

Workplace Safety and Health Guidelines

Working Safely During Installation, Maintenance and Replacement of Escalators and Moving Walks



WSHCOUNCIL

Tripartite Alliance for
Workplace Safety and Health

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1. Introduction

In addition to passenger and goods lifts, escalators and moving walks (herein referred to as “Esc/MW”) are the next indispensable part of our lives as many of us are working, entertaining and shopping in our highly dense built environment. The high concentration of high-rise buildings and infrastructures in Singapore has made Esc/MW another essential mode of moving safely and efficiently which involves machinery and moving parts.

The health and safety of persons working on Esc/MW is the responsibility of all persons associated with such work, particularly:

- the employers and supervisors of those persons working on Esc/MW;
- persons working on Esc/MW;
- persons who have control of premises containing the Esc/MW; and
- other persons working in the premises containing the Esc/MW.

Esc/MW that are installed and maintained properly will not only enhance user experience but will also prolong equipment lifespan. Therefore, it is important for all parties involved in such work to apply reasonable care upstream so that downstream installation, maintenance or replacement work is done safely.

All persons working on Esc/MW are expected to pay due care and attention to potential hazards, make provision for the proper use of safeguards and follow defined working procedures so that accidents and ill health can be avoided. This is particularly important as those working on an Esc/MW are likely to be working in areas not accessible to passengers and will not therefore be fully protected by those safeguards built into an Esc/MW for the benefit of passengers.

The effectiveness of such safe working procedures will be substantially improved if persons working on Esc/MW are able to benefit from features which are inherent in machinery manufactured/installed in accordance with the prevailing Singapore Standards SS 626: Code of Practice for design, installation and maintenance of escalators and moving walks. A crucial element in securing safe working is the initial training given to personnel, backed by subsequent experience and additional training for this aspect of the work.

1.1 Scope

This set of guidelines aims to provide information and recommends safe working practices (supported by training) for those responsible for, and involved in the examination, inspection, testing, service and maintenance, repair and replacement/refurbishment of Esc/MW. The work focus on the installation of various components is indicated in Annex 3.

Note

The scope does not cover pre-fabrication, transportation, lifting of the steel truss structure and cladding work which would be undertaken by a specialist contractor.

This set of guidelines also recommends provisions intended to ensure a safe working environment as well as the personal well-being of the workers to meet the requirements of relevant WSH legislations and Code(s) of Practice in all workplaces where installation, maintenance and replacement of permanently installed escalators and moving walks are required.

It serves to equip stakeholders in the Esc/MW industry with useful practical knowledge and good practices on installation, service and maintenance, and replacement/refurbishment of such Esc/MW in Singapore.

The recommendations relate to the safety of persons when gaining access to and from the work area on an Esc/MW installation and while working there. They also relate to the safety of others in the vicinity, whether working or not, who may be endangered by the actions of those working on escalators or passenger conveyors.

2. Abbreviation, Terms and Definitions

2.1 Abbreviation

2.1.1 Escalators and Moving Walks: “Esc/MW”

2.2 Terms and Definitions

2.2.1 Authorised Manager

An “Authorised Manager” is a person employed and appointed by the registered escalator contractor to oversee and ensure that the maintenance work is done safely. The person may be the maintenance manager in the company.

2.2.2 Competent Maintenance Person

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

2.2.3 Comb

A pronged section at each landing that meshes with the grooves.

2.2.4 Comb Plate

A platform at each landing to which the combs are attached.

2.2.5 Escalator

A power-driven, inclined, continuous moving stairway used for raising or lowering persons in which the user carrying surface (e.g. steps) remains horizontal.

Note

Escalators are machines – even when they are out of operation – and cannot be considered as fixed staircases.

2.2.6 Exterior Panel

A part of the exterior side of the enclosure of an escalator or moving walk.

2.2.7 Handrail

A power-driven moving rail for persons to grip while using the escalator or moving walk.

2.2.8 Interior Panel

A panel located between the skirting or lower inner decking and the handrail guidance profile or balustrade decking.

2.2.9 Escalator Owner

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

2.2.10 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.

2.2.11 Manufacturer or Supplier

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

2.2.12 Machinery

An escalator or a moving walk machine(s) mechanism and associated equipment.

2.2.13 Machinery Spaces

Spaces inside or outside of the truss where the machinery as a whole or in parts is placed.

2.2.14 Moving Walk

A power-driven installation for the conveyance of persons in which the user carrying surface remains parallel to its direction of motion and is uninterrupted (e.g. pallets, belt).

Note

Moving walks are machines – even when they are out of operation – and should not be used as a fixed access.

2.2.15 Other Entrants

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

2.2.16 Registered Escalator Contractor

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

Note

WSHC recommends minimum bizSAFE level 3 for registered escalator maintenance contractors.

2.2.17 Risk Assessment (RA)

“Risk assessment” is a comprehensive estimation of the probability and the degree of possible injuries or damage to health or property, in order to identify appropriate mitigating measures.

2.2.18 Safe Work Procedure (SWP)

“Safe Work Procedure” refers to a formal procedure, resulting from a risk assessment, which specifies safe methods of work to ensure that the hazards relevant to the task being undertaken are eliminated and the remaining risks are minimised.

2.2.19 Skirting

A vertical part of the balustrade interfacing with the steps, pallets or belt.

2.2.20 Work Authorisation

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

2.2.21 Workplace

“Workplace” refers to premises or part of premises where work is carried out.

Note

This can include:

- Any place that is accessible to those at the workplace; and
- Any means of access to/from the workplace, e.g. staircase, corridor.

3. 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 the public at workplaces.

