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1. Preface

Lifts have become part of our lifestyle 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 and indispensable mode of vertical transportation.

Lift works, if not carried out safely, will expose the persons who are working on them and other personnel in or around the vicinity of the workplace to unnecessary risks. Therefore, it is important for all parties involved in such works to ensure that lift modernisation, installation or dismantling (MID) operations are carried out safely.

2. Scope

This publication aims to provide information and guidance to meet the requirements of relevant legislation and Code(s) of Practice in all workplaces where modernisation, installation or dismantling of permanently installed electric passenger and goods lift are required. It serves to equip stakeholders in the lift industry with useful practical knowledge and good practices on MID of such lifts in Singapore.

3. Definitions

3.1 Project Manager

A "project manager" is a person employed and appointed by the registered lift contractor to oversee and ensure that lift MID 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 Person

A "competent person" is a person who has sufficient skills, experience and training to perform lift MID 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 install or commission lifts. In this document, the use of the term "lift contractor" has the same meaning as "registered lift contractor".

3.7 Lift Owner

"Lift owner" refers to a person who has the legal power of disposal of the lift and is responsible for its lift MID works, operation and use.

3.8 Lift Pit

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

For details on the requirements of lift contractors, refer to *Specific Registration Requirements for Mechanical & Electrical Workhead* under "ME09, Lift and Escalator Installation" from the BCA.

3.9 Lift Well (Hoist Way or Lift Shaft)

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

3.10 Machine Room

A "machine room" is the room in which machine(s) and/or the associated equipment are placed. It is any enclosed or partially enclosed space that:

- is not primarily designed or intended for prolonged 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 of the well where the machinery as a whole or its parts (including controller) are placed.

3.12 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.

3.13 Other Entrants

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

3.14 Soffit

"Soffit" refers to the lowered portion of a ceiling.

4. Introduction

4.1 Background

4.1.1 Performing Lift Modernisation, Installation or Dismantling Work can be Hazardous

Performing MID work on permanently installed electric passenger and goods lift can be hazardous. Therefore it is important for all stakeholders to fully understand the hazards so as to protect their own well-being and that of others, such as members of the public.

Types of hazards generally faced by workers working in these environments include:

- falling hazards due to working at elevated locations, such as:
  - from car tops;
  - through lift entrances that are under construction or modifications;
  - from temporary open sides or gaps, for example, floor openings at machine rooms;
  - between different floor levels which are not properly barricaded; and
  - work activities being conducted at different height levels within/ around the vicinity of the hoist way.
- mechanical hazards, such as:
  - crushing (e.g., hit by lift car, counterweight or rail brackets);
  - shearing (e.g., caught by moving or rotating machines); and
  - pinching (e.g., caught in-between moving objects).
- electrical hazards when working with:
  - electrical wiring; and
  - control panels.
- fire hazards, such as:
  - hot work (e.g., welding or torch cutting of brackets).
- tripping hazards, such as:
  - loose or disorganised materials on floor; and
  - loose cables on floor.
- ergonomic hazards, such as:
  - manual lifting posture; and
  - physical space restriction.
- chemical hazards, such as:
  - solvents.
- physical hazards, such as:
  - sharp corners; and
  - unmarked or unguarded openings.

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 and other personnel in or around the vicinity of the workplaces.

4.2.1 Lift Owner's or Occupier's Responsibilities

The lift owner or occupier of the premises where lift MID work is conducted should ensure that the working environment is safe for work, so as to avoid or minimise conflicting work among different work parties.

Areas for lift owner or occupier to consider include:

- Render safe any machinery or equipment within the working environment;
- Provide a safe route of access and egress to the lift machine room, machinery space and hoist way without exposing workers to hazards. For example, a safe means of access and egress to the workplace is:
  - clear of obstacles;
  - free of tripping hazards; and
  - adequately illuminated.
- Provide clear and visible warning signs at prominent locations along the route to the lift machine room, machinery space and hoist way;
- Provide sufficient and suitable lighting for entry into or working in the lift machine room, machinery space and hoist way;
- Establish protocol and control of entry to the working environment. For example, only authorised entrants are allowed to enter machine room or machinery spaces;
- Ensure that the lift contractor is registered under Singapore's statutory laws and licensed to perform lift modernisation and installation works;
- Ensure that the lift contractor has done risk assessment (RA) for lift MID operation;
- Ensure that the lift contractor has adopted relevant permit-to-work (PTW) procedures, for example, when working at height or when hot works are required during lift MID work;
- Ensure that a fall protection plan is in place when MID work requires open sides. The following are common open sides:
  - lift entrances under construction or modification; and
  - machine room openings for passing of ropes or delivery of lift equipment.
- Ensure that the lift contractor has in place relevant safety and health training for workers and supervisors performing lift MID works;
- Ensure 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) at the site or building during an emergency;
- Nominate a representative to provide assistance and advice during emergency;
- Ensure that any potential disruption to the occupants of the premises is minimised during lift MID work; and
- Ensure that all waste materials from the lift MID work are properly disposed.

4.2.2 Lift Contractor's Responsibilities

It is important for the lift contractor to protect the safety and health of his or her workers by:

- Conducting RA to remove or control risks at the workplace;
- Maintaining a safe workplace and arrangement at work;
- Ensuring that the machinery, equipment, plant and articles are functioning properly.
- Ensuring that substances used are safe and that safe work processes (SWPs) are in place;
- Developing and putting into practice control measures for dealing with emergencies; and
- Providing workers with adequate instruction, information, training and supervision.

