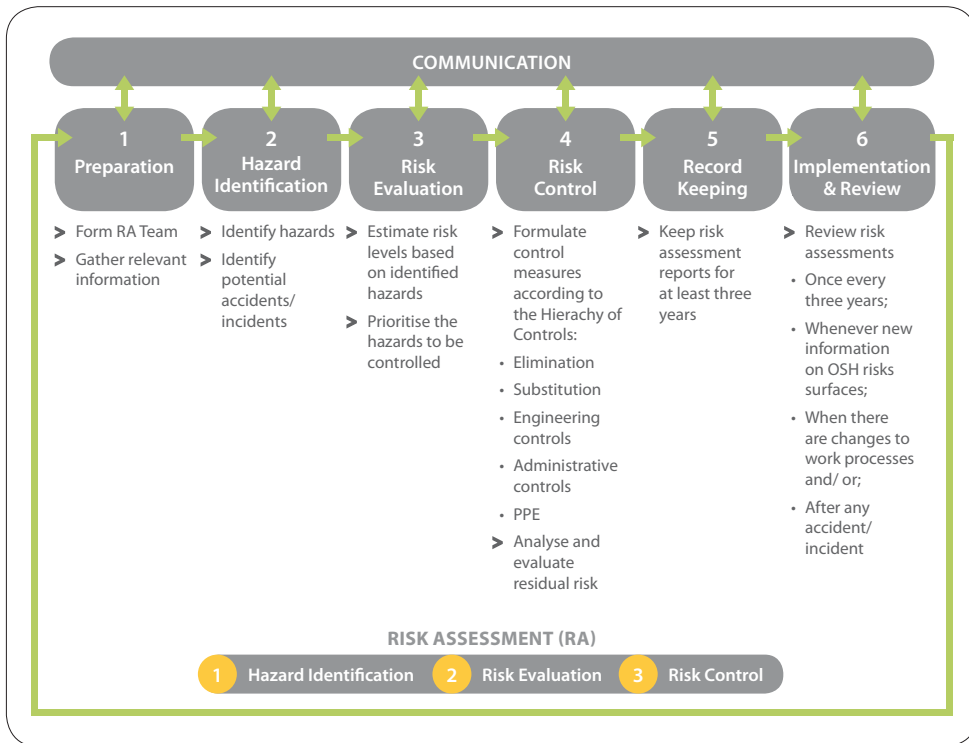


Figure 3: Example of a risk management approach.

6. Types of Hazards in Lift Maintenance

Many hazards can coexist in a lift maintenance work environment. Therefore it is important for the competent maintenance persons and other entrants to understand the hazards fully in order to protect their well-being.

The obvious dangerous working conditions in lift maintenance environment include working:

- Within limited space;
- In-between moving equipment;
- At elevated locations; and
- Adjacent to electrical terminations.

The associated common hazards in lift maintenance work include:

- Mechanical hazards;
- Electrical hazards;
- Working at height;
- Struck by falling objects; and
- Fire hazards.

6.1 Mechanical Hazards

6.1.1 Crushing Hazards

Crushing hazards in lift maintenance operations can be caused by:

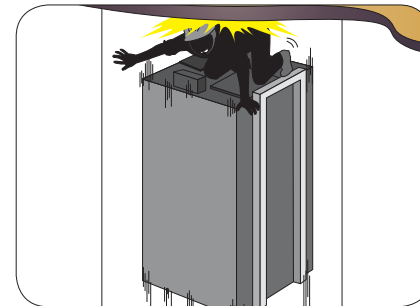


Figure 4: Being trapped between an ascending lift car and the soffit of the lift shaft.

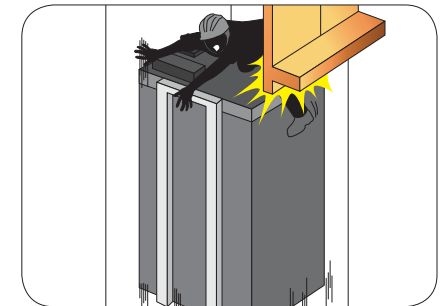


Figure 5: Being trapped between an ascending lift car and the door.

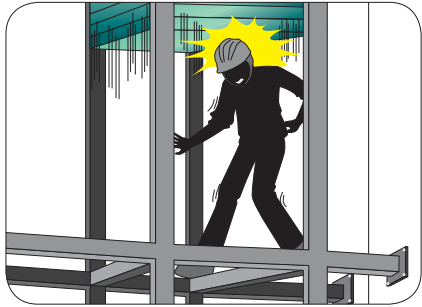


Figure 6: Being trapped between a descending lift car and counterweight inside the hoist way.

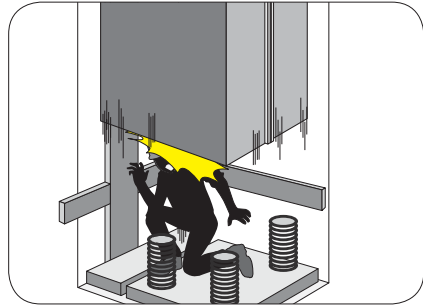


Figure 7: Being trapped between a descending lift car and the bottom of the lift pit.

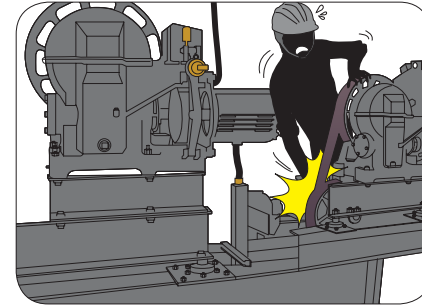


Figure 9: Fingers may get pinched when ropes come in contact with pulleys and sheavers.



Figure 10: Fingers may get pinched at the moving parts that are left uncovered.

6.1.2 Cutting, Shearing and Pinching Hazards

The cutting, shearing and pinching hazards in lift maintenance operations can be caused by:

- Landing door panels;
- Sharp corners of machine beams, under car channels, and so on.



Figure 8: An example of eliminating the sharp corners of machine beams.

1. Sharp corners (cutting hazards)
2. Round corners are used to eliminate the cutting hazards

6.2 Electrical Hazards

Electrical hazards during lift maintenance operations can be caused by:



Figure 11: Electrical panels without covers can expose workers to electrical hazards.



Figure 12: Damaged electrical cords.

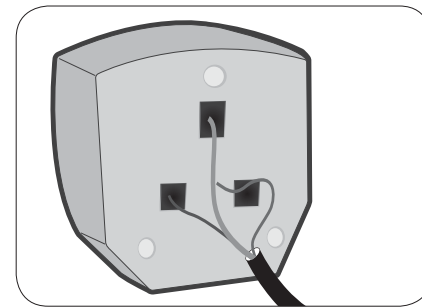


Figure 13: Exposed wires.

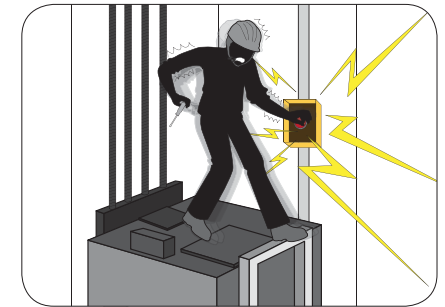


Figure 14: Electrocuted when worker comes into contact with non-finger safe termination blocks.

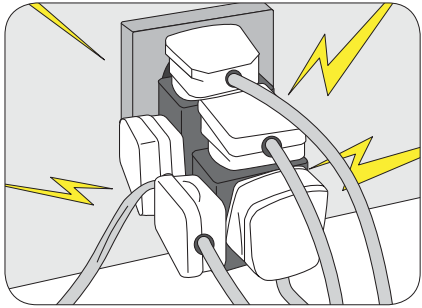


Figure 15: Overloaded circuits and plugs.



Figure 16: Flooded lift pit.



Figure 21: Falling off improperly constructed platform.

6.3 Working from Height

The hazards associated with working at elevated locations are:



Figure 17: Falling off open sides at the roof or edges of buildings.



Figure 18: Falling off the edge of the stairs.



Figure 19: Falling off the top of the lift car to the bottom of the lift pit.