3.1 Escalator Owner's Responsibilities

The escalator owner (EO) should ensure that the escalator maintenance environment is safe, conducive and healthy for work. The areas for the EO to consider include (non-exhaustive):

- Rendering any machinery or equipment within the maintenance environment safe;
- Providing a safe route of access and egress to the escalator landing platform (machine room), steps, steps and skirt panel without posing any safety risk to workers;
- Providing clear and visible warning signs at prominent locations along the route to the escalator landing platform (machine room), steps, steps and skirt panel;
- Providing enough and suitable lighting for entry into or working in the escalator landing platform (machine room);
- Establishing protocol and control of entry to the escalator maintenance environment. The escalator owner should manage the entry for all the personnel involved including their staff, escalator contractor and other trade contractors, if applicable;
- Ensuring that fall preventive measures are in place when escalator floor plates are opened, e.g. effective portable barriers for routine maintenance and effective barricades for major escalator works;
- As escalator maintenance is a regular feature, some of the common items, e.g. portable barriers, temporary caution signs could be stored on-site for easy retrieval whenever needed.
- Ensuring that escalator contractor has in place relevant safety and health training for workers and supervisors on escalator maintenance;
- Ensuring that thorough and site-specific risk assessments have been done together with the escalator contractor for the escalator maintenance operation;
- Ensuring that the rescue plan established by the escalator 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;
- Ensuring that the escalator contractor is registered under local statutory laws and licensed to conduct maintenance operations on escalators; and
- Ensuring a valid permit to operate is issued before operation or after any major alteration or replacement works is conducted to the escalator.

3.2 Contractor's Responsibilities

It is important for the escalator contractor (EC) to protect the safety and health of his/her escalator maintenance technicians by (non-exhaustive):

- Conducting site-specific risk assessment to remove or control risks at the workplace and communicating the risks, hazards and control measures to them;
- Maintaining a safe workplace and arrangement at work;
- Ensuring safety in machinery, equipment, plant, articles, substances and work processes at the workplace;
- Developing Safe Work Procedures (SWP) for maintenance works;
- Developing and putting into practice control measures for dealing with emergencies; and
- Providing escalator maintenance technicians with adequate instruction, information, personal protective equipment (PPE), training and supervision.

3.3 Authorised Manager's Responsibilities

An authorised manager (AM) is employed and appointed by the EC 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 addressed in Section 4.

3.4 Manufacturer's or Supplier's Responsibilities

Besides ensuring that the escalator is safe for public use, the manufacturer or supplier would need to mitigate all foreseeable health and safety risks that the machinery and escalator equipment provided may pose to the escalator maintenance person.

3.5 Competent Maintenance Person's Responsibilities

The competent maintenance person (CMP) should follow safe work procedures (SWP) strictly as specified by the escalator contractor. The competent person should not endanger himself/herself or others who are working around him/her by 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 escalator maintenance work.

3.6 Managing Agent's Responsibilities

The managing agent of the escalators should manage the escalators in the property in accordance to the specified terms and conditions stipulated by the EO and ensure all the SWP are strictly adhered to by the CMP when conducting maintenance work on the escalators.

4. Risk Assessment

Under the Workplace Safety and Health (Risk Management) Regulations, every workplace must conduct a Risk Assessment (RA) for all work activities. Workplace risks can be assessed in three simple steps:

STEP 1: Hazard Identification

Determine hazards associated with the activity of each work process, along with the potential accidents or ill-health that could result from these hazards. Person(s) who may be at risk as a result of being exposed to these hazards can also be identified.

STEP 2: Risk Evaluation

Estimate the risk levels of the identified hazards and their acceptability on:

- the severity of the hazard; and
- the likelihood of the incident.

STEP 3: Risk Control

Based on the outcome of the risk evaluation in STEP 2, risk controls should then be selected to reduce or confine the identified risk to an acceptable level.

These risk controls should be effective yet practicable. To control hazards and reduce risks, control measures should be observed in accordance with the hierarchy of control (See Figure 1).

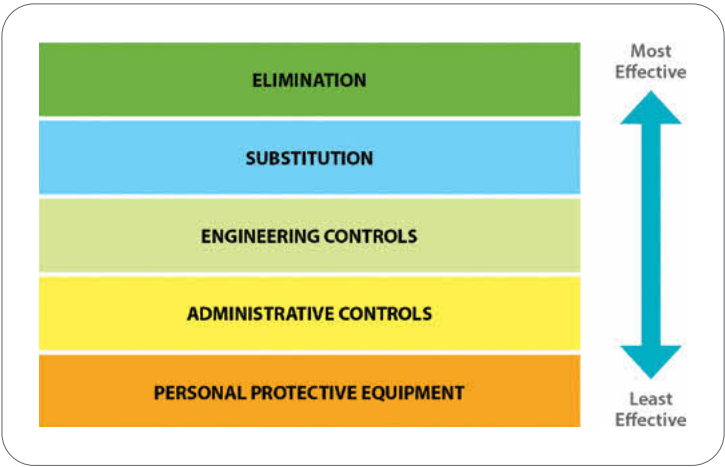


Figure 1: The hierarchy of control.

Hierarchy of Control

The type of control measures in the hierarchy of control is ranked in order of effectiveness. As far as possible, priority should be given to upstream risk control measures.

- **Elimination**

Elimination of risk refers to the removal of the worker's exposure to the hazards, effectively making all identified possible accidents and ill-health impossible. As elimination is the most effective method of risk control, it should be attempted first. Once the risk is eliminated, it will not appear in subsequent risk assessment forms.

- **Substitution**

This involves replacing a hazard with one that presents a lower risk.

- **Engineering Controls**

Engineering controls are physical means that limit the hazard. These include structural changes to the work environment or work processes.

- **Administrative Controls**

These controls reduce or eliminate exposure to a hazard by adhering to procedures or instructions. Documentation should emphasise all steps in the work processes and controls needed for work activities to be carried out safely.

- **Personal Protective Equipment (PPE)**

Proper use of PPE can keep workers safe at work. However, PPE should only be used in addition to other control measures (e.g. engineering control measures) or when all other measures are not feasible or practical. For PPE to be effective, it must always be properly worn when the user is exposed to the hazards. The PPE must also fit the user correctly and kept cleaned and stored in an appropriate place when not in use.

Note

- It may be necessary to use more than one risk control measure to reduce risks to the lowest possible level if a single measure is insufficient. For example, engineering controls such as using safer equipment, can be implemented together with administrative controls, for instance, training and Safe Work Procedures, to reduce a workplace risk.
- Engineering controls are a must in protecting employees from known hazards when they cannot be mitigated; however, those efforts are absolutely futile if the same time and effort is not expended on training employees on their proper use and purpose.
- Selecting an appropriate control is not always easy. It often involves doing a risk assessment to evaluate and prioritise the hazards and risks. In addition, both "normal" and any potential or unusual situations must be studied.
- Choosing a control method may involve: Evaluating and selecting temporary and permanent controls; implementing temporary measures until permanent (engineering) controls can be put in place; implementing permanent controls when reasonably practicable.