4.2.3 Project Manager's Responsibilities

A project manager is employed and appointed by the lift contractor to oversee and ensure that lift MID work is done safely. It is critical for the project manager to ensure that RA and control measures are carried out to reduce the risks to acceptable levels. The recommended steps to be put in place are:

- Forming in a RA team;
- Establishing an inventory of work activities;
- Identifying hazards and evaluating risks;
- Developing control measures;
- Implementing control measures to reduce or mitigate risk level;
- Developing and documenting SWPs;
- Updating residual risks in the risk register; and
- Arranging 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 provide proper information on the safe use of the machinery, equipment or hazardous substance. The manufacturer or supplier should evaluate the risk and implement control measures in the design for hazards such as:

- mechanical hazards;
- electrical hazards;
- falling from heights hazards;
- falling object hazards; and
- fire hazards.

4.2.5 Supervisor's Responsibilities

The supervisor should ensure that RA is done before any lift MID work starts. He or she should highlight all possible risks to the competent persons. The supervisor should ensure that control measures and SWPs are carried out by them. Before work starts, it is important for the supervisor to ensure that all necessary resources, equipment and training are made available.

4.2.6 Competent Person's Responsibilities

The competent person should follow SWPs 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 person should use the appropriate personal protective equipment (PPE) correctly while carrying out lift MID work. For training requirements (e.g., BCA trade test), refer to chapter 10.

5. Risk Management Approach

In line with WSH (Risk Management) Regulations 2006, RA must be conducted to identify safety and health hazards associated with lift MID works so as to assess their risk levels and implement control measures to eliminate or mitigate the risks to an acceptable level.

5.1 Key Elements of Risk Assessment

Conducting RA is the key to reduce risks related to lift MID work. Everyone, from lift owner to competent person must work together to ensure that the RA process identifies any foreseeable risk and adopt all reasonably practicable measures to make lift MID work safe. The RA 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 MID 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:

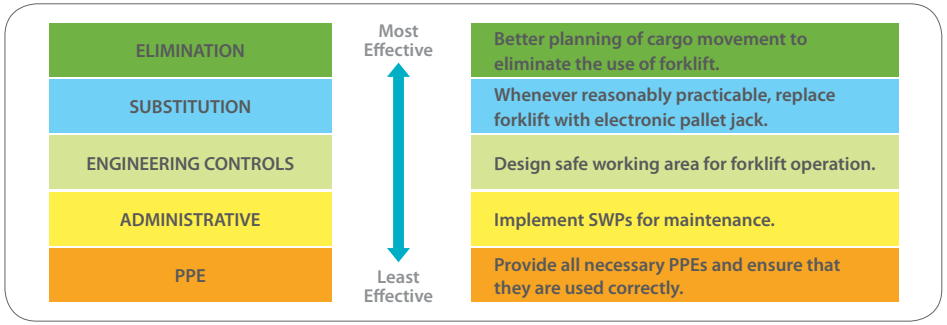

Figure 1: WSH hierarchy of control.

Elimination
Eliminate all hazards in the lift MID environment, effectively making accidents, incidents and ill-health impossible, so that the competent persons are able to carry out their lift work safely.

Substitution
This involves replacing the hazardous process by another process that presents a lower risk.

Engineering Control
Engineering controls are physical means that limit the hazard.

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 controls to use to carry out the activity safely.

For examples on safety signs, refer to *BS 7255:2001 : Code of practice for safe working on lifts.*

Personal Protective Equipment
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.

5.2 Communication

The outcome of the RA should be communicated to all competent persons who may be exposed to the risks during lift MID works. It is necessary for project managers/ supervisors to inform the competent persons of:

- the work activities to be carried out;
- associated safety and health hazards affecting them and the nature of 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 SWPs; and
  - changes to work conditions and risks control measures, if any.
- A main contractor's daily coordination meeting and toolbox meetings are possible channels to carry out such communication.

Communication during Work

It is important to maintain effective communication between different working parties during work activities. Coordination of different work parties and activities will greatly enhance safety in the work area.

The following are some examples when clear communication is of paramount importance:

- when multiple trades/ contractors are working in the same area;
- when many people are working in the same work area; or
- when multiple work activities are being carried out at the same location.

Movement of the lift car must be controlled and only carried out when all parties in the lift shaft are alerted and all necessary precautions and measures have been implemented.

Warning signs can be used to inform persons of any restricted or hazardous areas.

All procedures developed for lift shaft work should include communication as a key element. Improper or no communication between working parties is highly hazardous.

5.3 Risk Assessment

It is essential to review or revise the RA at least once every 3 years. However, the review of the RA should also be done:

- when there is significant change to work practices or procedures including implementation of additional risk control measures; or
- after an incident arose during lift MID works.

5.4 Documentation

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

- the results or findings recorded in the RA;
- risk control measures taken or to be taken within an agreed and reasonable time frame; and
- any method statement on SWPs.