Figure 20: Falling through the opening landing door into the hoist way.

6.4 Struck by Falling Objects

The hazards associated with falling objects may be due to hand tools or equipment falling into hoist way during lift maintenance:

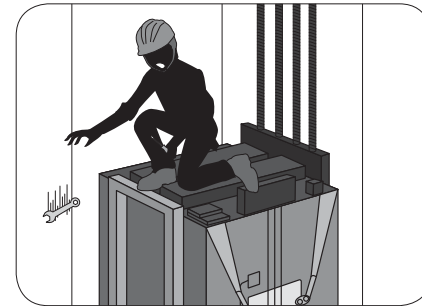


Figure 22: Hand tools falling from lift car top to hoist way.



Figure 23: Equipment falling through the landing door to hoist way.

6.5 General Hazard Considerations

While the most likely hazards for working in the lift maintenance environment are highlighted in section 6.1 to 6.4, other hazards can exist at the same time. Hence it is important to consider these general hazards.

See Table 1 for some of the factors that can be considered during risk assessment for lift maintenance operations.

MAINTENANCE AREAS						
Elements	Car	Machinery spaces	Pulley spaces	Areas outside lift car	Lift pit	Car top
Unauthorised entry		✓	✓	✓	✓	✓
Inadequate lighting (including access)	✓	✓	✓	✓	✓	✓
Uneven floor surface (holes, projection)	✓	✓	✓	✓	✓	✓
Slippery floor surface	✓	✓	✓	✓	✓	✓
Strength of the floor	✓	✓	✓	✓	✓	✓
Unsuitable dimensions (passages, maintenance places)	✓	✓	✓	✓	✓	✓
Unexpected movements	✓	✓	✓	✓	✓	✓
More than one lift car in the same area		✓	✓	✓	✓	✓
Manual handling		✓	✓	✓	✓	✓
More than one maintenance person working		✓	✓	✓	✓	✓
Absence of a means of communications	✓	✓	✓	✓	✓	✓
Ventilation and temperature for persons	✓	✓	✓	✓	✓	✓
Dangerous substances	✓	✓	✓	✓	✓	✓
Entrapment	✓	✓	✓	✓	✓	✓
Means/controls for rescue operations	✓	✓	✓	✓	✓	✓
Fire	✓	✓	✓	✓	✓	✓
	✓	Relevant			Not relevant	

Table 1: Examples of elements to be considered during risk assessment for lift maintenance operations.

7. Good Practices for Working Safely in the Lift Maintenance Environment

7.1 Authorisation Systems

7.1.1 Entry Authorisation System

The lift owner should set up an entry authorisation system to ensure security of the building and safe entry of the competent maintenance persons or other entrants to the lift maintenance environment. It is also advisable to put up early notices to inform the general public on the lift maintenance operation before the actual work starts.

7.1.2 Work Authorisation

The purpose of Work Authorisation is to ensure that the competent maintenance persons have been given the necessary instructions and support to carry out the lift maintenance operation. This authorisation is granted by the lift contractor through his authorised manager. Therefore, it is important for the lift contractors to ensure that:

- Risk assessment has been carried out on the lift maintenance work;
- Competent maintenance persons have been informed of the associated hazards in the lift maintenance work; and
- Necessary safety precautions and control measures have been implemented and enforced before lift maintenance work is carried out.

Additionally, the Work Authorisation should incorporate some of the safety requirements for lift maintenance work, such as:

- The competent maintenance persons shall be briefed on the Risk Assessment (RA) and Safe Work Procedures (SWP) before they carry out the lift maintenance work;
- RA and SWP for lift maintenance must address public safety such as safety barrier, warning signs;
- The competent maintenance persons must be issued with the appropriate PPE to perform the routine lift maintenance operations;
- Workers without sufficient and relevant experience should not work alone without supervision from competent maintenance persons or supervisor; and
- Proper documentation should include:
 - competent maintenance persons:
 - i. letter of appointment covering job scope
 - ii. training records
 - lift owners:
 - iii. job order/ contract

7.1.3 Work Authorisation for Non-Routine Maintenance Operations

A separate Work Authorisation for non-routine maintenance work (NRMO) is recommended. These include work activities that involve scaffolds, hot-work and working at car-top beyond the safety railings.

This separate Work Authorisation would help to list some of the job details and ensure control measures have been put in place. For example:

- Lift identification and location
- Type of work activities
- Validity of the Work Authorisation:
 - date and time of start of work;
 - date and time of expected work completion; and
 - expiry date of work authorisation;
- Approved job statements, safe work procedures and risk assessment
- Lifting or other equipment consideration
- Hot work consideration
- PPE consideration:
 - safety helmet;
 - safety shoes;
 - eye protection;
 - hand protection;
 - fall protection/ lifelines; and
 - Other personal equipment, such as torchlight;
- Control measures:
 - barricades;
 - signboards; and
 - lighting;
- Emergency preparedness:
 - emergency response plan and logistics;
 - rescue equipment; and
 - name and contact number of emergency responders;
- Names and signatures of supervisor and authorised manager

Refer to Annex 3 for examples of Work Authorisation form on working at height.

7.1.4 Stages of Work Authorisation System for NRMO

A work authorisation typically consists of the following stages:

7.1.4.1 Stage 1—Risk Assessment by Supervisor

The supervisor should:

- Conduct site survey/ inspection;
- Generate an inventory of work activities, risk assessments and develop safe work procedures; and
- Keep a record of the above-mentioned document and use it as reference whenever a safety appraisal is required for the same site.

7.1.4.2 Stage 2—Safety Appraisal conducted by an appointed person

Before any NRMO, safety appraisal should be conducted by a person who is appointed by Authorised Manager. The appointed person should:

- Determine the hazards and establish appropriate monitoring plan to ensure that the conditions of the lift environment remain unchanged during the whole lift maintenance operation;
- Ensure that the competent maintenance person has been briefed on the work activities, method statements and safe work procedures; and
- Review, endorse and forward the Work Authorisation for NRMO form to the authorised manager for approval.

7.1.4.3 Stage 3—Approval by Authorised Manager

The authorised manager may approve a work authorisation for NRMO if he is satisfied that:

- Effective steps have been taken to ensure the safety of the competent maintenance person and other entrants who may be using the available lift nearby; and
- All reasonable practicable measures have been taken adequately to ensure the safety and health of persons who will be entering or working in the lift environment.

After the Authorised Manager has reviewed and approved the authorisation form for NRMO, a copy of the form will be returned to the supervisor. At the same time, he will record the results of the application in a registry that is normally kept in the lift contractor's office.

Notes

- At any time during the NRMO, the Authorised Manager reserves the right to revoke or re-endorse the form if necessary (refer to Annex 3).
- If a stop work order is issued on site, the Work Authorisation for NRMO form is automatically revoked.

7.2 After Issuance of Work Authorisation for NRMO

After a work authorisation for NRMO has been issued, the supervisor should:

- Ensure that a copy of the Work Authorisation for NRMO form is available on site at all times during the course of the work;
- Review the site's status regularly and necessity for re-endorsement or revocation; and
- File and retain the form for a reasonable period after completion of work.

7.3 Record-keeping

It is important for the lift contractor to keep a record for the past Work Authorisation for NRMO forms together with all maintenance records for a period of at least five years after the issue of the records.

For details on record retention, refer to Building Maintenance and Strata Management (Lift and Building Maintenance) (Amendment) Regulations 2007.

7.4 Good Practices for Lift Maintenance Work

7.4.1 Access to Lift Machine Room, Pulley Spaces and Hoist Way

The lift owner is required to ensure a safe access to lift machine room, hoist way and lift landings as per SS550 : 2009 Code of Practice: Installation, operation and maintenance of electric passenger and goods lifts.



Figure 24: An example of ringed hoops used for the cat ladder near the building opening.



Figure 25: An example of vertical cat ladder in a single plane.