Refer to Annex 1: An example of Risk Assessment Form/Inventory of Work Activities for Escalators and Moving Walks.

The sample provided in this guidelines is for user's reference. The workplace should prepare proper and appropriate risk assessment for each work activity to be carried out.

For more information on risk management and risk assessment, refer to the Code of Practice on Workplace Safety and Health (WSH) Risk Management.

5. Types of Hazards During Installation, Maintenance and Replacement Work Pertaining to Escalators and Moving Walks

Many hazards can exist in an escalator work environment. Therefore, it is important for the competent persons to understand the hazards fully in order to protect their well-being.

The associated common hazards in escalator work include but not limited to the following:

- Mechanical Hazards;
- Electrical Hazards;
- Working at Height;
- Fire Hazards;
- Slip and Trip;
- Manual Handling;
- Posture/Ergonomics;
- Struck by Falling Objects;
- Fatigue due to Prolonged Working Hours; and
- General Hazard Considerations.

5.1 Mechanical Hazards

5.1.1 Crushing, Cutting and Pinching Hazards

Cutting and pinching hazards in escalator work can be caused by the following ways:

- Hands may get caught by rotating parts if escalator suddenly moves
- Sharp edges of panels and floor plates
- Risk of hand pinch when removing and covering floor plates

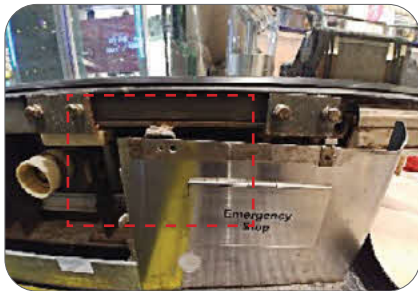


Figure 2: Sharp edges of skirt guard.

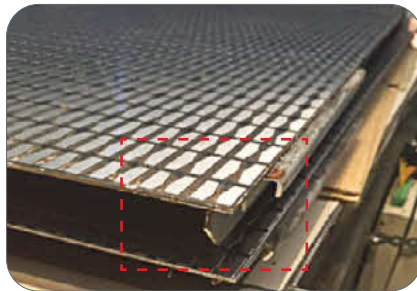


Figure 3: Sharp edges of floor plates.



Figure 4: Fingers pinched by floor plates.



Figure 5: Hands may get caught between rotating parts.

5.2 Electrical Hazards

Electrical hazards in escalator work can be caused by:

- Damaged/exposed wires or termination
- Defective electrical equipment
- Overloaded circuits and plugs



Figure 6: Damaged electrical cords.



Figure 7: Overloaded circuits and plugs.

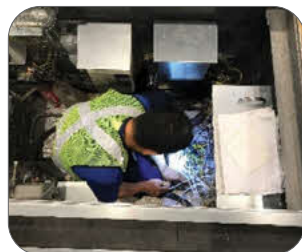


Figure 8: Electrical shock through contact with live electrical panel/cables.

5.3 Working at Height

The hazards associated with working at elevated locations are:

- Fall into escalator opening
- Fall off escalator truss



Figure 9: Fall off from open sides of escalator truss.



Figure 10: Fall into escalator opening during installation.



Figure 11: Fall when getting in/out of escalator machine room/pit.



Figure 12: Fall into escalator opening during servicing.

5.4 Fire Hazards

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



Figure 13: A designated bin for the disposal of oily rags.



Figure 14: A "No Smoking" sign.

5.5 Slip and Trip

The hazards associated with slip and trip are:

- Slip on oily surface
- Trip due to lack of space at work area



Figure 15: Oil spillage on floor surface in escalator motor room.



Figure 16: Removing oil stain from shoe sole to prevent slip.



Figure 17: Tripping on loose cables and sprinkler pipe at escalator machine room/pit.



Figure 18: Knocking on equipment parts and tripping on trunking due to lack of space in the escalator machine room.

5.6 Manual Handling

The hazards associated with manual handling:

- Risk of cuts/lacerations if load drops
- Risk of back injury when lifting heavy load and machinery



Figure 19: Risk of back injury when lifting heavy load.



Figure 20: Risk of finger cut/laceration when load drops.



Figure 21: Risk of foot injury when load drops.

5.7 Posture/Ergonomics

Heavy load, overexertion, awkward postures and incorrect lifting technique can lead to increased risk of musculoskeletal disorders (MSDs) to the hand, arm, neck, shoulder and back.



Figure 22: Risk of back injury when lifting heavy load.



Figure 23: Bad posture due to space constraints.



Figure 24: Limited working area beyond escalator pit.

5.8 Struck by Falling Objects

- Exposed to members of public
- Falling objects may hit co-worker working at the pit



Figure 25: Tools not being secured.

5.9 Fatigue Due to Prolonged Working Hours

Demanding worksite conditions are often accompanied by prolonged working hours. Long working hours can result in workers' fatigue. Fatigue is a state of tiredness leading to reduced mental and/or physical performance that can compromise workplace safety. Fatigue among workers can decrease a worker's alertness and concentration. The best approach to preventing fatigue is to ensure workers have sufficient breaks and adequate rest. Realistic demands by stakeholders can help to mitigate the long working hours and improve the stressful work environment.

For more information, refer to WSH Guidelines on Fatigue Management and Section 9 on Improving Working Conditions and Personal Well-Being.

5.10 General Hazard Considerations

While the most likely hazards for working in the escalator and moving walk environment have been highlighted above, 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 works involving escalators and moving walks.

Table 1: Example of elements of hazard to be consolidated during risk assessment.