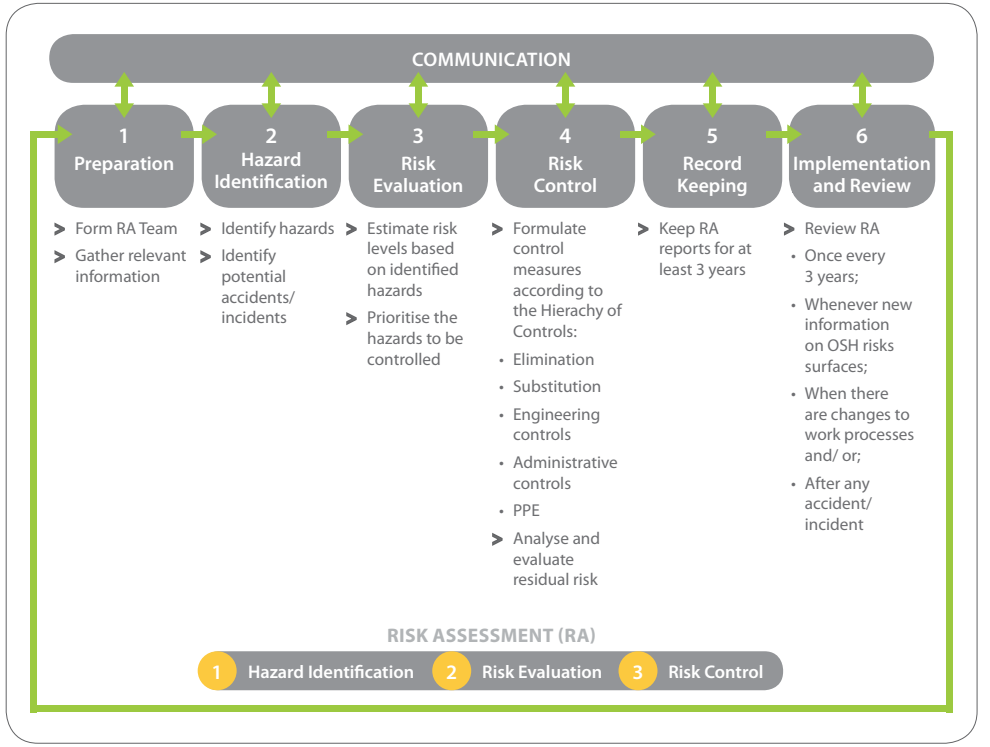

Figure 2: Example of a risk management approach.

6. Lift Modernisation, Installation or Dismantling Works

6.1 Lift Modernisation

Lift modernisation helps to enhance lift performance by replacing old equipment. Generally lift modernisation takes place when:

- The lift equipment becomes less efficient in energy use;
- The lift equipment has reached the end of its economic service life;
- Alternatives to the lift equipment are available; and
- The traffic in a building has increased.

6.2 Lift Installation

Below are some key steps for lift installation. The lift contractor will:

- Carry out site preparation for new installation;
- Start the installation by fixing parts for the hoist way onto the hoist's way walls;
- Run the trunking or conduits along the hoist way's wall from floor to floor and pull wires through the trucking or conduits once they are in place;
- Install electrical components and related devices at each floor and at the main control panel in the machine room;
- Install geared or gearless machines with a traction drive wheel that guides and moves heavy steel cables connected to the elevator car and counterweight;
- Assemble the steel frame of a lift car;
- Install the car's platform, walls, doors, guide shoes, rollers, and so on onto the lift car;
- Install outer doors and door frames at the lift entrances on each floor;
- Fine tuning all the equipment after the installation to ensure that the lift is working properly according to specification; and
- Conduct testing and commissioning together with the lift owner.

6.3 Lift Dismantling by Scaffolding Method

Below are some key steps for lift dismantling using the scaffolding method. The lift contractor will:

- Hoard up the lift lobby;
- Display safety warning signs;
- Position and secure lift car cage to top level;
- Erect scaffolding;
- Dismantle landing door and jamb;
- Remove counterweight and frame;
- Dismantle lift shaft items;
- Dismantle lift car and wire ropes;
- Dismantle trucking and guard rails;
- Dismantle lift pit items;
- Dismantle lift motor room items; and
- Retain scaffold for new lift installation, otherwise dismantle scaffolding.

6.3.1 Site Requirements

Below are some site requirements for dismantling of lifts. The lift contractor has to:

- Obtain possession of work area from client or owner;
- Submit relevant application to authority if necessary;
- Terminate lift services;
- Conduct RA and develop SWPs;
- Arrange logistic arrangement;
- Hoard up work area;
- Display safety warning signs;
- Arrange logistics for tools and equipment;
- Provide scaffold structure in lift shaft as needed;
- Provide temporary lighting and ventilation; and
- Provide lifting equipment such as lifting appliances or gears and hand-held tools.

6.4 Types of Work Activities

The following table summarises the work activities associated with lift MID operations:

Work activities (note: the sequence of the work activities may vary)	Modernisation (M)	Installation (I)	Dismantling (D)
Site preparation	✓	✓	✓
Delivery of lift parts to site (unloading)	✓	✓	
Dismantling landing door and jamb	✓		✓
Remove counterweight and frame	✓		✓
Dismantling old lift hoist way and car top equipments	✓		✓
Dismantling of lift car	✓		✓
Dismantling of main and governor rope	✓		✓

Dismantling of controller and wirings	✓		✓
Dismantling lift pit equipment	✓		✓
Dismantling old machine room equipments	✓		✓
Decommissioning			✓
Remove parts from site	✓		✓
Installation of lift hoist way equipments	✓	✓	
Installation of controller and wirings	✓	✓	
Installation of main and governor ropes	✓	✓	
Installation of lift pit equipment	✓	✓	
Installation of support I-beam and machine room equipments	✓	✓	
Installation of lift car	✓	✓	
Installation of door operator (door mechanism)	✓	✓	
Installation of car top equipment	✓	✓	
Testing and commissioning	✓	✓	

Table 1: **Summary of work activities for lift MID operations.**

7. Types of Hazards in Lift Modernisation, Installation or Dismantling Works

Many hazards can coexist when lifts are undergoing MID works. Therefore it is important for the competent persons to understand the hazards fully so that they can safeguard their well-being.

The working conditions when lifts undergo MID works include working:

- within limited space;
- in-between moving equipment;
- at elevated locations;
- below moving parts; and
- adjacent to electrical terminations.

The working conditions above may lead to the following hazards:

- mechanical hazards;
- electrical hazards;
- physical hazards;
- working at height;
- struck by falling objects;
- fire hazards; or
- chemical hazards.