The access/ egress consists of access route to passageway and the passageway itself. Some examples of a safe access to passageway are:

- Staircase or “ship’s ladder”;

- Cat ladders with ringed hoops from 2 metres upward. This would offer some form of fall protection if the cat ladder is located close to the building’s edge;
- The vertical cat ladder in a single plane;

The characteristics of a safe passageway include:

- Clear, unobstructed and sheltered (at least a width of 1 metre and height of 2 metres) for ease of movement by the competent maintenance person;
- Non-slip floor surfaces;
- Railings at the edge of the access route or passageway when its width is less than 1.5 metres from the roof or building’s edge;
- Lighting of not less than 50 lux and installed with permanent electric light fixture to provide clear vision throughout the day; and
- Ventilation is adequate.

7.4.2 Working Safely in the Machinery Room or Machinery Space

The lift owner is required to ensure that the lift machine room and hoist ways are in good conditions as stated in Singapore Standards, SS 550 : 2009 Code of Practice: Installation, operation and maintenance of electric passenger and goods lifts.

7.4.2.1 Characteristics of a Well-Maintained Lift Machine Room and Hoist way

Some of the characteristics of a well-maintained lift machine room and hoist ways are:

- Protection against weather;
- Lockable machine room or maintenance door;
- Illumination levels of 200 lux at machine rooms from permanent lighting fixtures;
- Properly maintained lighting and switch socket outlets that are compliant to CP5 : 1998 Code of Practice for Electrical installations. Lighting switches should be installed near the entrances to machine rooms and machine spaces, preferably within an arm’s length, so that the working space can be lit before entering;
- Relevant safety signs are displayed within the machinery room. For examples on safety signs, refer to Code of Practice for Safe working on lifts, BS7255 : 2001; and
- Adequate ventilation to keep the lift machinery and associated equipment at a temperature not exceeding 38°C when measured at a distance of 1 metre from such equipment.



Figure 26: Examples of local ventilation system.

7.4.2.2 Good Practices for Working in Machine Room or Machinery Space

The following are some good practices for working in the lift machine room or machinery space:

- Lift contractor to conduct risk assessment before starting work;
- Competent maintenance person to:
 - abide by all safety and warning signs strictly;
 - conduct a thorough check before starting work. This is especially important when there is more than one lift in the lift maintenance environment. This would help the competent maintenance person to have a better understanding on the relationship between the specific lift, its corresponding lift well and its associated equipment;
 - keep all machine room(s) or machinery space door(s) locked at all times when unattended during the lift maintenance operation. This is to prevent any intrusion by other persons when the work activities are carried out;
 - render the lift inoperative and lock out before any inspection, cleaning, oiling or lubrication of wire ropes and moving parts;
 - block the lift car in order to prevent any downward movement of the lift prior to removing any hanging cables or repairing any support system of an electric/ hydraulic lift;
 - put back the protection guard immediately once the maintenance work for the dangerous part of any machinery is completed; and
 - return all equipment and facilities for maintenance, service or installation work (e.g., propping device) to their proper locations or positions.

7.4.2.3 Good Practices for Working with Moving Parts in Machine Room or Machinery Space

The following are some good practices for working with moving parts in the machine room or machinery space:

- If possible, use pulley guards with a viewing window for ropes or pulleys inspection. This would reduce the chances of contact between any body parts and the moving machinery while the competent maintenance person is performing such tasks.



Figure 27: An example of pulley guards with a viewing window for rope inspection.

- If necessary, some form of stopping devices (e.g., emergency stop switches) can be installed next to the machinery. It is important to install the devices within easy reach by the competent maintenance person when he is conducting the inspection.
- If possible, safety guards could be used for the moving parts of governors, tension pulleys and selector.



Figure 28: An example of an emergency stop switch next to drive sheave.



Figure 29: An example of safety guards provided for moving parts.

7.4.2.4 Good Practices for Controlling Electrical Hazards in the Machine Room or Machinery Spaces

The following are some good practices for controlling electrical hazards in the machine room or machinery spaces:

- In order to reduce the risk of electrical shocks by electrical parts inside the lift control panels, suitable guards or other forms of protection (e.g., finger-safe terminal blocks) should be installed to isolate these electrical parts.



Figure 30: Examples of finger-safe terminal block.

- Use clear marking and labelling to identify electrical wires and terminations. Additionally, clear markings are critical for lift isolators and distribution boards as they are required to be identified individually in an emergency.



Figure 31: Examples of clear marking and labelling on electrical wires and terminations.



Figure 32: Examples of clear marking on lift isolators and distribution boards.

- Where incoming supply of electricity (400V AC) is monitored through relays and such relays require a replacement, it is important for the lift contractor to ensure that a Work Authorisation for NRMO procedure is in place due to its high risk nature.
- When the main power is cut off for work to be done on the machinery, it is important for the lift contractor to have an authorisation system to ensure that the control of electrical energy is monitored. In addition, lockout and tagout procedure can be used as one of the control measures to isolate the source of electrical energy.

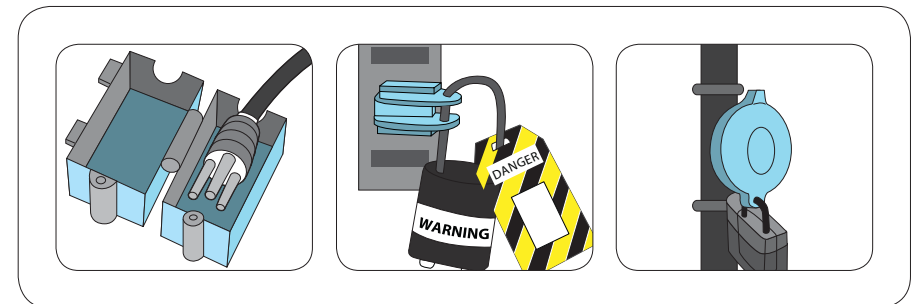


Figure 33: Examples of using lockout and tagout to isolate the source of electrical energy in the machine room.

7.4.2.5 Good Practices for Controlling Other Hazards in Machine Room or Machinery Space

The following are some good practices for controlling other hazards in the machine room or machinery space:

- Place corner protectors or round off the edges or corners of machine beams, bed frames and channels to remove sharp edge hazards.
- Keep the floor of the machine rooms free from oil to reduce the risk of slips and falls.

- For machinery spaces (i.e., machine-roomless), it is necessary for the main features of its maintenance platform to comply with SS 550 : 2009 Code of Practice: Installation, operation and maintenance of electric passenger and good lifts. For example:
 - blocking device and an electric cut-off switch are used to keep the drive stationary;
 - platform is able to support the weight of two persons with tools; and
 - platform is guarded with safety railings.

For details, refer to Code of Practice for Working Safely at Height and Singapore Standard, SS550 : 2009 Code of Practice: Installation, operation and maintenance of electric passenger and good lifts.

7.4.3 Working Safely on Lift Car Top

It is critical for the lift contractor to ensure that risk assessment is carried out before any work starts on the car top. When the lift car top is used as a working platform, it is advisable for the lift contractor to ensure that safe work procedures are in place and agreed by all stakeholders.

For requirements of working at height, refer to Code of Practice for Working Safely at Height.

7.4.3.1 Good Practices on Working Safely on Lift Car Top

The following are some good practices for working safely on lift car top:

- The competent maintenance person should:
 - position the lift car top stopping device within 1 metre of the landing threshold and check for proper operation before accessing the lift car top;
 - inspect the lift car top control and check its operational effectiveness before carrying out any work on the car top;
 - confirm adequate lighting (illumination of minimum 50 lux or any other higher lighting levels) is available on the access platform before working;
 - look out for any safety signs before working on the lift car top;
 - ensure that there are necessary means to interrupt the normal control circuit for preventing undue car movement before working;
 - confirm that necessary controls have been implemented for all the foreseeable risks according to the risk assessment. For example, lift car fan, door operators and light fittings are properly guarded to control the risk of shearing by moving parts or contact with electrical terminations. Guard rails or other fall protection measures are to be provided at the lift car top to prevent worker from falling through the gap between the lift and hoist way;

For design requirements of guard rails, refer to Singapore Standard, SS550 : 2009 Code of Practice: Installation, operation and maintenance of electric passenger and good lifts.