Hazards	Escalator Installation Work	Escalator Maintenance Work
Unauthorised entry	✓	✓
Inadequate lighting	✓	✓
Uneven floor surface	✓	
Slippery floor surface		✓
Limited working space	✓	✓
Unexpected movements	✓	✓
More than one escalator in the same area	✓	✓
Manual handling	✓	✓
More than one person working	✓	✓
Absence of a means of communications	✓	✓
Ventilation and temperature for persons	✓	✓
Dangerous substances	✓	✓
Fire	✓	✓

Legend:  Not Relevant  Relevant

6. Good Systems and Processes for Implementation by Escalator and Moving Walk Owners with Contractor

6.1 Authorisation Systems

6.1.1 Entry Authorisation System

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

6.1.2 Permit-to-Work System for Escalator Installation

The escalator installer shall apply the permit-to-work (PTW) for high-risk activities (such as working at height) set up by the worksite occupier. For more information, please refer to WSH (Construction) Regulations Part III Permit-to-Work System.

6.1.3 Work Authorisation for Escalator Maintenance

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 escalator maintenance operation. This authorisation is granted by the escalator contractor through his/her authorised manager. Therefore, it is important for the escalator contractors to ensure that:

- Risk assessment has been carried out on the escalator 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 Method statement, Risk Assessment (RA) and Safe Work Procedures (SWP) before they carry out the lift maintenance work;
- Method statement, RA and SWP for lift maintenance must address public safety such as safety barrier and 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

6.1.4 Work Authorisation for Non-Routine Maintenance Operations

A separate Work Authorisation for non-routine maintenance operations (NRMO) is recommended. This includes work activities that involve scaffolds, mobile elevating work platforms, hot work and working at height.

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

- Escalator 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 2 for examples of Work Authorisation Form.

6.1.5 Stages of Work Authorisation System for NRMO

A work authorisation typically consists of the following stages:

6.1.5.1 Stage 1: Risk Assessment by Supervisor

The supervisor should:

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

6.1.5.2 Stage 2: Safety Appraisal Conducted by an Appointed Person

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

- Determine the hazards and establish appropriate monitoring plan to ensure that the conditions of the escalator environment remain unchanged during the whole escalator 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.

6.1.5.3 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 escalator or stairs 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 escalator 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 escalator contractor's office.

Note

- At any time during the NRMO, the Authorised Manager reserves the right to revoke or re-endorse the form if necessary (refer to Annex 2).
- If a stop work order is issued on site, the Work Authorisation for NRMO form is automatically revoked.

6.2 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 work;
- Review the site's status regularly and the necessity for re-endorsement or revocation; and
- File and retain the form for a reasonable period after completion of work.

6.3 Record-keeping

It is important for the escalator 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. Good Practices and Safe Work Procedures for Escalator and Moving Walk Installation, Maintenance and Replacement Work

Escalators and moving walks are good means to move high amount of human traffic quickly within or between buildings. As such, they are typically found in places with high human traffic such as shopping centres or public transport hubs. They are usually located in open areas within the building and are transit points between floors.

Hence, installation, maintenance and replacement work for escalators and moving walks must take into consideration the possible elements in these environments.

The following are some examples of good practices when carrying out works on escalators and moving walks.

7.1 Before Commencement of Work

7.1.1 Securing the Job Site

- Communicate to the Esc/MV owner what the work involves and which equipment will be out of service as well as the access restricted area during work.
- Esc/MW owner, in turn, will create awareness of this among other building occupants and to provide diversion of human traffic, if required.
- Place effective barricade at the entry and exit points of the equipment to warn and guard against unauthorised persons from gaining access to the work area.

Note

The work area includes the escalator entry and exit floor plates and shall extend to the floor space area to give workers enough space to perform their work and place the necessary tools and equipment.

- The barricade shall be readily identifiable and adequately secured to guard against unintentional displacement and adverse weather conditions.



Figure 26: **Barricade to prevent unauthorised entry.**

- Appropriate safety signs shall be prominently displayed on the barrier (or around the escalator or moving walks, if applicable) to inform the public to keep away from work area.
- When work is completed, inform the Esc/MW owner that either the equipment is back in service or has been locked and tagged out of service pending further repairs or service.

7.1.2 Removing an Escalator or Moving Walk from Service

- Before stopping an equipment, ensure that there are no passengers on it.
- For works which do not require power to the equipment, turn off the main-line switch and other power sources to the escalator, lock it in the “off” position (or otherwise secure to prevent energy activation) and attach an appropriate lockout/tagout device (Figure 27) to it. Test and verify the functionality of the lockout.



Figure 27: **LOTO for the main-line switch of Esc/MW.**

- For works which require that electrical power to be maintained on the equipment, written procedures to enable safe working conditions with power on including safe access procedures are to be established.

- If the unit is left unattended, the following must be in place:
 - The unit shall be placed under lockout/tagout.
 - Steps, pallets, comb plates, comb plate teeth, trap doors and floor plates shall be put back in place to prevent exposed openings.
 - When one or more steps are removed or the brakes are under repair, block the unit electrically and mechanically by two independent means to prevent the unit from moving in either direction. The actuated machine and auxiliary brakes are acceptable independent means to prevent movement.

7.2 Accessing and Working in Machine Room or Pit

There are many moving parts and electrical equipment in the machine room and pit. In addition, the working areas may be limited. Below are some good practices when accessing and working in the machine room or pit.

7.2.1 Removing the Floor Plates

- Always wear hand gloves (Figure 28) when removing floor plates as they are usually heavy with sharp edges.
- Prepare an area nearby to safely place the floor plates.
- Follow the manufacturer's instructions when removing the floor plates.
- Lift each floor plate slightly with proper lifting tools (Figure 29) and avoid pinch point by using a blocking tool (Figure 30) when necessary. Then raise the floor plate up on one end until it can be safely managed and carried to a safe area nearby.



Figure 28: Wear hand gloves when handling floor plates.

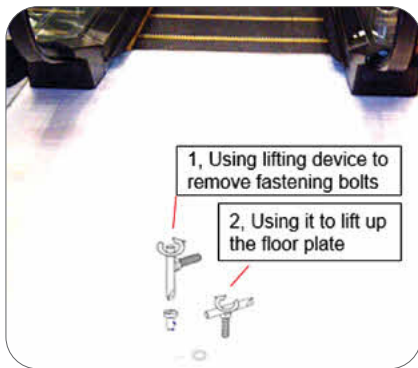


Figure 29: Lifting device for floor plate.