7.1 Mechanical Hazards

7.1.1 Crushing Hazards

Crushing hazards during lift MID operations can be caused by:

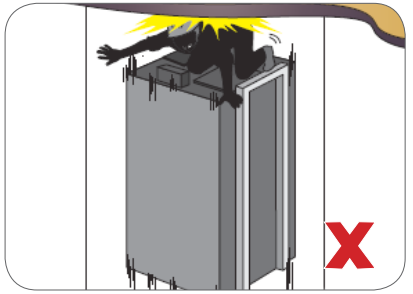

Figure 3: **Being trapped between an ascending lift car and the soffit of the lift shaft.**

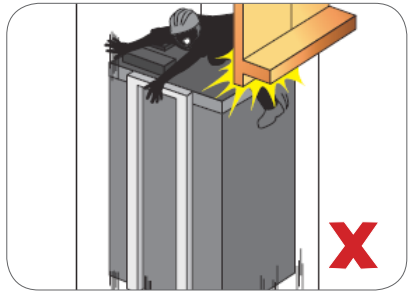

Figure 4: **Being trapped between an ascending lift car and the door.**

Figure 5: Being trapped between a descending lift car and counterweight inside the hoist way.

Figure 6: Being trapped between a descending lift car and the bottom of the lift pit.

- Heavy loads have to be correctly secured including the consideration for handling filler weights for the counterweight frame.

Figure 7: Filler weights, designed to be less than 25 kg per piece for safe manual lifting and handling.

7.1.2 Cutting, Shearing and Pinching Hazards

These hazards in lift MID works can be caused by:

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

Sharp corners (cutting hazards).

Round corners are used to eliminate the cutting hazards.

Figure 8: Example of eliminating the sharp corners of machine beams.

Figure 9: Fingers may get pinched when ropes or loose clothing come into contact with moving parts of machinery.

7.2 Electrical Hazards

Electrical hazards during lift MID operations can be caused by:

- Improperly maintained equipment.

Figure 10: Electrical panels without covers can expose workers to electrical hazards.

Figure 11: Damaged electrical cords.

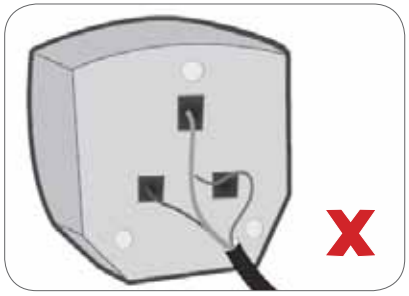

Figure 12: Exposed wires.

Figure 13: Worker can get electrocuted when he comes into contact with non-finger safe termination blocks.

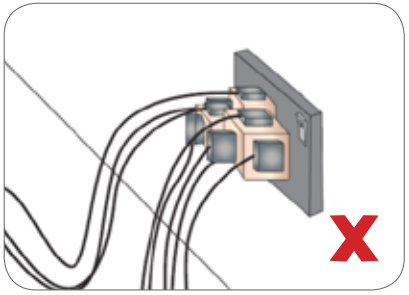

Figure 14: Example of overloaded circuits.

Figure 15: Wet or damp conditions due to water seepage into sub-controller.

Figure 16: Electrocuted when worker comes into contact with improper insulated emergency battery operated power supply (EBOPS).

Note

Emergency battery operated power supply (EBOPS) provides electrical power supply (AC) to keep the lighting and ventilation systems of a lift car working whenever there is a power failure.

Figure 17: Worker can get electrocuted when he comes into contact with defective electrical equipment.

Figure 18: Worker can get electrocuted when he comes into contact with exposed electrical terminations.

Figure 19: Worker can get electrocuted when he comes into contact with a flooded or damp hoist way.

7.3 Working at Height

The falling hazards associated with working at elevated locations are:

Figure 20: Falling off open sides at the roof or edges of buildings.

Figure 21: Falling off the unprotected edge of stairs.

Figure 22: Falling into the hoist way from lift landings.

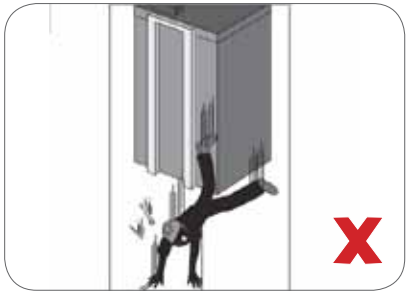

Figure 23: Falling off the top of lift car to the bottom of the lift pit.

Figure 24: Falling off improperly constructed platforms and ladders when worker is using them to help replace ropes, sheaves, and so on.

- Falling into machine room openings for hoisting equipment that are not properly covered.

Figure 25: Falling through openings in machine room floor that were not properly covered during lift installation work.

Figure 26: Falling off suspended or moving platforms such as gondola (left) and false cars (right).

Figure 27: **Falling off cantilevered platform (above) or a simply supported platform.**

Figure 28: **Falling off metal scaffolds.**

Figure 29: **Potential fall hazard—floor openings in motor room.**

Figure 30: **Falling off elevated secondary machine rooms with no railings.**

Figure 31: **Falling off pit ladders.**

7.4 Struck by Falling Objects

The hazards associated with falling objects during lift MID works are:

Figure 32: **Hand tools falling from lift car top down to hoist way.**

- Struck by falling rope when worker loses control of the rope during roping operation.

Figure 33: **Equipment or materials falling through landing door into hoist way.**

7.5 Hit by Moving Objects

The hazards associated with moving objects during lift MID works are:

Figure 34: **Hit by stationary bracket when the lift moves.**

Figure 35: **Being knocked against or hit by object being handled.**

- Wooden and netting partitions can be used to keep workers safe from moving objects.

Figure 36: **Wooden partition used to isolate hoist way to prevent workers from being hit by items accidentally dropped from other hoistways.**

Figure 37: **Netting partition used to isolate hoist way to prevent workers from being hit by items accidentally dropped from other hoistways.**

7.6 Fire Hazards

- Fire hazards posed by cloth or rags that absorbed oil or solvents can be controlled by disposing it away from work areas. Similarly, lubricating or machine oils, or solvents should be stored away from work areas.
- Fire hazards are posed by hot work which is incompatible with painting works, due to solvents in paint emitting flammable gases.
- Smoking presents fire hazards.

