Lift and Escalator Safety: Key Audit Findings and Case Studies (Oct 23 – Sep 24)

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(29 slides)

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2. CASE STUDIES
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1. KEY FINDINGS FROM INSPECTIONS

KEY FINDINGS FROM **INSPECTIONS** - Lifts

Non-Compliances Between October 2023 and September 2024

Doors

Findings involved lift cars moving when a 25mm obstruction was introduced

Alarm Bell & Intercom

Either or both the emergency alarm bell or/ and the intercom is not functioning as intended.

EBOPS

lift car's lighting or ventilation fan fails to function when the normal power supply is disrupted.

Overspeed Governor

The governor tension pulley switch was found to be incorrectly installed, rendering it unable to trigger when the governor ropes elongate

Door Protective Devices

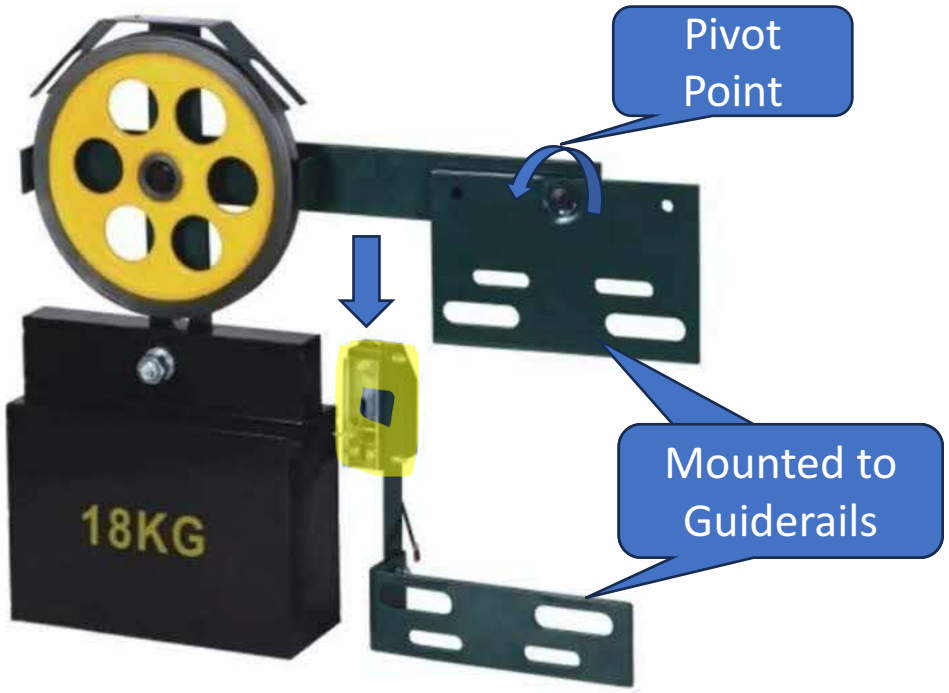
Light curtain, door sensor, or mechanical safety edge not functioning as intended