- note the number of persons allowed on the lift car top and keep it to the minimum. It is critical for workers to stand clear of moving rope, sheaves or other moving objects. Special care is needed where the lift car tops are curved or domed;
 - follow an established communication protocol for all persons working on the car top;
 - hold firmly onto rigid parts of the lift car structure when the lift is moving. At no time should he hold onto any wire rope when the lift is moving;
 - avoid contact with the counterweights of any adjacent lift in the same lift well. He should keep himself within the perimeter of the lift car top especially when the lift is moving; and
 - maintain good housekeeping by clearing up and cleaning the car top immediately after the lift maintenance work to ensure that no tools or parts which would fall off when the lift is returned to service are left lying around.
- It is advisable that only one competent maintenance person is appointed to take sole control of the car movement if more than one person is working on the car top. All persons on the car top should understand the procedures for activating the car movement.

7.4.4 Working Safely Within the Hoist Way

The lift contractor should ensure that risk assessment is carried out before any work starts in the hoist way. If working at lift car top is not suitable, the lift contractor should ensure that other means of access are available for the competent maintenance person to carry out his maintenance work safely.

For example, when a cantilever or other form of supporting structure from the hoist way is used for machine-roomless elevators, the lift contractor is required to:

- Engage a Professional Engineer to certify the design and calculation;
- Engage MOM-approved contractors to erect the structure; and
- Install the structure under the supervision of the Professional Engineer.

For requirements of working at height, refer to Code of Practice for Working Safely at Height and relevant WSH Regulations.

7.4.4.1 Good Practices for Working Safely in the Hoist Way

The following are some good practices for working safely in the hoist way:

- The competent maintenance person should:
 - abide by all safety signs in the hoist way;
 - set up barriers in front of the landing door when required. This would prevent unauthorised persons from intruding into the machine room or machinery space while the competent maintenance person is working in the hoist way;

- isolate the source of the electrical energy and consider using lockout-and-tagout when necessary;
- familiarise himself with all safe means of egress before entering the hoist way;
- note the number of persons allowed to work in the hoist way and keep it to the minimum, working only at one level at any time; and
- ensure that no other person, tools, access equipment, and so on are in the hoist way before the lift returns to normal operations. He should return all equipment and facilities for maintenance, service or installation work (e.g., propping device) to their proper locations or positions. This could be included as part of an end of a work checklist.

7.4.5 Working Safely at Lift Landings

All lift landing doors should remain closed at all times. If there is a need to open the lift landing door for maintenance operations, the unlocking and opening of the lift landing door must be carried out by the competent maintenance person only. The lift contractor should ensure that the control measures have been implemented to address all foreseeable risks according to risk assessment.

7.4.5.1 Lift Barrier

It is unsafe for the lift landing door to remain open longer than necessary. However, if the lift landing door needs to remain unlocked and opened for any length of time, the lift contractor must implement control measures to prevent any falling hazards. For example, a lift barrier is used to warn the public against any unauthorised entry. It can help to prevent falling hazard or objects from falling through the landing opening. In areas where there is traffic flow, barriers can be used to divert the traffic. Normally this barrier is placed about 1 metre away from the sills of landings at the lift lobbies and it is able to stand on its own.



Figure 34: An example of using lift barrier to warn the public of falling hazards.

7.4.5.2 Door Stopper

A door stopper can be used to prevent the lift door from being accidentally shut by placing it onto the sills of lift landings. The competent maintenance person can use it to keep landing doors open with a small gap.

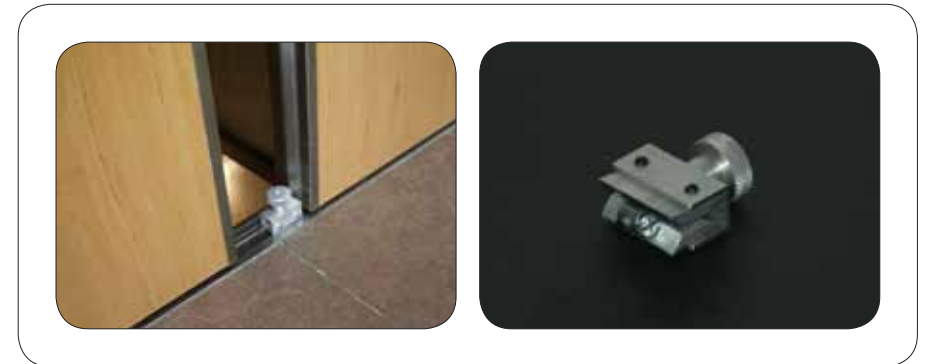


Figure 35: An example of door stopper to prevent door from getting accidentally shut.

7.4.6 Working Safely in Lift Pit

When the competent maintenance person is carrying out the maintenance work in the lift pit, it is critical that the lift is operating *only* at inspection speed. Before entering the pit, he has to confirm that all stopping devices are effective. In some situations, he may also need to isolate and lock off the main power supply.

7.4.6.1 Good Practices for Working Safely in Lift Pit

The following are some good practices for working safely in the lift pit:

- The competent maintenance person should confirm that adequate lighting (illumination of minimum 50 lux or any other higher lighting levels) is available in the lift pit before working;
- In situations where the counterweight screen is not available, the lift contractor has to put up a safety sign in a prominent position to warn the competent maintenance person;
- For hydraulic lifts, the competent maintenance person has to ensure that a mechanical restraint device is in place before any maintenance work is started in the lift pit. This device would prevent the lift from moving if the lift is activated accidentally while the competent maintenance person is working in the lift pit. For example, pit props are used for hydraulic lifts where there is a possibility of crushing when the down travel is not limited mechanically;
- The competent maintenance person should:
 - confirm that the safety guard for tension pulleys in the lift pit and pulleys under the lift car are in place;
 - use the provided pit ladder or handhold for the pit ladder to have a safe descent into the lift pit; and

For design requirements of a pit ladder, refer to Singapore Standard, SS550 : 2009 Code of Practice: Installation, operation and maintenance of electric passenger and good lifts.

- familiarise himself with the locations of the lighting and pit stop switches. If the lift pit is deeper than 1 metre, he should identify the location of the secondary pit stop switch. In many cases, the location of the first pit stop switch is located near the lowest landing while the secondary pit stop switch should be located on an adjacent wall from the first pit stop switch.
- The lift pit should be kept clean and dry to prevent any slip and fall hazard. Therefore, it is necessary for the competent maintenance person to remove any oil stains and grease before, during or after every lift maintenance work.

7.4.7 Other Good Practices in General Areas of Lift Maintenance Operations

7.4.7.1 Documentation

All relevant documents and records should be updated and kept in their proper locations. Examples for documents and records to be provided by manufacturer or supplier:

- Installation, operation and maintenance manuals;
- Equipment layout;
- Equipment arrangement;
- Hydraulic circuit diagrams;
- Wiring diagrams;
- Operation/ maintenance logbooks; and
- Process flow charts.

Documents and records to be provided by the lift contractor are:

- Risk assessment record; and
- Safe working procedures and checklists.

7.4.7.2 Display of Name and Identification Badge

The competent maintenance person and his supervisor should wear the lift contractor's uniform and display their identification badge at the workplace. This would help the lift owner to identify any intruder at the workplace.

7.4.7.3 Communication

The lift contractor should establish an effective and reliable communication plan during the lift maintenance operation. This is particularly important if routine maintenance is carried out by a single competent maintenance person.

When choosing a means of communication, it is advisable to anticipate all foreseeable risks or conditions within the lift maintenance environment. Whatever system is used, it is important that all messages can be communicated easily, rapidly and clearly between relevant people. A regular monitoring mechanism should be available at all times to ensure the well-being of the

competent maintenance persons, for example, conducting a regular check with walkie-talkies every two hours.

The communication channel should note the limited penetration of radio signals into buildings and below-ground structures. For example, some radio frequency/ wireless devices do not work effectively in a hoist way where there is metal or concrete shielding between the interior of the space and the outside. Therefore, it is essential for the competent maintenance person to have means of raising an alarm, for example, using a whistle to alert the attendants or security guards at the lift lobby.

7.4.7.4 PPE

Use PPE only as a last resort after all other control measures have been considered. In some occasions, it is used as a short term contingency during emergency, maintenance, repair or as an additional protective measure. The success of this control depends critically on the protective equipment chosen, and its fit, and if it is worn at all times and maintained properly.