Figure 38: **Fire hazard presented by welding, grinding, plasma cutting or gas cutting (above).**

Figure 39: **A designated bin for the disposal of oily rags.**

Figure 40: **A no-smoking sign.**

7.7 Physical Hazards

These are the physical hazards associated with lift MID works:

Figure 41: Climbing in and out of lift pits may be difficult.

Figure 42: Slipping, tripping and falling due to uneven ground.

Figure 43: Manual handling within the confines of the shaft can be difficult.

Figure 44: Improper posture can lead to injuries.

7.8 Toxic/ Irritants (Chemical) Hazards

These are the chemical hazards associated with lift MID works:

- Contact with grease or machine oil.

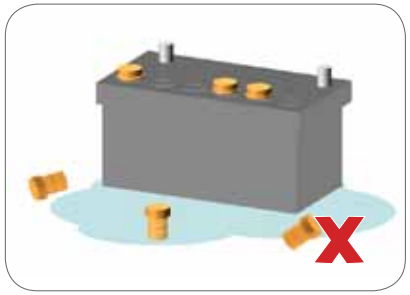

Figure 45: Contact with battery acid can cause burns and skin irritation.

Figure 46: Oil spill kits.

8. Good Practices for Lift Modernisation, Installation or Dismantling Works

8.1 Site Preparation or Requirement for Lift Modernisation, Installation or Dismantling

8.1.1 Kickoff Meeting

It is important to have a kickoff meeting with all the relevant stakeholders (e.g., building owner, working team, contractors and subcontractors) before any lift MID work starts. The meeting should at least include:

- project scope;
- project schedule;
- required tooling and equipment;
- working method;
- manpower resource;
- restrictions;
- means of communication; and
- specific information and requirement related to project or site (if any).

8.1.2 Agreement to Start

During the joint inspection by building owner and lift contractor, it is essential to ensure that the following items are identified or in place before the lift contractor takes possession and starts any lift MID work on site:

- Site pre-requisite for commencement of works include:
  - construction works;
  - access and egress;
  - designated storage place;
  - nearby utilities (e.g., lights and electrical power);
  - checklist confirmed and signed off; and
  - emergency response plan.
- General site safety checks include checks on:
  - access and egress route;
  - designated work area;
  - entrance protection;
  - machine room or space protection;
  - all barricades;
  - workplace lighting;
  - warning notices;
  - housekeeping; and
  - existing terminated services (if needed).

- Method safety check includes:
  - method statement;
  - SWPs;
  - PTW; and
  - safety checklist.
- Public safety check includes:
  - barricade;
  - fence;
  - warning notice; and
  - hoarding (note: hoarding shall not be removed during lift installation).
- Personal safety check includes making sure that the worker has:
  - adequate safety training or attended refresher course; and
  - adequate and appropriate PPE.
- site house-rules;
- toolbox meeting;
- any special safety requirement or conditions;
- RA; and
- insurance policy in force.

8.1.3 Essential Information

It is also necessary to obtain other essential information such as:

- existing equipment:
  - size;
  - weight;
  - data;
  - drawings; and
  - special dismantling method (if any).
- packing list.

8.1.4 Handing Over

It is important to have an official handing over from building owner to lift contractor before any lift MID work starts. The items for handing over include:

- barricades for open sides;
- hoarding for public safety;
- clearing of shaft and pit area;
- removal of protruding reinforcement bars;
- hoisting hooks or beams in lift well and/ or in lift machine room;
- clearing area around lift landing;
- removing stagnant water;
- electrical power supply at lift lobby; and
- adequate storage space.

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

The lift owner is required to ensure that the safe access to lift machine room, hoist way and lift landings complies with *Singapore Standard SS550 : 2009 Code of Practice: Installation, operation and maintenance of electric passenger and goods lifts*.

Access or 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"; and
- cat ladders which are securely fitted. They should be fitted with ringed hoops from 2 metres upward if they exceed 3 metres in height. This would offer some form of fall protection if the cat ladder is located close to the building's edge.

Figure 47: Example of cat ladder with ringed hoops.

Figure 48: Example of cat ladder without hoops above 2 metres.

The characteristics of a safe passageway include:

- Clear, unobstructed and sheltered (at least a clear width of 1 metre and clear height of 2 metres) for ease of movement by the competent person;
- Non-slip floor surfaces;
- Railings at the edge of the access route or passageway when it 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 that the
- Ventilation is adequate.

8.3 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 to comply with *Singapore Standard SS 550 : 2009 Code of Practice for Installation, operation and maintenance of electric passenger and good lifts.*

8.3.1 Characteristics of a Well-maintained Lift Machine Room, Machinery Space and Hoist Way

Some characteristics of a well-maintained lift machine room, machinery space and hoist ways are:

- protection against severe weather;
- lockable machine room or maintenance door;
- illumination levels of 200 lux from lighting fixtures at machine rooms;
- proper lighting and switch socket outlets that are compliant to *Singapore Standard CP5 : 1998 Code of Practice for Electrical Installations* and *Singapore Standard CP88: Part 1: 2001 Code of Practice for Temporary Electrical Installation Part 1: Construction and Building Sites;*
- 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; and
- adequate ventilation in machine room.

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

8.3.2 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:

- The lift contractor must conduct RA before starting work.
- Competent persons are 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 work environment. This would help the competent person to have a better understanding on the relationship between the lifts, its corresponding lift well and associated equipment;
  - Keep all machine room or machinery space door(s) locked at all times when it is not in use during lift MID operation. This is to prevent any intrusion by other persons when work activities are being 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 system from any movement of the lift prior to removing any hanging cables or support system of an electric or hydraulic lift;
  - Put the protection guard back to its designated place immediately once the work for the dangerous part of any machinery is completed; and
  - Return all equipment and facilities (e.g., propping device) to their designated locations or positions after use.