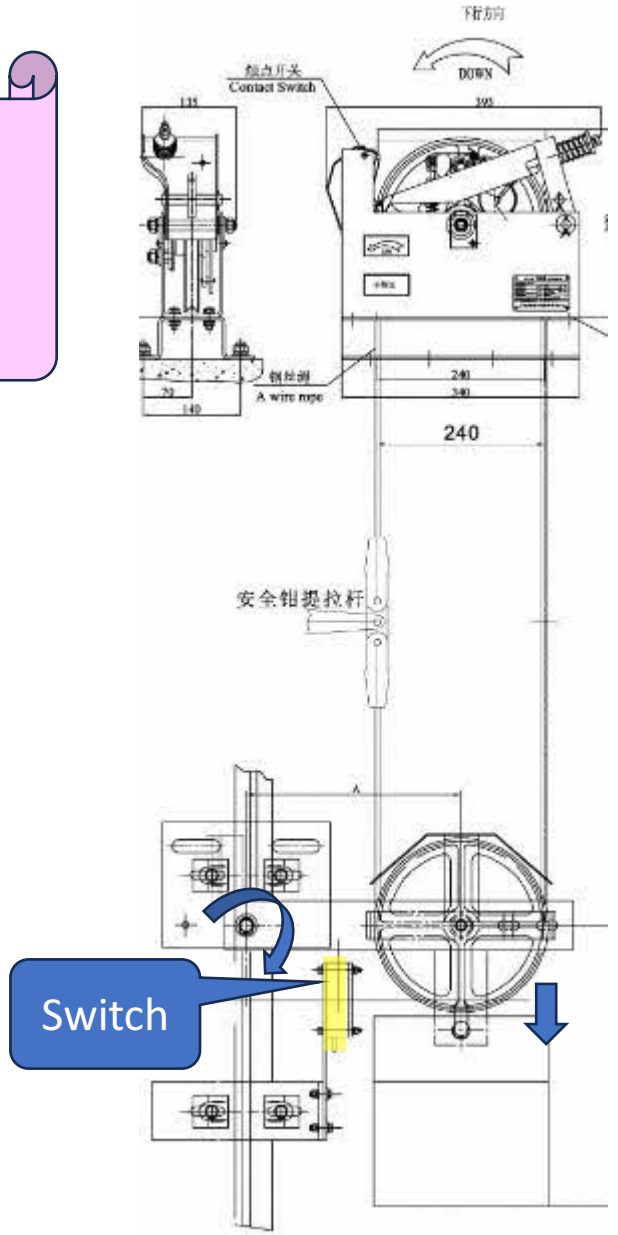
Governor tension pulley switch

Proper installation

- Rope elongates &
- lever dropped
- Switch activated

Requirement since
CP2:2000





KEY FINDINGS FROM **INSPECTIONS** – Escalators

Non-Compliances Between October 2023 and September 2024

Operational Clearances, Gaps

The gap between the skirt panel and escalator step exceeds 4mm

Auxiliary Brake

The Auxiliary Brake Switch has been bypassed.

Safety Switch

The comb plate switch is not functioning as designed.

Bypass of Auxiliary Brake

Safety switches are essential safeguards designed to prevent accidents and protect lives. They act as a last line of defence against failures.
Bypassing or tampering of safety switches are considered **serious violations.**

Important Takeaway

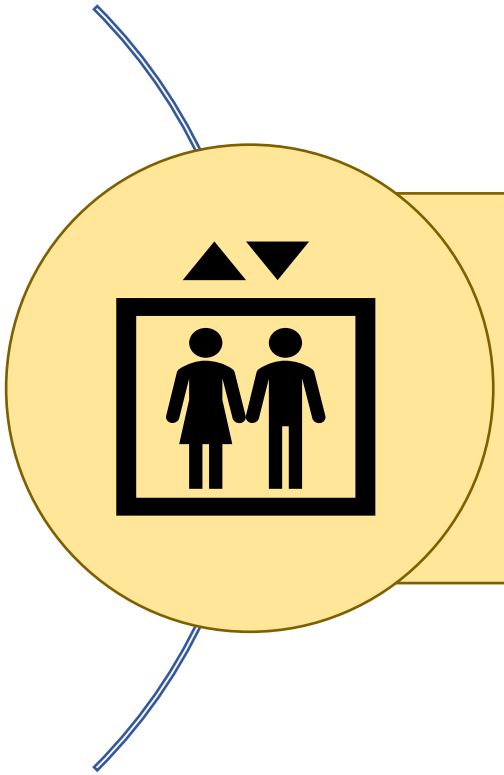
No amount of convenience or cost-saving is worth risking human lives.

<u>Contractor Duties During Routine Maintenance:</u>

1. Conduct comprehensive safety checks on all critical components
2. Test and verify all safety devices
3. Repair malfunctioning components immediately - no deferring safety-critical issues.