The following are some examples of PPE commonly used by competent maintenance person:

- **Head Protection**
A safety helmet is required when there is a risk of head injury. It is important to wear a safety helmet which complies with applicable codes or international standards.
- **Eye and Face Protection**
Eye protection is required in all hot work or steel cutting work. If eye-irritating chemicals, vapours or dusts are present, it is necessary to wear a pair of appropriate safety goggles. The eye and face protection equipment should comply with applicable codes or international standards.
- **Hand Protection**
Gloves and protective clothing made of a suitable resistant material should be worn to protect the skin from exposure to potential injuries. Specialty gloves may be required to protect the wearer against heat, cold, or when handling material or tools.
- **Foot Protection**
Special foot protection may be worn to protect the wearer against slippery surfaces, electricity, falling objects, chemicals, or sparks. Safety shoes are required to comply with applicable codes or international standards.
- **Hearing Protection**
All persons are required to wear hearing protection if they are exposed to excessive noise. The hearing protection devices are required to comply with applicable codes or international standards.
- **Safety Harness/ Restraint Belt**
Safety harness or restraint belt has to be worn when there is a potential of falling from height. When wearing a safety harness or restraint belt, it is advisable to take extra care that such equipment would not introduce a new hazard or hinder any free movement within the work area. Serious consideration on the hazards and rescue arrangements when selecting the type of safety harness or restraint belt should be covered. The safety harness or restraint belt is required to comply with applicable codes or international standards.

8. Emergency Preparedness for Lift Maintenance

The competent maintenance person has to understand clearly and familiarise himself with the emergency procedure. This would enable him to act promptly and know how to deal with the emergency appropriately and safely.

The following are some examples of the emergency scenarios in lift maintenance:

- Fire Emergency;
- Entrapment (typically due to electrical, mechanical failures or malfunctions which usually happen in lift pit, car-top, lift motor room); and
- Injured worker (conscious, partially conscious or unconscious in lift pit, car-top, lift motor room).

8.1 Establishment of Emergency Response Plan

The lift contractor should establish and implement an emergency response plan for emergency situations that relate to lift maintenance work activities.

The following items are recommended to be included in the emergency response plan:

- Types of emergency (e.g., fire, entrapment and injuries);
- Communication protocol (e.g., emergency contact numbers and notification to relevant parties concerned);
- Appropriate types or methods to address the emergency situation (e.g., self-rescue, SCDF and specialist);
- Identify a competent Incident Commander to communicate, coordinate internally and/or with SCDF on site and provide technical support or assistance as and when required by internal rescue or SCDF;
- Effective means to assemble the required technical/ engineering personnel and Incident Commander at site in a timely manner; and
- Logistics support such as tools and equipment, PPE, fall protection equipment, and so on.

8.2 Emergency Response Arrangement

The emergency response arrangement is dependent on the types of emergency and their associated risks or hazards present on site.

For example:

- Fire at lift pit or lift machine room;
- Entrapment on lift car top or in lift pit due to electrical and/ or mechanical failures; and
- A fully or partially injured person, following a fall or caught in-between objects, hit by/ against object inside a lift pit, lift motor room, in-cage, hoist way, landing, and so on.

By conducting the risk assessment for emergency response, it would help to determine the appropriate arrangement and strategies for the particular situation. The following are examples of emergency response strategies:

- Self-rescue when the situation allows and where the hazards are understood and control measures are available. Self-rescue may be conducted only if the person is capable and it is safe to do so.
Reminder: Do not take unnecessary risks.
- Emergency response member who is trained and competent or a team of competent members.
Reminder: Do not take unnecessary risks.
- Rescue by SCDF which requires site incident coordination and may need the support of lift contractor's logistics and resources to facilitate the rescue operation.

8.3 Emergency Response Consideration

The lift contractor should plan and prepare for all the possible emergency responses at the work site. Serious consideration should be given to:

8.3.1 Communication Protocol for Worker Safety Check

Note that when an injured person is incapacitated or partially or fully unconscious, the person is unable to communicate to his supervisor, co-worker or SCDF for help. Therefore, it is critical for lift contractor to establish an operation system check to ensure that all workers on-site are contactable and safe during their normal course of work.

8.3.2 Factors for Considering Self-Rescue, Internal Rescue or by SCDF

- Safe Access/ Egress;
- Adequate lighting;
- Adequate ventilation;
- Types of injury;
- Physical size (e.g., height and weight of the injured); and
- Spoken language preferred (translator may be required).

8.3.3 Emergency Response Plan Exercise

In an emergency rescue operation, proper coordination, communication and logistics should be managed and implemented timely. Therefore, it is important that the appointed Incident Commander coordinates a table-top emergency exercise annually, and keeps the record of such an exercise. The record typically includes:

- Time and date of exercise;
- Personnel involved;
- Brief description of the type of exercise;
- Post evaluation; and
- Any improvement on the exercise conducted.

8.4 Logistics Required for Emergency Response

Generally the logistics equipment should be readily available and retrievable from the nearest location. This would ensure that there are suitable and sufficient rescue equipment during internal or SCDF's rescue operation. It is critical that all logistics equipment are properly maintained, and made readily available in the shortest possible time.

The following are some items that are required during the emergency response:

8.4.1 Tools and Equipment

The lift contractor should make available or organise equipment for such emergency responses. These tools can include those commonly associated with lift installation and major or minor repairs, such as ladder, chain-block, electrical winch, slings, chains, welding machines, and grinding machines.

8.4.2 Electrical Cabling, Lighting and Mechanical Ventilation

The lift contractor is to provide at least:

- Electrical cabling and plugs with suitable connector (industrial and household type);
- Electrical lighting;
- Mechanical exhaust and supply fans with flexible ducting; and
- Torchlight with spare batteries.

8.4.3 Communications equipment

The lift contractor should provide communication equipment like:

- Walkie-talkie;
- Mobile phone with sufficient spare batteries and charger;
- Conventional hand signal and relayed verbal communication may be considered in the absence of walkie-talkie or in close proximity.

8.4.4 PPE

The lift contractor should provide adequate and appropriate PPE during an emergency, for example, safety helmet, gloves, welding shield, mask and ear protector. In addition, the lift contractor is required to provide adequate fall protection equipment such as body harness, lanyard, fall arrestor and lifeline, and so on.

8.5 Emergency Response Team

The lift contractor has to appoint or organise an emergency response team (ERT) comprising engineers, technicians, servicemen or repairmen to address any mechanical, electrical, or software support during an emergency. Additionally, the ERT has to provide technical and in-house logistics support to SCDF to facilitate the rescue operations.

8.6 Training

The competent maintenance persons are to be trained on the procedures of the emergency response plan and guidelines on addressing emergency situations.

The ERT should be trained so that the team is able to perform the role effectively. The team members need to be familiar with the rescue plan options and the procedures for different types of emergency.

The rescuers should be familiar with the rescue equipment. They should check and ensure that all the equipment are in order and good working condition prior to use.

The lift contractor needs to evaluate the training programme for its effectiveness and relevancy, and conduct capability evaluation of rescuers and others who are involved.

9. Training for Personnel Involved

It is essential to provide training to all personnel involved in the routine and non-routine lift maintenance work. This is to ensure that they understand the hazards associated with the work environment, measures to prevent and control hazards, safety precautions to take, and emergency procedures.

9.1 Personnel to be Trained

9.1.1 Competent Maintenance Person

A competent maintenance person is the person who is required to carry out maintenance work on the lift. It is important for the person to undergo basic safety training and be informed of hazards in his work and the safe work procedures. For example, the training could involve safe manual handling of the lifting appliances and lifting gear, and the proper usage and maintenance of the PPE.

9.1.2 Supervisor

A supervisor is the person whose main duty is to oversee the lift maintenance work. In addition to the basic safety training, the supervisor should receive further training on:

- Hazards associated with the installation;
- Services/ maintenance and repair of lifts; and
- Safe work practices.

The supervisor should brief all competent maintenance persons before he allows them to start any lift maintenance work.

9.1.3 Authorised Manager

An authorised manager is a person who has overall control of the lift maintenance work at a workplace. The authorised manager needs to have thorough knowledge of the required duties and responsibilities. These duties include ensuring that the lift maintenance environment and workplace are, as reasonably practicable, free of hazards, and that measures have been taken to eliminate or control the risk(s) identified in the risk assessment.