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

- Whenever there is a risk of coming into contact with any moving parts, suitable guard or protection should be used to reduce the chances of contact with any body parts or loose clothing.

Figure 49: **Example of pulley guards with a viewing window for rope inspection.**

8.3.4 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.

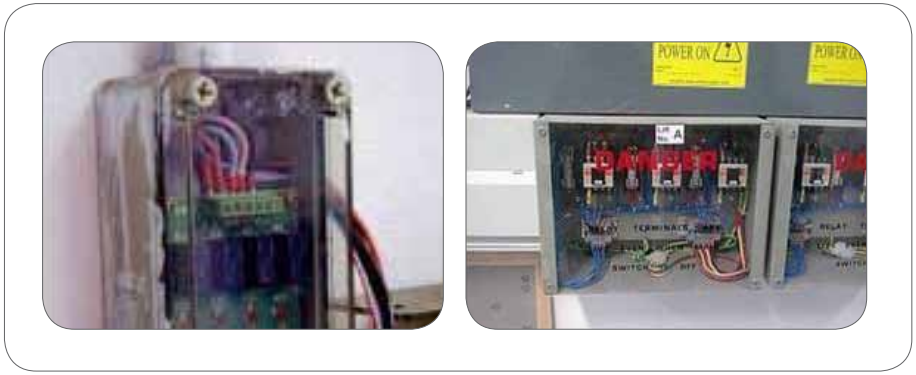

Figure 50: **Examples of finger-safe terminal block.**

- Use clear marking and labelling to identify electrical wires and terminal blocks. Additionally, clear markings are critical for lift isolators and distribution boards as they are required to be identified individually in an emergency.
- Where incoming supply (400V AC) is monitored through relays prior to the installation of such relays, it is important for the lift contractor to ensure that a work authorisation is in place due to its high risk nature.

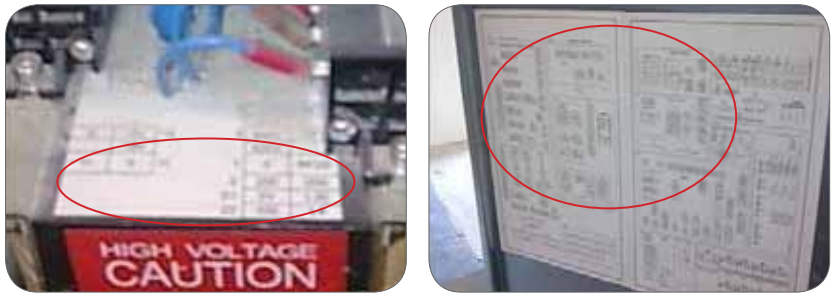

Figure 51: **Examples of clear marking and labelling on electrical wires and terminal blocks.**

Figure 52: **Examples of clear marking on lift isolators and distribution boards.**

- When 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 53: **Examples of using lockout and tagout to isolate the source of electrical energy in the machine room.**

8.3.5 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 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 *Singapore Standard SS550 : 2009 Code of practice for installation, operation and maintenance of electric passenger and good lifts*. For example:
  - Blocking device and an electric cutoff switch are used to keep the drive stationary; and
  - Platform is guarded with safety railings.

For details, refer to the *Code of Practice for Working Safely at Height* and *Singapore Standard SS550 : 2009 Code of practice for installation, operation and maintenance of electric passenger and goods lifts.*

8.4 Working Safely on Lift Car Top

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

8.4.1 Good Practices on Working Safely on Lift Car Top

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

- The competent person should:
  - Position the lift car top stopping device within 1 metre of the landing;
  - Inspect the lift car top control and check its operational effectiveness before carrying out any work on the car top;
  - Threshold and check for proper operation before accessing the lift car top;
  - Confirm adequate lighting (illumination of minimum 50 lux) 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;

Figure 54: **Proper checks must be done before accessing the car top.**

- Confirm that necessary controls have been implemented for all the foreseeable risks according to the RA. For example, lift car fan, door operators and light fittings are properly guarded to control the risk of shearing by moving parts or coming into 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 requirement of guard rails, refer to *Singapore Standard, SS550 : 2009 Code of Practice: Installation, operation and maintenance of electric passenger and goods 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 from any moving rope, sheaves or other moving objects. Special care is needed when the lift car tops are curved or domed;
- Follow an established communication protocol for all persons working on the car top;
- Hold firmly onto the rigid parts of the lift car structure when the lift is moving. At no time should the competent person hold onto any wire rope when the lift is moving;
- Avoid contact with counterweights of any adjacent lift in the same hoist way. He should keep himself within the perimeter of 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 installation or modernisation work to ensure that no tools or parts which would fall off when the lift resumes to service are left lying around.

- It is advisable that only one competent 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. For example:
  - If a worker (Worker A) is working on the car top and the other worker (Worker B) is in the lift car, then worker A should take sole control of the car movement.
  - If a worker (Worker A) is working at the lift pit and the other worker (Worker B) is in the lift car, then Worker A should take command of the car movement and the pit switch or stopping device if it is within his reach.

8.5 Working Safely Within the Hoist Way

The lift contractor should ensure that RA 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 person to carry out his 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 the requirement of working at height, refer to *Code of Practice of Working Safely at Height* and other relevant WSH Regulations.