Note: *Lift Maintenance Outcome Guidebook*

https://www1.bca.gov.sg/regulatory-info/lifts-escalators/e-guides



2. Case Studies - Lifts

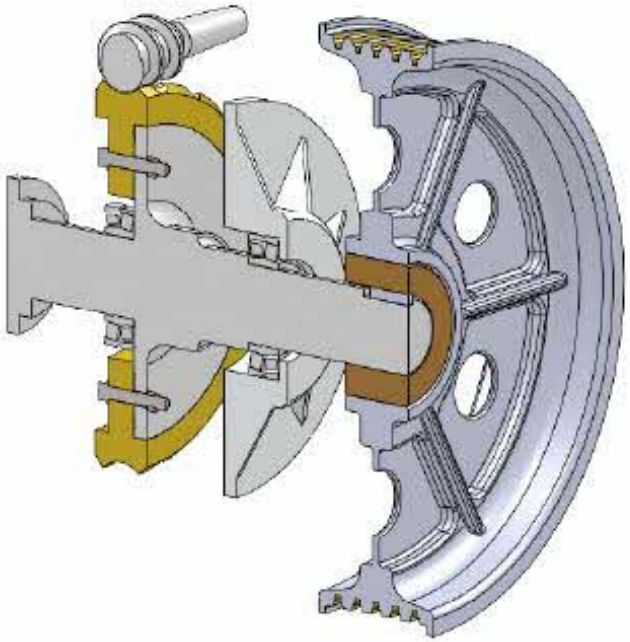
Case Studies – Lifts

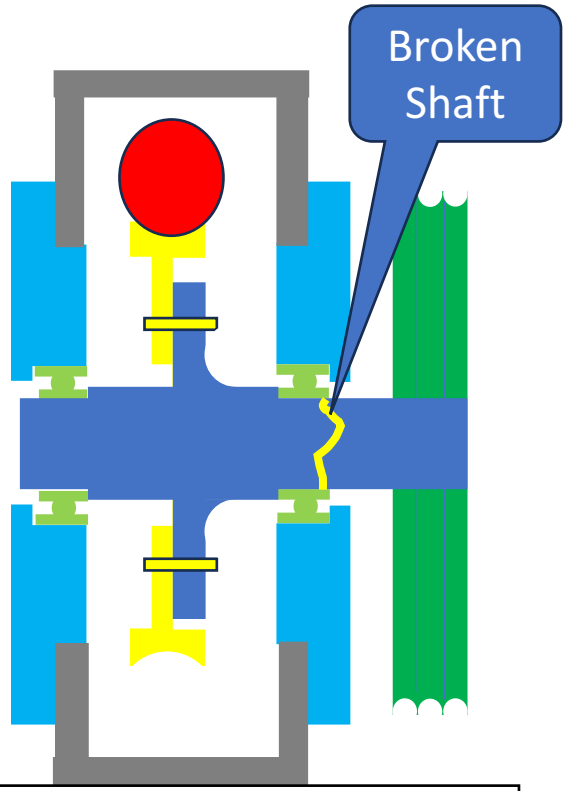
Inadequate Execution of Replacement Procedures

① Fractured Sheave Shaft due to improper bearing replacement procedures

② Dislodgement of Counterweight sheave due to incorrect CWT Pulley size

Case Study①- Fractured Sheave Shaft





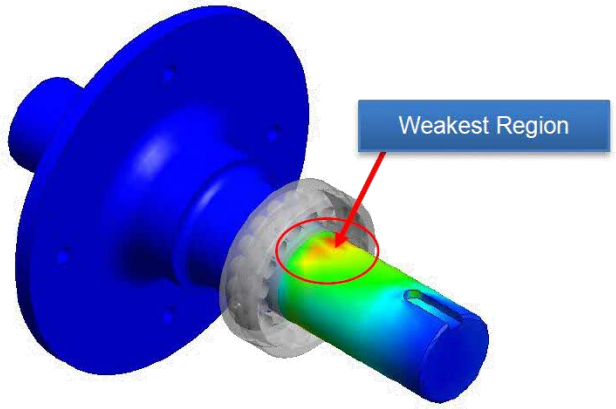
Section view of Traction Machine *(For Illustration)*	Side view *(For Illustration)*

Case Study①- Fractured Sheave Shaft

Material Property Alteration:

The hot work has affected the mechanical properties of the shaft material.

1. Heat affected zones (HAZ) often experience changes in **hardness**. Some areas may become harder due to rapid cooling, while others may soften due to annealing effects.
2. The **yield strength** and **ultimate tensile strength** can be altered, and changes are often non-uniform across the welded area and HAZ.
3. Welding can reduce the metal's **ductility**, making it more brittle in certain areas.
4. Welding introduces **residual stresses** that can affect the shaft's performance and longevity.
5. The altered microstructure in the welded area may have different **corrosion** properties compared to the base metal.