Figure 30: Safety block for floor plate.

- Proper care should be taken when stacking floor plates to avoid tipping. Do not step on the stacked floor plates to avoid tripping.

7.2.2 Working in the Pit (Lower Landing)



Figure 31: Provision of additional socket for portable light.

- Switch on the lighting available to ensure visibility of the pit condition and equipment layout.
- When entering and leaving pit/machine room:
 - Never jump into the pit/machine room.
 - Never place your hand or foot on the hand wheel.
- All safety switches such as the pit stop switch and inspection control should be verified to be working properly in both directions before activating them:
 - Never leave the key in the “RUN” position at any time and be sure to remove the key from the key switch after every test.
- Do not enter a pit if it is wet and when there is any source of electrical power present.
- Remove oil or debris which can cause slipping and tripping.
- At the lower landing pit, usually there is no means of disconnecting the high voltage. If it is necessary to place your body within the pit for tasks which do NOT require power, you must disable power at the machine room (Upper Landing) and ensure power is locked-out and tagged-out.
- Operate the inspection control with both hands to prevent unintentional movement of the equipment and to ensure both hands are clear of the equipment before activation.



Figure 32: Good housekeeping for the pit.

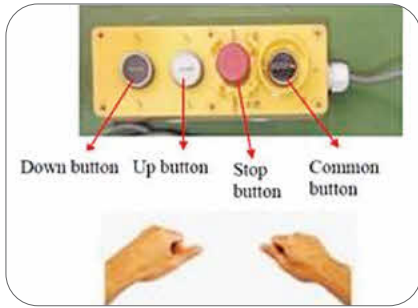


Figure 33: **Operate the inspection control with both hands.**

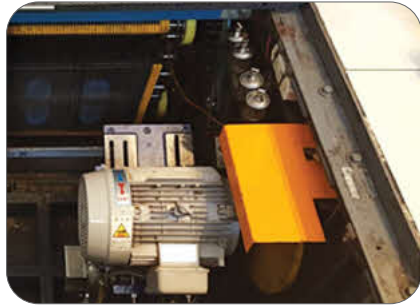


Figure 34: **Machine cover to prevent getting caught during testing of escalator movement.**

- When work has been completed, check that the area is clean and dry, and ensure the floor plates are put back in place.

7.2.2.1 Assembling or Disassembling of Steps

Esc/MW steps can be heavy, and the CMP may be in an awkward position in the pit while removing the steps. The good practices below can alleviate health and safety hazards while assembling and disassembling steps:

- Avoid twisting the body while handling the step.
- Lift the step straight out. Where possible, get a second person outside the pit to assist with the vertical lift out of the pit and the proper stacking of steps out of the immediate work area.

7.2.3 Working in the Machine Room (Upper Landing)

The main difference from working in the lower landing pit is that the main-line and controller are usually in the machine room together with the motor and gearbox. Hence, apart from the good practices described in section 7.2.2: Working in the Pit (Lower Landing), the below practices are also applicable:

- Whenever power is not required for the work:
 - Disconnect the main-line
 - Lockout and Tagout
 - Verify the Zero Energy State of Power
- If the task involves works on the controller, remove the controller from the pit so that the works can be carried out on the landings.
- As the controller can be bulky, proper care should be taken when removing it from the pit to avoid injury. Common methods are:
 - Use the controller lifting tool (Figure 35) provided by the manufacturer, if available.

Note

Check the tool's lifting capacity against the controller's weight, including the cables attached to the controller.

- If the lifting tool is not available, it is recommended to have two persons, regardless of controller weight, to lift the controller out of the pit. This allows the workers to adopt a proper ergonomic position when carrying out their work. Each person will stand to one side or the other side of the pit, with the spine vertical, with both feet in a stable position and the legs providing the power for lifting.
- A clear path must be provided in front of the controller. The controller must be secured to prevent it from tipping.
- In cases where the controller cannot be removed, written procedures to enable safe working conditions are to be established.
- The motor/gearbox can reach high temperatures during the operation. Precautions must be taken to avoid contact with them under these conditions. Warning signs or other visual indications must be placed on such machinery.



Figure 35: Controller lifting tool.

7.2.4 External Machine Room

Some installations have machine rooms outside the pits. In such arrangements, good practices relating to rotating machinery and electrical equipment are similar to those mentioned in 7.2.3: Working in the Machine Room (Upper Landing).

7.3 Working at the Inclined Section

Most works are to be carried out in the top and bottom pits. However, there might be occasions where working at the inclined section is required. Below are some good practices for these occasions:

- If the handrail balustrade is not in place and a fall hazard exists, fall protection must be used.



Figure 36: Full body harness.



Figure 37: Wire rope lifeline used for fall protection.

- Ensure proper and safe footing, and watch out for grease or oil that may present a slipping hazard.
- If steps are removed:
 - Avoid riding on the escalator or moving walk.
 - Stepping and walking on step-axes is not allowed.
 - Entry to and exit from the truss frame must be achieved by safe means such as temporary walkway or temporary step platform (Figure 38).



Figure 38: Temporary step platform.

- When one or more steps are removed or the brakes are under repair, block the unit electrically and mechanically by two independent means to prevent the unit from moving in either direction:
 - Apply the service brake and auxiliary brake (if available) and/or
 - Block the step band either by ratchet straps or synthetic slings by securing the step chain and steps in both directions.



Figure 39: **Brake release tool to be applied.**



Figure 40: **Ratchet straps to be applied.**

- For any work or tasks, when steps are removed, worker shall not reach with hands, arms or tools more than an arm's length beyond the plane of the step chain unless the step chains are also mechanically blocked by two independent means to prevent unintended movement in either direction.