9.2 Planning an Effective Training Programme

An effective training programme should be planned using a five-step process:

- Conduct a “training needs” assessment
 - Determine the gaps and identify the area and level of training required.
- Set goals and objectives
 - Describe the desired end result of training and state what are the expectation on the participants at the end of the training programme.
- Select training methods
 - Methods of training include lectures, discussions, demonstrations and laboratory sessions.

- Develop and present the lessons
 - Lesson planning, programme preparation, selecting the facility, printed materials, social amenities and delivery (use of audio-visual materials).
- Evaluation of effectiveness of training
 - Programme evaluation in the form of oral or written tests and skill demonstration.

9.3 Elements of Training and Training Courses

In-house briefings and training on workplace hazards, and specific procedures are to be conducted to ensure that all personnel are informed before any work starts at the workplace. Such workplace hazards and specific procedures may include:

- Work Authorisation system;
- Safe use of lifting appliances and lifting gear;
- Safe access and egress;
- Hazardous environmental conditions;
- Safe use of PPE;
- Mechanical hazards:
 - crushing;
 - shearing;
 - pinching; and
 - struck by moving object;
- Working at height;
- Electrical hazards;
- Communication procedures; and
- Emergency response plan.

9.4 Factors for Training, Refresher or Supplementary Training

Only trained personnel should be involved in lift maintenance work. Refresher training or supplementary training is required to ensure that the work can continue to be carried out safely.

Under the following situations, it is advisable for the lift owner or lift contractor to conduct refresher training or supplementary training for any personnel who are involved in the lift maintenance work:

- The risk assessment or procedures have been reviewed and changed;
- Change in duties or appointment of new duties;
- Work involving a new type of lift equipment or new hazards which were not encountered before; and
- The personnel involved demonstrated a lack of understanding of his duties, method statement, risk assessment or any safe work procedure.

9.5 Competency of Trainers

The competency of the trainers plays an important part in ensuring that:

- The contents of the training are successfully conveyed to the trainees; and
- Trainees are accurately assessed and evaluated on their understanding of the training contents.

All trainers should have a thorough working knowledge on the training subjects. Such knowledge could be acquired through a combination of training (both formal and informal), education and experience. To ensure relevancy, trainers are required to have experience in lift maintenance or installation work, either past or current, in the lift industries.

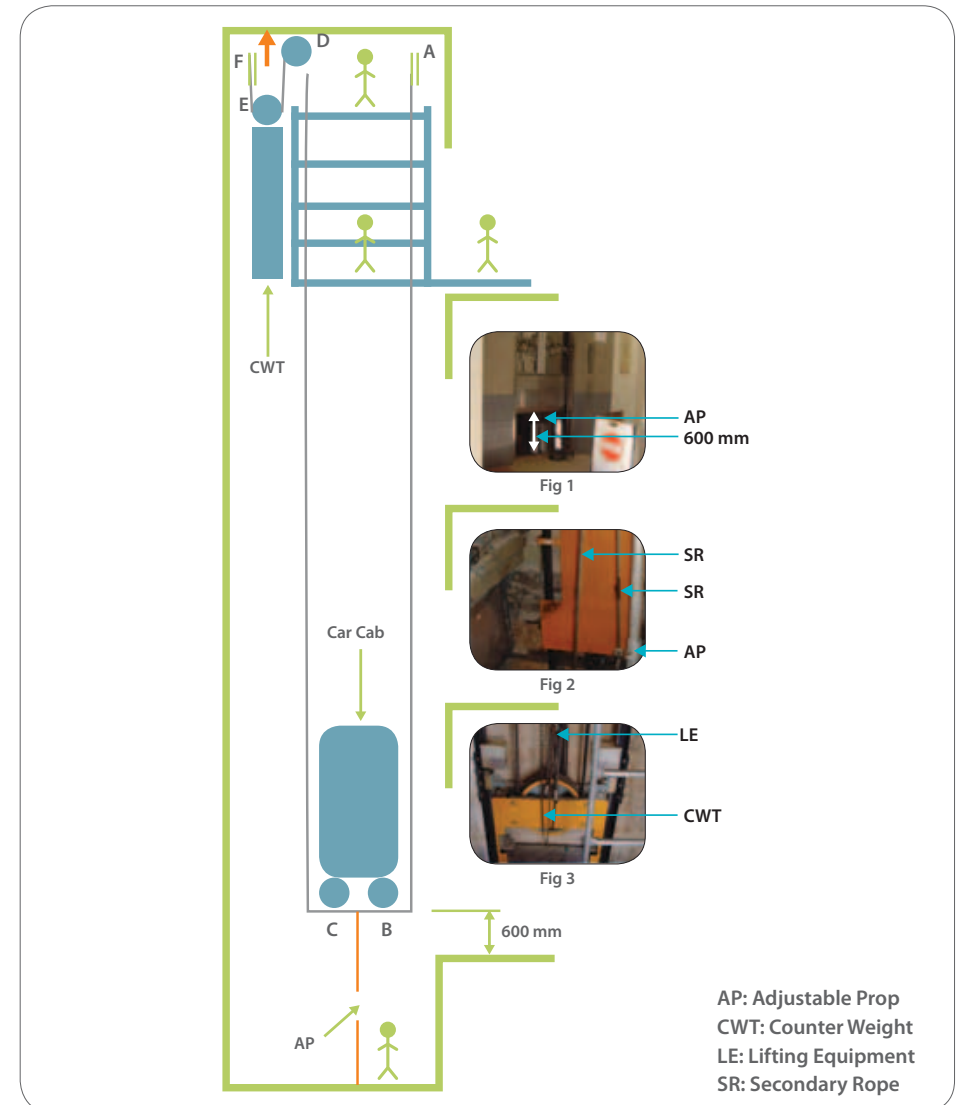
9.6 Assessment of Training

As part of the training process, it is necessary for trainers to conduct an assessment to evaluate each trainee's understanding on the training subjects. This is to ensure that overall objectives of the training programme have been achieved and trainees have a clear understanding of the training contents.

10. Annexes

Annex 1: Main Ropes Replacement

10.1.1 Method Statement



Method Statement Replacement of Main Ropes (Machine Room Less) (REV: 01052010)

STEP 1

Lift installers shall move to the lift car top and put the lift car operation to maintenance mode operation (slow speed).

STEP 2

Lift installers shall then move the lift car to lift pit level until its undercarriage reaches the position of the top of adjustable prop (AP). A gap between the bottom of lift car and entrance door sill of 600 mm has to be maintained (Fig 1).

STEP 3

Fix a secondary safety rope (SR) to the lift car undercarriage and secure it to the buffer base or a rigid bracket (Fig 2).

STEP 4

When Step 3 is completed, proceed to install a cantilever scaffold at the upper most level of the lift hoistway. Cantilever scaffold shall be assembled and disassembled by qualified personnel only (required by law).

STEP 5

Next, installers fix a lifting equipment (LE), for example, chain block, or hand winch of a hoisting capacity two times the safe working load (CWT) and secure the counterweight (CWT) components to machine overhead beam.

STEP 6

Subsequently, lift the CWT in the direction of the red arrow using the LE to loosen the tension of the main ropes connecting point A to point F. (Fig 3)

STEP 7

The next step on replacement of main ropes shall then be conducted in such a way that a minimum of two ropes are secured between CWT and lift car at all times. Lift installers can now disconnect and remove old ropes, one at a time, and re-install new ropes starting from hitch point F by sliding through point E, D, C, B and connect to hitch point A. Dismantled ropes are to be placed at the lift lobby area. Numbers of installers require in the procedure are illustrated in the diagram.

STEP 8

When Step 7 is completed, release the LE slowly from the machine overhead beam until an acceptable tension for the main ropes is achieved. Next, remove the LE from the machine overhead beam and place it at the lobby. Proceed to the lift pit area to remove the AP and SR installed earlier.

STEP 9

At lift pit, first, installers proceed to remove the SR secured earlier at the car undercarriage follow by removing the AP. The AP can be lowered by unwinding the handle from the prop. Installer shall climb out from the lift pit area. Then, installer will access, through the second floor landing door or lift car trap door, to car top working platform for next check on maintenance mode operation.