Hot work may make the shaft wear out faster, weaker or even fail unexpectedly.

Important takeaways

Standard Procedures

Cutting or welding are not proper ways to replace bearings. These methods can damage the shaft and make it unsafe.

Adherence to Manufacturer Guidelines and Standard Operating Procedures (SOPs):

1. Always use proper tools for bearing removal and installation.
2. Do not chisel or hit the shaft with hard objects, as this can cause dents and surface damage to the shaft.
3. No welding repair on the shaft.
4. Before deviating from SOPs, consult with the manufacturer or a certified expert.
5. Regular training, supervision are essential.

Case Study ② - Dislodgement of CWT pulley

- Dimensional Discrepancy:
  - Difference in dimensions between replacement and original pulley
  - Improper Installation
    - Replacement pulley **forcefully fitted** into existing mounting plates.
- Root Cause:
  - Incompatible parts replacement
  - Improper installation

Images redacted for sensitivity reasons

Counterweight (CWT) pulley fell on Car Top after replacement

Important takeaways

Compatibility Verification

- Prioritize Purchasing Parts from Original Equipment Manufacturers (OEMs)
- Always verify **compatibility** of replacement parts • **Check dimensions** and **specifications** meticulously before installation

Proper Installation Procedures

- **Never force-fit** components
- If parts don't fit easily, stop and **reassess** the **situation**

Documentation

- Maintain detailed records of all **original equipment specifications** for each component
- Document any **changes or replacements** thoroughly

Training

- Ensure technicians are **trained** on the importance of **using compatible parts**
- Provide **guidance on proper installation procedures** and when to escalate issues

2. Case Studies - Escalators

Case Studies – Escalators

Case Studies between October 2023 and September 2024

Operational Clearances, Gaps

The gap between the skirt panel and escalator step exceeds 4mm

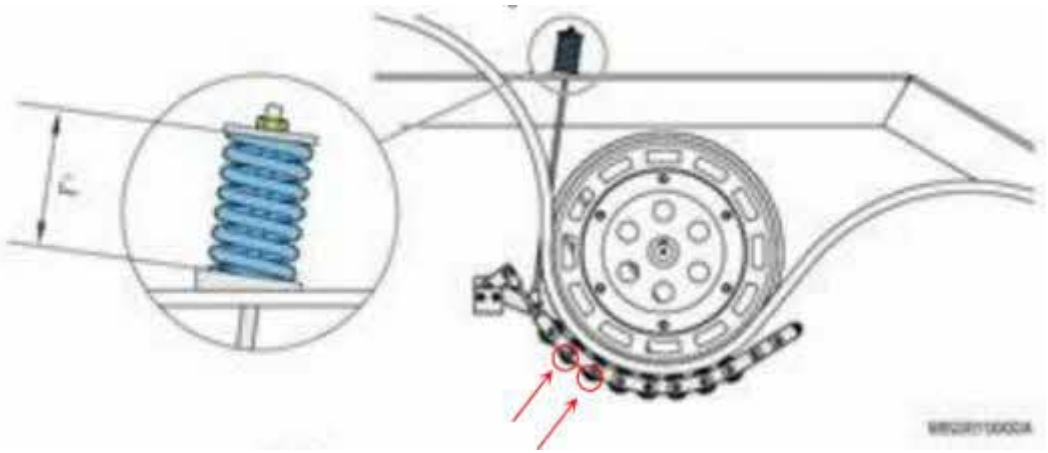
Handrail System

Intermittent stoppage of handrail or stoppage of handrail

Handrails are a primary point of contact for escalator users, ensuring their proper function is crucial for public safety.

Case Study ①

- Handrail rollers was recently replaced before incident.
- It was observed that two of the eight rollers in the pressure roller assembly were not in contact with the handrail. This compromised the effective pressure exerted on the handrail against the tensioning pulley causing intermittent stoppage of handrail.