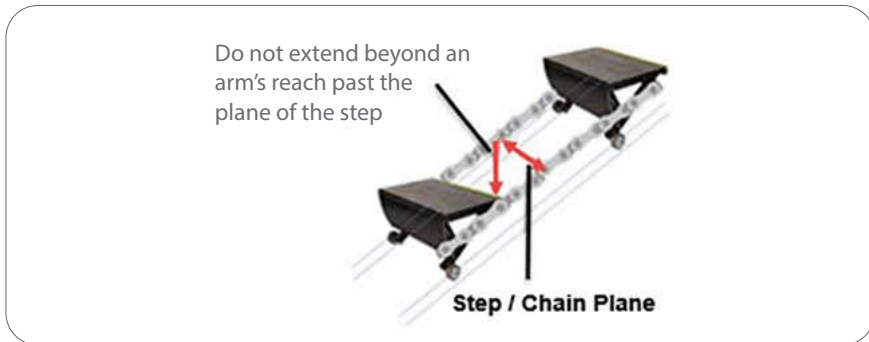


Figure 41: **Never reach with hands, arms or tools more than an arm's length in the truss.**

Observation of operation with steps removed shall be done from a safe distance, either in the pit if there is adequate space or the landing area, but never in the inclined section.

8. Good Practices in Escalator and Moving Walk Operations

8.1 Documentation

All relevant documents and records should be updated and kept in their proper locations.

Examples of documents and records to be provided by the manufacturer or supplier are:

- 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 escalator/moving walk contractor are:

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

8.2 Identification – Uniform, Display of Name and Identification Badge

The CMP and the supervisor should wear the Esc/MW contractor's uniform and display their identification badge at the workplace.

8.3 Communication

The Esc/MW contractor should establish an effective and reliable communication plan during the Esc/MW maintenance operation. This is particularly important if routine maintenance is carried out by a single CMP.

When choosing a means of communication, it is advisable to anticipate all foreseeable risks or conditions within the maintenance environment. Whatever system is used, it is important that all messages can be communicated easily, rapidly and clearly among relevant people. A regular monitoring mechanism should always be available to ensure the well-being of the CMP, for example, by conducting a regular check with walkie-talkie every two hours.

8.4 Attire and Personal Protection Equipment (PPE)

- Escalator companies are encouraged to provide comfortable attire, preferably made of light and breathable material, to allow for proper air circulation as well as effective sweat absorption to keep the technician cool during warm weather.
- High visibility vests or designs incorporated into the attire are also encouraged especially for the CMP involved in outdoor working environment with high vehicular traffic or low visibility environment.
- PPE such as safety helmet/bump cap, safety masks, goggles, anti-slip shoes and gloves should be provided where appropriate.
- 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 whether it is fit for purpose, and maintained properly and complies with prevailing codes or standards.
- The following are examples of PPE commonly used by the CMP during installation work (under construction) and maintenance work (during occupancy).



Figure 42: Attire and personal protective equipment.

Note

The description can be found in the WSH Guidelines on Working Safely During Maintenance of Electric Passenger and Goods Lifts.

8.5 Safety Signs and Symbols

- Where appropriate, all necessary warning signs should be fitted.
- Safety signs and symbols are important because they come with safety message(s) and they tell people what to observe and follow. A competent maintenance person (CMP) must be familiar with the signs and symbols and adhere to them.

Note

The description can be found in the WSH Guidelines on Working Safely During Maintenance of Electric Passenger and Goods Lifts.

8.6 Housekeeping

Good housekeeping goes hand in hand with safe working practices in the workplace, and results in a safe and comfortable workplace. It increases productivity and can prevent slipping, tripping, falling, and fire hazards. For more information, refer to WSH Guidelines on Workplace Housekeeping.

8.7 Emergency Preparedness

The CMP must have a clear understanding of the emergency procedure and be familiar with it. This would enable him/her to act promptly and to deal with the emergency appropriately and safely.

Examples of the emergency scenarios in Esc/MW include:

- Fire Emergency;
- Entrapment;
- Injured worker; and
- Injured public, but without causing harm to the CMP.

Note

The details on Establishment of Emergency Response Plan, Emergency Response Arrangement, Emergency Response Consideration, Logistics Required for Emergency Response, Emergency Response Team and Training can be found in the WSH Guidelines on Working Safely During Maintenance of Electric Passenger and Goods Lifts.

9. Improving Working Conditions and Personal Well-Being

Workplace incidents could result from workers who are tired, stressed, unhealthy, sick, or uncomfortable. Mitigating measures include the following:

9.1 Environmental Conditions Around Escalators and Moving Walks

- Access, Egress and Maneuverability – Working environment in and around escalator pits are generally confined, with very little room for maneuverability. As such, take reasonable periodic stretch-break to allow the body to adjust back to at-ease position considering the CMP's physical and mental conditions.
- Temperature and humidity – Thermal comfort within the escalator pits depends on various factors like location of escalators and their surrounding environment (outdoor vs indoor, aircon vs non-aircon, etc). Where appropriate, the escalator company should provide forced ventilation such as portable fans directed at the technicians. The location of such portable devices should be assessed and communicated to all stakeholders involved in the work activity.
- Illuminance – A well-lit working environment improves visibility and promotes better situational awareness of the technicians. A minimum of 200 lux illuminances (working area) and 50 lux illuminances (access route) are required (refer to SS 626). Where illuminance of the workspace falls below the required standard, escalator companies should consider portable lighting devices (Figure 43) for technicians so that they may have a better lit and thus, safer working environment.



Figure 43: A maintenance personnel using a portable lighting device.

9.2 Well-Being of Persons Working Alone

Where reasonably practicable, maintenance specialists should not be performing their work in isolation from other workers without supervision. This may present certain risks because there is no one to assist them should an incident occur. Escalator companies should conduct a risk assessment, together with relevant stakeholders like building owner representatives or managing agents, to address the concerns of maintenance specialists working in isolation. Where applicable, the following procedures are recommended:

- Before commencing work, the maintenance specialist should register his/her presence with the owner's site representative and obtain contact details of the site representative in case of emergencies;
- Suitable arrangements should be made periodically to confirm the continued well-being of the lift specialist (for example, by contacting the maintenance specialist via mobile phone);
- Suitable arrangements should be made to organise assistance in the event of an emergency; and
- The specific arrangements and frequency of confirming the maintenance specialist's continued well-being should be described in the relevant safe work procedure document and should be acted upon.

9.3 Guiding Principles for Provision of Rest Areas

The CMP typically performs his/her work at the Esc/MW premises and may not have proper rest areas to take his/her breaks. Service buyers and providers should also agree on the usage of the rest areas, such as frequency and duration of rest, to minimise possible disputes.