8.5.1 Good Practices for Working Safely in the Hoist way

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

- The competent person should:
  - Abide by all safety signs in the hoist way;
  - Familiarise himself with all safe means of egress before entering the hoist way;
  - Isolate the source of the electrical energy (e.g., using lockout-and-tagout).
  - Note the number of persons allowed to work in the hoist way and keep it to the minimum;
  - Work only at one level at any time; ensure that no other person, tools, access equipment, and so on are in the hoist way before the lift is returned to its normal operations; and
  - Return all equipment and facilities to their proper locations or positions after maintenance, service or installation work (e.g., propping device). This could be included as part of an "end of work" checklist.
- Before any MID work commences:
  - Ensure that scaffolds used within the hoist way are erected according to *CP 14 : 1996 Code of practice for Scaffolds* and it is inspected every week;
  - Check that the shaft entrance protection is in place on the landing. This would prevent persons from falling into the hoist way;
  - Check that hoarding is in place during lift MID work to prevent the public from accessing the lift entrance;

Figure 55: **Example of shaft entrance protection.**

Figure 56: **Example of hoarding during lift modernisation.**

- Provide isolation (e.g., partition) for concurrent work activities between common hoist ways. If such provision is not possible, then it is recommended for the competent person to work on two lifts at the same level at the same time;
- Ensure that trained riggers are employed for rigging activities;
- Ensure that riggers understand the rigging operation well; and
- Ensure that all hoisting points are verified.

8.5.2 Good Practices when Working on Moving Platform

Moving platforms are often used for work in lift shafts. To ensure safety during the use of moving platforms:

- Ensure that the moving platform is tested by a professional engineer and approved for use;
- Ensure that guardrails and toe-boards are installed;
- Users should only use proper or designated access points;
- Users must be trained to use the moving platform;
- Users should always use appropriate fall protection equipment (e.g., separate vertical lifeline); and
- Obey safe working load.

8.6 Working Safely at Lift Landings

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

8.6.1 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 is to 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 hazards or objects from falling through the landing opening. In some traffic flow area, 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 57: **An example of using lift barrier to prevent unauthorised access.**

8.6.2 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 person can use it to keep landing doors open with a small gap.

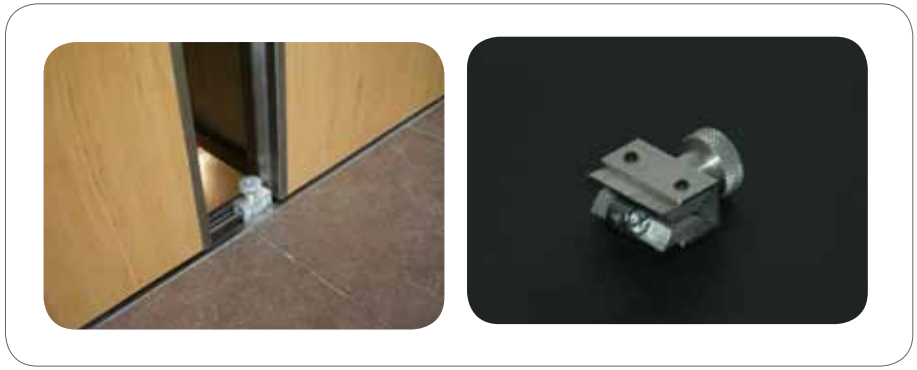

Figure 58: **An example of using a door stopper to prevent doors from being accidentally shut.**

8.7 Working Safely in Lift Pits

When the competent person is carrying out work in the lift pit, it is critical that the lift is operating at inspection speed only. 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.

8.7.1 Good Practices for Working Safely in Lift Pits

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

- The competent 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 is to put up a safety sign in a prominent position to warn the competent person;
- For hydraulic lifts, the competent person is to ensure that a mechanical restraint device is in place before any lift work starts in the lift pit. This device would prevent the lift from moving if the lift is activated accidentally while the competent 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 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 location 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.
- Lift pits should be kept clean and dry to prevent any slips, trips and falls hazards. Therefore, it is necessary for the competent person to remove any oil stains and grease before, during or after every lift work.

8.8 Working Safely during Testing and Commissioning

Each type of lift is unique and requires very specific checks based on its make and design. Therefore, its manufacturer's instructions and warnings must be adhered to. The following key points must be checked before any testing and commissioning (T&C) work can be carried out:

- Motor room:
  - power supply;
  - brake adjustment;
  - motor room to be secured before lift shaft work begins; and
  - governor machine is installed.
- Hoist way
  - obstruction in lift shaft;
  - landing doors must be properly secured;
  - correct number of counterweight blocks loaded (may vary according to stage);
  - car top clearance;
  - bottom run-by clearance; and
  - buffer installed and filled with oil.
- Communication
  - effective communication with the installation team; and
  - effective communication with co-workers (T&C).

8.9 Other Good Practices in General Areas of Lift Manufacturing, Installation or Dismantling Operations

8.9.1 Documentation

All relevant documents and records should be updated regularly and be 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 or maintenance logbooks; and
- process flow charts.

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

- RA records; and
- SWPs and checklists.

8.9.2 Display of Name and Identification Badge

To help the lift owner identify intruders at the work place, competent persons and supervisors should be easily identifiable, for example, by wearing the lift contractor's uniform and displaying their identification badge at the workplace.

8.9.3 Communication

The lift contractor should establish an effective and reliable communication plan during the lift MID operation.

When choosing a means of communication, it is advisable to anticipate all foreseeable risks or conditions within the lift working 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 persons.

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

8.9.4 Personal Protective Equipment

During risk mitigation, 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 being chosen and whether they are being fitted correctly, worn at all times and maintained properly.