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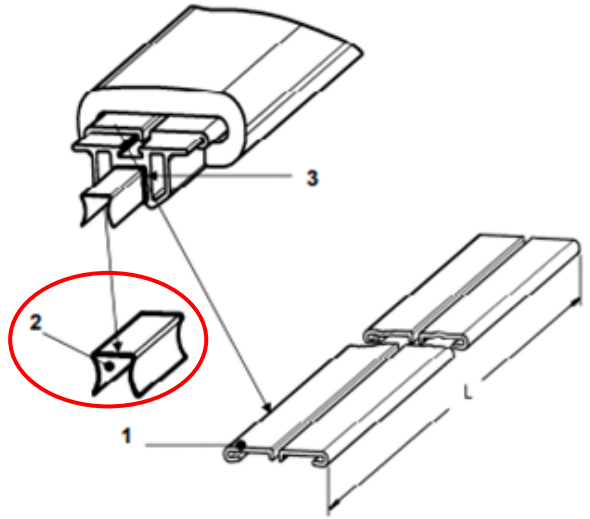
Case Study ② - Handrail Insert

- The handrail guide insert sits between the stationary guide rail and the moving handrail, reducing friction between them. It's clipped to the handrail guide with/ without a holding bracket at one end.
- Due to frequent movement causing wear and tear, the insert may occasionally fall into the escalator system, potentially causing jams or creating sharp edges on the handrail.



Case Study ③ – Handrail Pressure Rollers

- Wear and tear of handrail pressure rollers.

Case A – Excessive wear and tear	Case B – Excessive wear and tear

Images redacted for sensitivity reasons

- Is your current maintenance regime superficial or inadequate? Are inspections being carried out thoroughly and regularly?
- Deterioration observed in such a short timeframe points to a systemic problem in the maintenance process.
- It's vital to conduct a comprehensive review of maintenance procedures, assess and improve staff training programmes, and enhance quality control measures. These are steps that will help ensure that critical safety checks are not overlooked in the future.

Case Study ④ – Tensioning Spring

- Handrail tensioning springs were loose. The spring height gauges indicated that the 'Normal' level had fallen below the datum.
- The loose springs meant the pinch rollers couldn't apply enough pressure to the left handrail. This led to insufficient friction between the drive rollers and the handrail. As a result, the left handrail slipped when pressure was applied to it.

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Important takeaways

Regular Maintenance

- Implement **frequent, scheduled inspections** of the entire handrail system
- Check for **wear, damage** and **proper tension** (according to OEM standards)
- Regularly verify **proper alignment** of the handrail with steps/ pallets. To address any misalignment promptly to prevent accelerated wear

Traceability

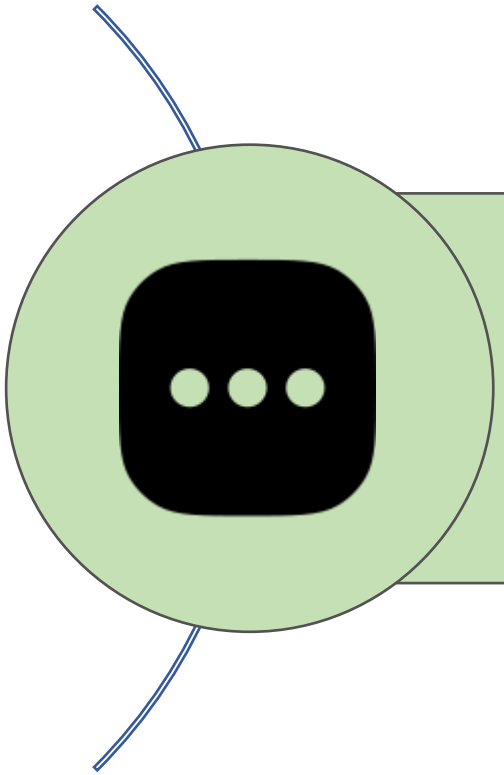
- **Track** the **age** and **usage** of handrail components
- **Replace parts proactively** based on manufacturers recommendations or wear indicators
- **Maintain** detailed **records** of all maintenance activities and **observations**
- Use this data to **identify trends** and potential issues before they become critical