General guidelines to consider include:

- Location – Areas with adequate privacy, ease of access and clear indication as rest areas.
- Size and facilities – Adequate size with enough seats and tables at any given time. Basic amenities like storage for personal belongings or food items, hot/cold water dispenser, etc.
- Environment – Clean and free from WSH hazards. Adequately lit, quiet with limited exposure to loud noises. Well-ventilated and sheltered from weather elements.



Figure 44: Rest area.

9.4 Management

Management must provide adequate tools and instruction to the technicians for their proper discharge of assigned tasks during installation, maintenance or replacement work. For maintenance of outdoor escalators and moving walks, workers should take periodic rest breaks. If exposed to environmental elements such as inclement weather, they should stop work if necessary.

9.5 Administrative Procedures

Esc/MW companies are encouraged to work together with service buyers to conduct thorough and site-specific risk assessment, implement Safe Work Procedures that take into consideration the above factors, and communicate these to their technicians so as to ensure their safety, health and well-being.

10. References

- Singapore Standard SS 626: Code of Practice for Design, Installation, and Maintenance of Escalators and Moving Walks
- BS 7801:2011 Escalators and Moving Walks – Code of Practice for Safe Working on Escalators and Moving Walks
- WSH Guidelines – Working Safely During Maintenance of Electric Passenger and Goods Lifts
- Safety Assessment Federation – Guidelines for the Safe Operation of Escalators and Moving Walks
- Code of Practice for Safety at Work (Lift and Escalator), Labour Department, Hong Kong.
- Code of Practice for Safety at Work (Lift and Escalator). Occupational Safety and Health Branch, Labour Department (<http://www.labour.gov.hk/eng/public/os/lift.exe>)
- Safety Code for Elevators and Escalators. ASME A17.1-2013 / CSA B44-13

11. Acknowledgements

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Changi Airport Group	Mr Terence Lim Poo Huat
Metal Industries Workers' Union	Mr Don Lim
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Building and Construction Authority	Mr Benny Lau
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Workplace Safety and Health Council	Mr Han Kin Sew Mr Royston Lim Mr Ng Siak Chew Mr Dennis Choo

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12. Annexes

Annex 1: Sample of Work Activities and Risk Assessment Form for Escalators and Moving Walks

Inventory of Work Activities		
Company:		
No	Process / Location	Work Activities
Escalator Routine Maintenance		
1.	Maintenance Work in Escalator Motor Room	1.1 Setting of barricade
		1.2 Removing / Recovery of landing platform (Cover Plate)
		1.3 Entry of / Exiting the machine room
		1.4 Checking of control panel parts
		1.5 Checking of traction machine
		1.6 Lubrication work (oiling & greasing)
		1.7 Checking of safety switches
2.	Maintenance Work in Truss	2.1 Removing / Recovery of deck cover & skirt guards
		2.2 Removing / Recovery of steps
		2.3 Lubrication of step collar guide's pins & chains
		2.4 Checking and adjustment of driving mechanism. Inspection of handrails, guides, and rollers
		2.5 Inspection of safety switches in truss
3.	Maintenance Work in Pit	3.1 Removing / Recovery of landing platform (Cover Plate)
		3.2 Entry of / Exiting the pit
		3.3 Inspection of step chain
		3.4 Checking of safety switches
		3.5 Adjustment / Lubrication work at step chain & tension guides

Annex 1: Sample of Work Activities and Risk Assessment Form for Escalators and Moving Walks

Company	Hitachi Elevator Asia Pte Ltd		RA Leader	Approved By		Reference Number
Process	Maintenance Work in Escalator Motor Room		RA Member 1	Signature		
Location			RA Member 2			
Original RA Date			RA Member 3	Name		
Next Review Date			RA Member 4	Designation		
Last Review Date			RA Member 5	Date		

Hazard Identification				Risk Evaluation				Risk Control						
No	Work Activity	Hazard	Possible Injuries / Ill Health	Existing Risk Controls	S	L	RPN	Additional Controls	S	L	RPN	Implementation Persons	Due Date	Remarks
1.1	Setting of barricades	Public may fall at work area.	Bodily Injury to public	Set up barricades at upper and lower platform of escalator.	3	2	6	Check that there are no members of the public at the escalator before stopping the escalator.	3	1	3	Engineer / Technician		

Hazard Identification				Risk Evaluation				Risk Control						
No	Work Activity	Hazard	Possible Injuries / Ill Health	Existing Risk Controls	S	L	RPN	Additional Controls	S	L	RPN	Implementation Persons	Due Date	Remarks
1.2	Remove landing platform (Cover Plate)	Falling into hole opening	Bodily Injury to worker	Set up barricades at upper and lower platform of escalator.	3	2	6	Display warning / no entry sign at the barricades.	3	1	3	Engineer / Technician		
		Accidental dropping of platform	Foot Injury	Use proper tool to remove platform. Safety shoes must be worn.	3	2	6	Clean tool (free from oil) before use.	3	1	3			
		Improper lifting position	Back injury due to improper lifting position	Adopt correct posture.	3	2	6	Lift platform together with co-worker.	3	1	3			

Annex 2: Sample of Work Authorisation Form

Purpose of the Authorisation Form				
☐ Working at Height		☐ Hot Work		☐ Lifting Operation
☐ Others:				
WA No.	Job No.	Project 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 7 days. It is non-automatic renewable. Applicant has to resubmit WA for approval. Daily WA shall apply whenever applicable. 3) WA is to be approved by Authorised Manager before commencing work. 4) Approved WA to be available at site, preferably displayed prominently where work is carried out. 5) WA will be revoked & shall be considered invalid if any safety non-compliance/lapse is found and communicated.				
Part 1: Application — To Be Completed by Applicant (Work activities to be carried out by lift contractor/sub-contractor)				
Description of lift maintenance (Non-Routine):				
Safety Requirements – General Safety			Applicant	
1) Conduct Risk Assessment. 2) Conduct daily toolbox meeting. 3) Set up fencing at work area and display “No Entry”/ “Danger – Keep Out” warning sign. 4) Appropriate PPE is to be worn: • Helmet/Hard Hat/Body Harness/Restraint Belt/ Safety Shoes • Others as required per work activity 5) Provide adequate lighting/ventilation where required. 6) Others:_____			Name	
			Company	
			Signature	
			Date	
			HP	
			Site Supervisor	
			Signature	
			HP	