The following are examples of PPE commonly used by competent persons:

- **Head protection**
  A safety helmet is required when there is a risk of head injury. It is important to wear a safety helmet that complies with applicable codes or international standards.
- **Eye and face protection**
  Eye protection is required in all hot works or steel-cutting works. 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 against heat, cold, or when handling materials or tools.
- **Foot protection**
  Special foot protection may be worn to protect 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 or restraint belt**
  Safety harnesses or restraint belt are to be worn when there is a possibility of falling from heights. When wearing the 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. Consideration must be made on the hazards and rescue arrangements when selecting the type of safety harness or restraint belt. The safety harness or restraint belt is required to comply with applicable codes or international standards.

8.9.5 End-of-day Activities

To ensure the safety of workers and the general public, the following should be done before leaving the work area at the end of a working day:

- locking up the hoarding door;
- reinstating any barricades that have been opened for work;
- securing of lift landing door (if applicable);
- clearing away tools or materials;
- making sure that all workers have left the work area; and
- switching off all powered appliances.

9. Emergency Preparedness for Lift Manufacturing, Installation or Dismantling

Each lift MID job should have an emergency response procedure which should be in line with the building emergency response procedure. This should be briefed to all personnel, enabling them to act promptly and be able to deal with the emergency appropriately and safely.

The following are some examples of emergency scenarios during lift MID work:

- fire emergency;
- entrapment; and
- injured worker.

9.1 Establishment of Emergency Response Plan

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

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

- types of emergency (e.g., fire emergency, entrapment and injuries); and
- communication protocol (e.g., emergency contact numbers and notification to relevant parties concerned).

The plan should consider means of communication during emergency situations such as:

- Walkie-talkie;
- Mobile phone;
- Emergency whistle;
- Conventional hand signals and relayed verbal communication may be considered in the absence of walkie-talkies or in close proximity;
- Appropriate types or methods to address the emergency situation (e.g., self-rescue, Singapore Civil Defence Force [SCDF] and specialist);
- Identify a competent Incident Commander to communicate, coordinate internally and/or with SCDF on site and to provide technical support or assistance as and when it is required by internal rescue or SCDF;
- Ensure that there are means to account for each worker (e.g., using a register);
- Establish an assembly area;
- Effective means to assemble, in a timely manner, the required technical or engineering personnel and Incident Commander at the site; and
- The plan should consider any specialised resources (e.g., equipment, PPE, fall protection equipment) that would be required in the event of a rescue.

Emergency equipment can include:

- torchlight with spare batteries; and
- PPE.

Adequate and appropriate PPE such as safety helmet, gloves, welding shield, mask and ear protector should be provided. 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.

9.2 Emergency Response Arrangement

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

- Self-rescue or internal rescue when the situation allows and when the hazards are understood and control measures are available. Self-rescue may be conducted only if the person is capable and that it is safe to do so.

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.

9.3 Emergency Response Consideration

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

9.3.1 Communication Protocol for Worker Safety Check

An injured person may not be able to get help from co-workers, his supervisor or the SCDF, due to incapacitation or unconsciouness. Therefore, it is critical for the lift contractor to establish a system to account for workers at the site and to ensure that they remain contactable and safe during work.

9.3.2 Factors for Considering Self-rescue, Internal Rescue or by SCDF

They include:

- safe access or egress;
- adequate lighting;
- adequate ventilation;
- types of injury; and
- physical size (e.g., height and weight of the injured).

9.3.3 Emergency Drill

In an emergency rescue operation, proper coordination, communication and logistics should be managed and implemented timely. Therefore, it is important to conduct emergency drill regularly, and keep records of such drills. The record typically includes:

- time and date of drill;
- personnel involved;
- brief description of the type of emergency scenario;
- post evaluation; and
- any improvement on the drill conducted.

10. Training for Personnel Involved

It is essential to provide training to all personnel involved in the lift MID 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.

Specific types of training include:

- appropriate work at heights courses;
- WSH coordinator courses;
- safety courses for supervisors; and
- Construction Safety Orientation Course (CSOC) for workers.

Aspects that should be covered by internal training:

- basic safety training that are relevant to lift MID work;
- work at heights;
  - working on scaffolds; and
  - working on cantilevers or simply suspended platforms.
- general electrical safety;
- basic risk identification or assessment;
- safe use of lifting equipment;
- safe manual handling;
- emergency response (e.g., first aid);
- fire prevention;
- product training; and
- technical methods or processes such as installation.

Internal training should be conducted with a properly structured syllabus.

10.1 Personnel to be trained

10.1.1 Competent Person

A competent person is the person who is required to carry out lift MID work. It is important for the person to undergo basic safety training and be informed of hazards in his work and the SWPs. 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.

10.1.2 Supervisor

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

- hazards associated with the installation;
- services or maintenance and repair of lifts; and
- SWPs.

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

10.1.3 Project Manager

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

10.2 Planning an Effective Training Programme

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

i. Conduct a "training needs" assessment:
   - Determine the gaps and identify the area and level of training required.

ii. Set goals and objectives:
   - Describe the desired end result of training and state what are the expectations on the participants at the end of the training programme.

iii. Select training methods:
   - Methods of training include lectures, discussions, demonstrations and laboratory sessions.

iv. Develop and present the lessons:
   - Lesson planning, programme preparation, selecting the facility, printed materials, social amenities and delivery (use of audiovisual materials).

v. Evaluate the effectiveness of training:
   - Programme evaluation in the form of oral or written tests and skill demonstration.

10.3 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.
- falling from height;
- electrical hazards;
- communication procedures; and
- emergency response plan.

10.4 Factors for Training, Refresher or Supplementary Training

Only trained personnel should be involved in lift MID work. Refresher training or supplementary training is required to ensure that the work can continue to be carried out safely. It is recommended to conduct refresher training at least once every 2 years.

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

- The RA 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, RA or any SWPs.

10.5 Competency of Trainers

Lift contractors should have trainers who 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 MID work.

10.6 Assessment of Training

It is necessary for lift contractors to make sure that trainers conduct 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.

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