STEP 10

Execute a final check to confirm proper installation. When confirmed, qualified cantilever scaffold installers can now disassemble the cantilever scaffold from the lift hoistway. Lift installers proceed to tidy up the working area and hand over to lift supplier for final commissioning.

Annex 2: Sample of Risk Assessment Form for Lift Maintenance Operation (pp.47–62)

INVENTORY OF WORK ACTIVITIES			
Company:			
No.	Process/ Location:	Work Activities	
1	Access to lift machine room.	1.1	Access to rooftop using cat ladder.
		1.2	Moving to lift machine room via roof access.
		1.3	Access to lift machine room using cat ladder.
2	Servicing of lift traction machine and controller/ lift machine room.	2.1	Moving about in the machine room.
		2.2	Working on the controller/ traction motor terminals.
		2.3	Working on stalled traction machine (main sheave), governor and floor selector.
		2.4	Checking of main ropes and governor rope.
3	Maintenance work on lift car top.	3.1	Opening lift door and accessing to the lift car top.
		3.2	Working on lift car top.
		3.3	Checking of electrical parts (PCB, Indicator, button, switches, apparatus box, door motor and connection, etc).
4	Working in lift pit.	4.1	Access to lift pit.
		4.2	Working in lift pit.
5	Working inside lift car and lobby.	5.1	Servicing door at lobby.
		5.2	Checking lift levelling at lobby.
		5.3	Working inside lift car.

RISK ASSESSMENT FORM

Company:	Conducted by: (Names, designations) (Date)	
Process/ Location:	Lift motor room at site	Next Review Date:
Approved by: (Name, designation) (Date)	Last Review Date:	

1. Hazard Identification		2. Risk Evaluation				3. Risk Control			
1a.	1b.	1c.	1d.	2a.	2b.	2c.	2d.	3a.	3b.
No.	Work Activity	Hazard	Possible Accident/ Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)
1.1	Access to rooftop using cat ladder.	Slip and fall from cat ladder.	Fatal or fracture. Persons-at-Risk	1) Provide adequate lighting. 2) Provide cat ladder with ringed hoops. 3) Wear safety harness (if necessary) and safety shoes.	Ma	R	M	NIL	Service Engineer/ Supervisor.

***Assumption:**

All conventional practices and procedures will be followed and need not be listed specifically. These include:

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- all normal supervision, maintenance and inspection routines; and
- all safe work procedures (SWPs) and PTW.

Severity	Likelihood	Remote (R)	Occasional (O)	Frequent (F)
Major (Ma)		M	H	H
Moderate (Mo)		L	M	H
Minor (Mi)		L	L	M

H = High Risk, M = Medium Risk, L = Low Risk

1. Hazard Identification		2. Risk Evaluation				3. Risk Control			
1a.	1b.	1c.	1d.	2a.	2b.	2c.	2d.	3a.	3b.
No.	Work Activity	Hazard	Possible Accident/ Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)
1.1	Access to rooftop using cat ladder.	Falling object (from person in front climbing the cat ladder).	Head injury. Persons-at-Risk	1) Put up warning sign to remind workers NOT to stand right below the cat ladder while someone is climbing.	Mo	R	L	NIL	Service Engineer/ Supervisor.
1.2	Moving to lift machine room via roof access.	1) Install railing at the building's edge.	Concussion or death caused by loose live wire when the workers access the lift car top.	1) Provide adequate lighting along the access route. 2) Put up safety signs along the access route. 3) Wear safety shoes. 4) Maintain good housekeeping along the access route.	Ma	R	M	NIL	Service Engineer/ Supervisor.

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No.	Work Activity	Hazard	Possible Accident/ Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)
1.2	Moving to lift machine room via roof access.	Slip and fall due to wet floor.	Minor fracture or cut.	1) Provide adequate lighting along the access route. 2) Put up safety signs along the access route. 3) Wear safety shoes. 4) Maintain good housekeeping along the access route.	Mo	R	L	NIL	Service Engineer/ Supervisor.
		Working at height (building's edge).	Fatal.	1) Install railing at the building's edge. 2) Put up safety signs at the building edge.	Ma	R	M	NIL	Service Engineer/ Supervisor.

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No.	Work Activity	Hazard	Possible Accident/ Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)
1.3	Access to lift machine room using cat ladder.	Slip and fall from cat ladder.	Fatal or major fracture.	1) Provide cat ladder with ringed hoops. 2) Provide adequate lighting 3) Wear safety harness (if necessary) and safety shoes.	Ma	R	L	NIL	Service Engineer/ Supervisor.
2.1	Moving about in the lift machine room.	Trip and fall due to uneven floor.	Minor fracture or cut.	1) Provide adequate lighting. 2) Put up safety signs. 3) Wear safety shoes. 4) Level uneven floor surface.	Mo	R	M	NIL	Service Engineer/ Supervisor.

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No.	Work Activity	Hazard	Possible Accident/ Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)
2.1	Moving about in the lift machine room.	Slip and fall due to oily floor. Pinch by protruding points.	Minor fracture or cut. Cut or bruise.	1) Provide adequate lighting. 2) Put up safety signs. 3) Wear safety shoes. 4) Maintain good housekeeping in the machine room. 1) Safety briefing on all pinch point hazards before starting work. 2) Wear hand gloves (Note: Do not wear gloves when checking traction machine and governor machine).	Mo	R	L	NIL	Service Engineer/ Supervisor.
					Mo	R	M	Round off sharp corners	Service Engineer/ Supervisor.

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No.	Work Activity	Hazard	Possible Accident/ Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)
2.1	Moving about in the lift machine room.	Struck by low height objects or ceiling. Contact with live wires.	Head injury. Electrocution or serious injury due to electrical shock.	1) Provide adequate lighting. 2) Put up safety sign. 3) Wear safety helmet. 1) Provide adequate lighting. 2) Use clear marking and labelling to identify electrical wires and terminals. 3) Use protective cover for all terminals.	Mo	R	L	NIL	Service Engineer/ Supervisor.
2.2	Working on the controller/ traction motor terminals.				Ma	R	M	Round off sharp corners	Service Engineer/ Supervisor.

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No.	Work Activity	Hazard	Possible Accident/ Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)
2.3	Working on stalled traction machine (main sheave), governor and floor selector.	Pinching of fingers when contact with moving or rotating parts due to unauthorised start-ups.	Amputation.	1) Use lockout and tagout to prevent any unauthorised machine starts up.	Ma	R	M	NIL	Service Engineer/ Supervisor.
2.4	Checking of main ropes and governor rope.	Pinching of fingers when contact with moving or rotating parts.	Amputation.	1) After turning OFF the power supply, using lockout-and-tagout to prevent any unauthorised machine starts up. (Note: Do not wear gloves when checking main ropes and governor rope).	Ma	R	M	NIL	Service Engineer/ Supervisor.

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1a.	1b.	1c.	1d.	2a.	2b.	2c.	2d.	3a.	3b.
No.	Work Activity	Hazard	Possible Accident/ Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)
3.1	Opening lift door and accessing to the lift car top.	Lift car not at level (Fall from height).	Fatal or fracture.	1) Highlight lift car's top edges with bright coloured paint or adhesive safety tape. 2) Provide adequate lighting at lift lobby and hoistway. 3) Maintain good housekeeping at lift car top.	Ma	R	M	NIL	Service Engineer/ Supervisor.

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No.	Work Activity	Hazard	Possible Accident/ Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)
3.2	Working on lift car top.	Working at height.	Fatal or fracture.	1) Provide barricade at lift car top to keep worker within its perimeter. 2) Wear safety shoes. 3) Wear restraint belt when working on observation lift. 4) Provide adequate lighting. 5) Put up safety signs. 6) Maintain good housekeeping at lift car top.	Ma	R	M	NIL	Service Engineer/ Supervisor.