Part 2: Maintenance Staff		Verified By:	
☐ Acknowledgement that the above work activities shall be carried out in accordance with method statement and safe work practices. ☐ Handover by Building Owner/Managing Agent is in order and inspected. ☐ Other instructions/comments:	Name		
	Designation		
	Signature		
	Date		
Part 3: Safety		Verified By:	
☐ Satisfaction of the safety provision taken by applicant. ☐ DO NOT COMMENCE WORK: To be inspected prior to approval. Schedule Inspection: Date:_____ Time:_____ Safety Person-In-Charge:_____ HP:_____ ☐ WA is revoked by: _____(Name/Designation) on _____for safety non-compliances:_____	Name		
	Designation		
	Signature		
	Date		
	HP		
Part 4: Approval by Authorised Manager/Authorised Competent Person			
Work Authorisation is: Approved/Not Approved	Name		
	Designation		
	Signature		
	Date		
Part 5: Notification of Handover to Building Owner/Completion of Work by Applicant or Lift Contractor			
☐ Handover to Building Owner/Managing Agent is in order and inspected. ☐ WA has expired and to submit new WA application. ☐ Acknowledgement that the above work activity is completed.	Name		
	Designation		
	Signature		
	Date		

Annex 3

Illustration of Escalator

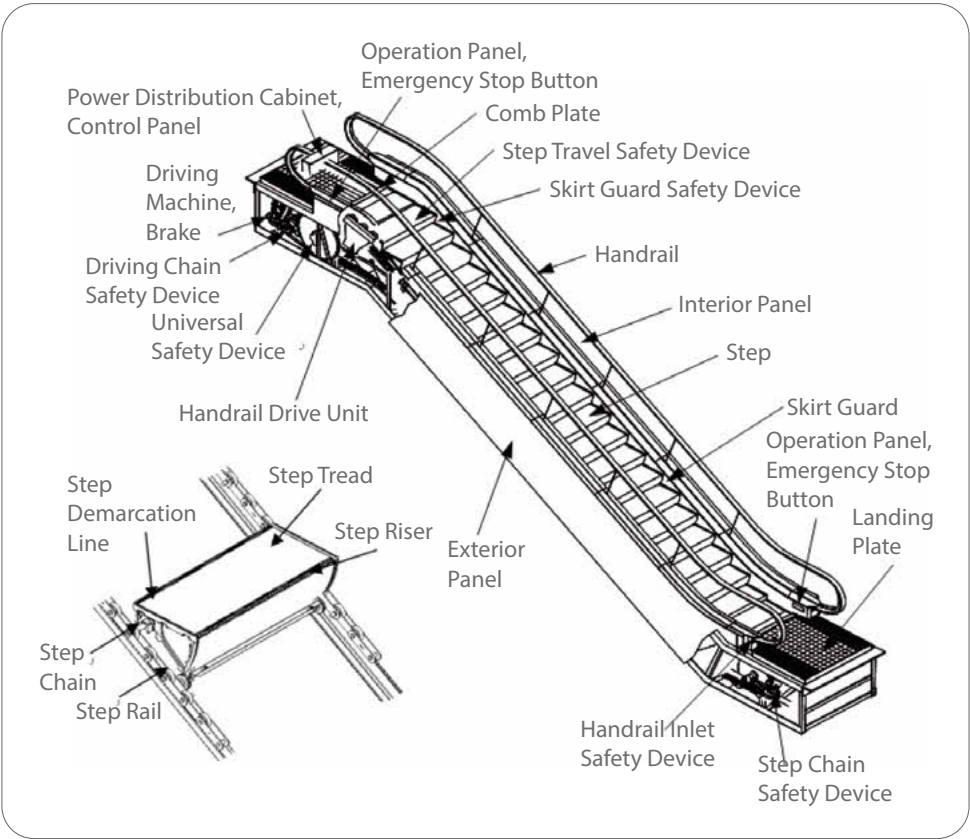
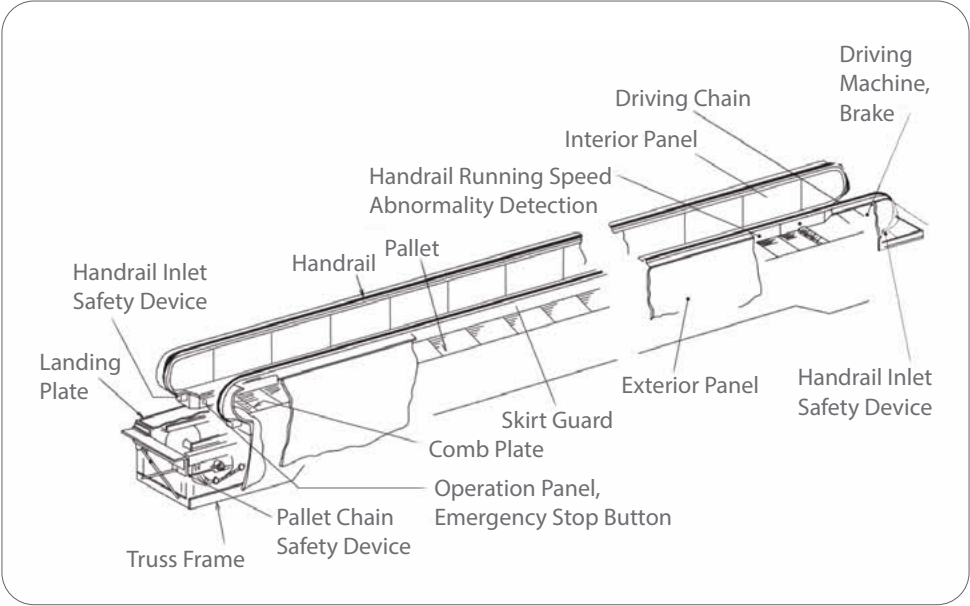


Illustration of Moving Walk



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