Training, Quality of Parts

- Ensure maintenance staff are **properly trained** on handrail system specifics
- Provide regular **refresher courses** on best practices and common issues
- Use only manufacturers **approved** replacement **parts**
- **Verify compatibility** and quality of all replacement components

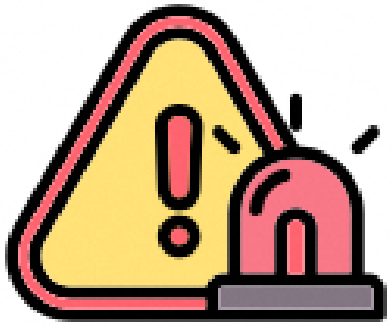
Learning Points

F	**Follow**	Vigilance • Strictly **adhere to all SOPs** during work and **never bridge or bypass safety switches**. • Regularly **reinforce** the importance of **thorough inspections**
A	**Assure**	Avoid complacency • Ensure technicians consistently perform all required checks during routine inspections • Ensure all technicians understand the critical function and proper operation of safety switches.
S	**Supervise and Check**	Monitoring • Closely **supervise subcontractors' work** and **conduct regular quality inspections** of both technician and subcontractor performance. • **Require engineer presence** for **major replacements**
T	**Training**	Education • Provide **training** and **refresher training** for both **technicians and subcontractors** on **replacement and repair procedures**.



3. OTHERS

Stakeholders during **Incidents**



Circular issued on 1st August 2022, APPBMSMA-2022-04

Reportable L&E Incidents: Immediate Notification to COB

- **Who**: All L&E owners (including MCSTs) and their service contractors
- **What**: Notify the Commissioner of Buildings (COB)
- **When**: As soon as practicable after becoming aware of the incident

Equipment Shutdown and get BCA's Approval to resume

Restrictions on Incident Site Modification

- **Who**: Any person (including the lift owner)
- **What**: Must not, without the Commissioner's consent:
  - Alter, replace, remove, or add any machinery, equipment, or article potentially contributing to the incident; or
  - Modify the scene of the incident.

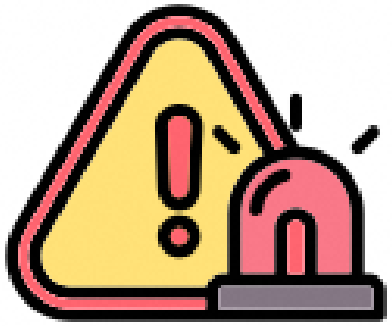
Stakeholders during **Annual Renewal**

Circular issued on 1st August 2022, APPBMSMA-2022-04

Reporting Unsafe L&E: Duties of Service Contractors

- **Who**: L&E service contractors engaged for periodic maintenance
- **What**:
  1. Notify the Commissioner of Buildings (COB)
  2. Inform the L&E owner of the unsafe condition
  3. Advise the L&E owner to immediately stop operation
  4. Report to COB if L&E continues operating unsafely
- **When**:
  1. Immediately upon finding L&E unsafe for operation
  2. Immediately if L&E continues operating in unsafe condition

Stakeholders during **Annual Testing**



Circular issued on 1st December 2021, APPBMSMA-2021-05

Annual L&E Inspections

Under the Regulations, owner of the equipment must engage a service contractor to examine, inspect and test the equipment **in the presence of a specialist professional engineer** and non-compliance is considered a compoundable offence under Regulation 7(3)(a) or (b)

- SPEs and LEIs play a crucial role in ensuring lift safety.
- Their expertise is essential during these annual inspections.
- Their absence could lead to overlooked issues or incomplete inspections.

Annual Testing

Contractor should ensure the following for Annual Testing:

1. SPEs is present
2. Document SPEs presence with photos and videos (With date and time stamp)
3. Maintain records (e.g. checklist with SPE endorsement) as proof of attendance

SPEs/ LEIs

1. Must attend the inspection
2. Document presence with photos/videos (With date and time stamp)
3. Ensure checklist with SPE endorsement

BCA will continue to conduct regular audits on Annual Testing:

- Verify physical presence of SPE onsite
- May require evidence of presence such as submission of SPE inspection photos/videos

BCA will withhold PTO until Annual Inspection has been properly conducted.

Enforcement Action will be taken against offenders

Thank you