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3.2	Working on lift car top.	Hit by counter- weight or stationary parts in hoistway when lift moves.	Head injury.	1) Provide Maintenance Speed Operation Mode. 2) Put up safety sign near half-way point. 3) Provide barricade at lift-car top to keep worker within its perimeter.	Ma	R	M	NIL	Senior Tech, Supervisor, Officer, Engineer.
3.3	Fatal or fracture.	Contact with live wires.	Electrocution or serious injury due to electrical shock.	1) Provide adequate lighting. 2) Use clear marking and labelling to identify electrical wires and terminals. 3) Provide protective cover for the terminals.	Ma	R	M	NIL	Service Engineer/ Supervisor.

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4.1	Access to lift pit.	Slip and fall from pit ladder.	Fracture.	1) Provide adequate lighting. 2) Wear safety shoes.	Mo	R	L	NIL	Service Engineer
4.2	Working in lift pit.	Hit by falling object.	Head injury.	1) Put up safety sign. 2) Provide barrier and signage at lift lobby landing. 3) Provide door lock to motor room (to prevent other party working near roping the opening the motor room). 4) Provide adequate lighting.	Mo	R	L	NIL	Service Engineer/ Supervisor.

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No.	Work Activity	Hazard	Possible Accident/ Ill Health & Persons-at-Risk	Existing Risk Control (if any)	Severity	Likelihood	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)
4.2	Working in lift pit.	Struck by lift car or counterweight due to unauthorised start up. Wet, oily or uneven floor.	Fatal. Minor fracture or cut.	1) Install counterweight screen (as per SS 550) 2) Put up safety sign. 3) Provide pit switch to disable any lift operation. 1) Provide adequate lighting. 2) Wear safety shoes. 3) Maintain good housekeeping at lift pit.	Ma	R	M	NIL	Service Engineer/ Supervisor
		Anti-rust (aerosol) spray vapours come into contact with eyes.	Eye irritation.	1) Wear safety goggles	Mi	O	L	NIL	Service Engineer/ Supervisor

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4.2	Working in lift pit.	Inhalation of anti-rust (aerosol) spray vapours. Pinching of fingers when contact with moving or rotating parts due to unauthorised lift start up. Contact with live wires.	Dizziness, headache or nausea Amputation. Electrocution or serious injury due to electrical shock.	1) Provide adequate ventilation. 2) Use appropriate breathing apparatus. 1) Provide pit switch to disable any lift operation.	Mi Ma Ma	O R R	L M M	NIL NIL NIL	Service Engineer/ Supervisor Service Engineer/ Supervisor Service Engineer/ Supervisor

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5.1	Servicing door at lobby.	Falling into hoistway.	Fatal or fracture.	1) Use lift barrier to prevent and warn the public against any unauthorised entry. 2) Maintain good housekeeping at lobby. 3) Move and park the lift at the working floor.	Ma	R	M	NIL	Service Engineer/ Supervisor
5.2	Checking lift levelling at lobby.	Trip and fall due to lift not being levelled at landing.	Fracture or cut.	1) Highlight lift car's top edges with bright coloured paint or adhesive safety tape. 2) Provide adequate lighting at lift lobby and hoistway. 3) Maintain good housekeeping at lobby.	Mo	O	M	NIL	Service Engineer/ Supervisor

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5.3	Working inside lift car.	Hit by falling object (e.g., loose ceiling board or lighting cover). Slip and fall due to oil drips or spills in lift car flooring.	Head injury. Fracture or cut.	1) Provide adequate lighting. 2) Wear safety helmet. 1) Provide adequate lighting at lift lobby and hoistway. 2) Maintain good housekeeping inside lift car.	Mo Mo	R R	L L	NIL NIL	Service Engineer/ Supervisor Service Engineer/ Supervisor

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Annex 3: Sample of Work Authorisation Form

WORK AUTHORISATION (NON-ROUTINE MAINTENANCE OPERATION) FORM				
Purpose of the authorisation form: <input type="checkbox"/> Working at Height <input type="checkbox"/> Hot Work <input type="checkbox"/> Lifting Operation <input type="checkbox"/> Others: _____ (Please specify)				
WA No:	Job No	Street Name	Block No	Lift No
	From (dd/mm/yyyy)	To (dd/mm/yyyy)	No. of Workers	
	1) Applicant(s) shall comply with WSH Act, WSH Subsidiary Legislations, NEA Legislations, Code of Practices, etc. 2) Work Authorisation (WA) is to be submitted 3 working days in advance (minimum). The maximum validity of a WA is not more than 7 days. WA is non-automatic renewable and Applicant has to resubmit WA for approval. Daily WA shall apply whenever applicable. 3) WA is to be approved by Authorised Manager before commencement of work. 4) Approved WA to be available at site, preferably displayed prominently where work at height is to be carried out. 5) Workers must complete CSOC (WP holders) and Safety Induction, adhere to Safety Management System (SMS), Safe Work Practices (SWP) and comply with all relevant Occupational Safety and Health (OSH) legislations including those from MOM, NEA, HDB, SCDF, etc. 6) WA will be revoked and shall be considered invalid if any safety non-compliance/ lapse is found and communicated.			
Part 1: Application (To be completed by lift contractor or sub-contractor)				
Description of Lift Maintenance (Non-Routine) :				
Safety Requirements (*refer to checklist, if any)			Applicant	
<input type="checkbox"/> General safety <input type="checkbox"/> Working platform <input type="checkbox"/> Hot work <input type="checkbox"/> Lifting equipment <input type="checkbox"/> Machine room <input type="checkbox"/> Lift car top <input type="checkbox"/> Within lift car <input type="checkbox"/> Lift pit			<input type="checkbox"/> Lift lobby <input type="checkbox"/> Public <input type="checkbox"/> Others (please specify): _____ _____ _____ _____	
			Name	
			Company	
			Signature	
			Date	
			HP	
			Site Supervisor	
			Name	
			HP	
Part 2: Maintenance Staff				
<input type="checkbox"/> Acknowledge the above work activities shall be carried out in accordance with method statement and safe work practices. <input type="checkbox"/> Handover by Building Owner/ Managing Agent is in order and inspected. <input type="checkbox"/> Other instructions/ comments _____			Verified by Name Designation Signature Date/Time	
Part 3: Safety				
<input type="checkbox"/> Satisfaction of the safety provision taken by applicant. <input type="checkbox"/> Do NOT commence work Next inspection : Date _____ Time: _____ <input type="checkbox"/> WA is revoked by _____ (Name/ Designation) on _____ (Date/ Time) for safety non-compliances : _____ _____			Verified by Name Designation Signature Date/Time HP	
Part 4: Approval by Authorised Manager/ Authorised Competent Person				
Work Authorisation is:			Name	
Approve / NOT Approve			Designation	
			Signature	
			Date/Time	
Part 5: Notification of Handover to Building Owner/ Completion of Work By Applicant or Lift Contractor				
<input type="checkbox"/> Handover to Building Owner/ Managing Agent is in order and inspected. <input type="checkbox"/> WA has expired and to submit new PTW application. <input type="checkbox"/> Acknowledgement that the above work activity is completed.			Name Designation Signature Date/Time	

11. Acknowledgements

Workplace Safety and Health Council and Ministry of Manpower would like to thank the following organisations for their contribution to this Technical Advisory:

Building and Construction Authority

DOST International Pte Ltd

Esmaco Pte Ltd (a division of UGL Premas Pte Ltd)

Hitachi Elevator Engineering (S) Pte Ltd

Singapore Lift and Escalator Contractors and Manufacturers Association

We thank Fujitec Singapore Corpn Ltd for their assistance on the cover photo.

Main Ropes Replacement and Method Statement (pp. 43–45) are reproduced with permission from DOST International Pte Ltd.

12. Useful References

- BS7255 : 2001 Code of practice for Safe working on lifts, United Kingdom.
- BS EN 13015 : 2001 +A1 :2008 Maintenance for lifts and escalators—Rules for maintenance instructions, United Kingdom.
- Code of Practice for Safety at Work (Lift and Escalator), Labour Department, Hong Kong.
- Guide on Safety in Lift Repair & Maintenance, Labour Department, Hong Kong.
- Method Statment, Replacement of Main Ropes (Machine Room Less), Rev: 01052010, DOST International Pte Ltd, Singapore.
- Singapore Standard SS550 : 2009 Code of practice for installation, operation and maintenance of electric passenger and good lifts, Singapore.

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