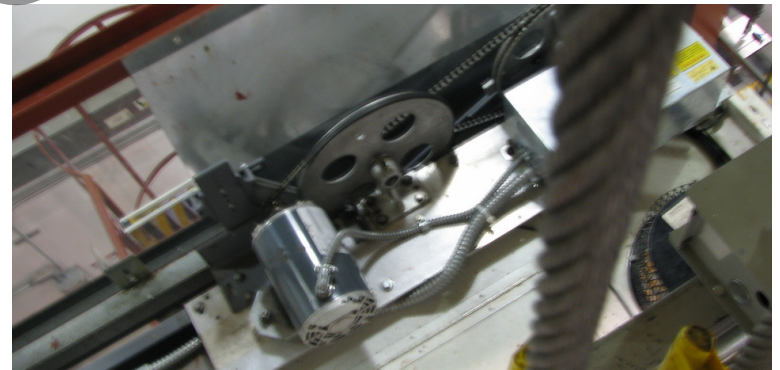
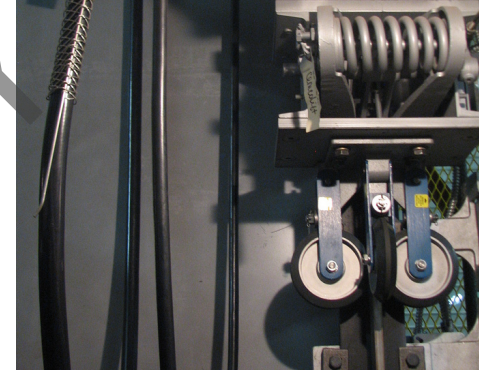
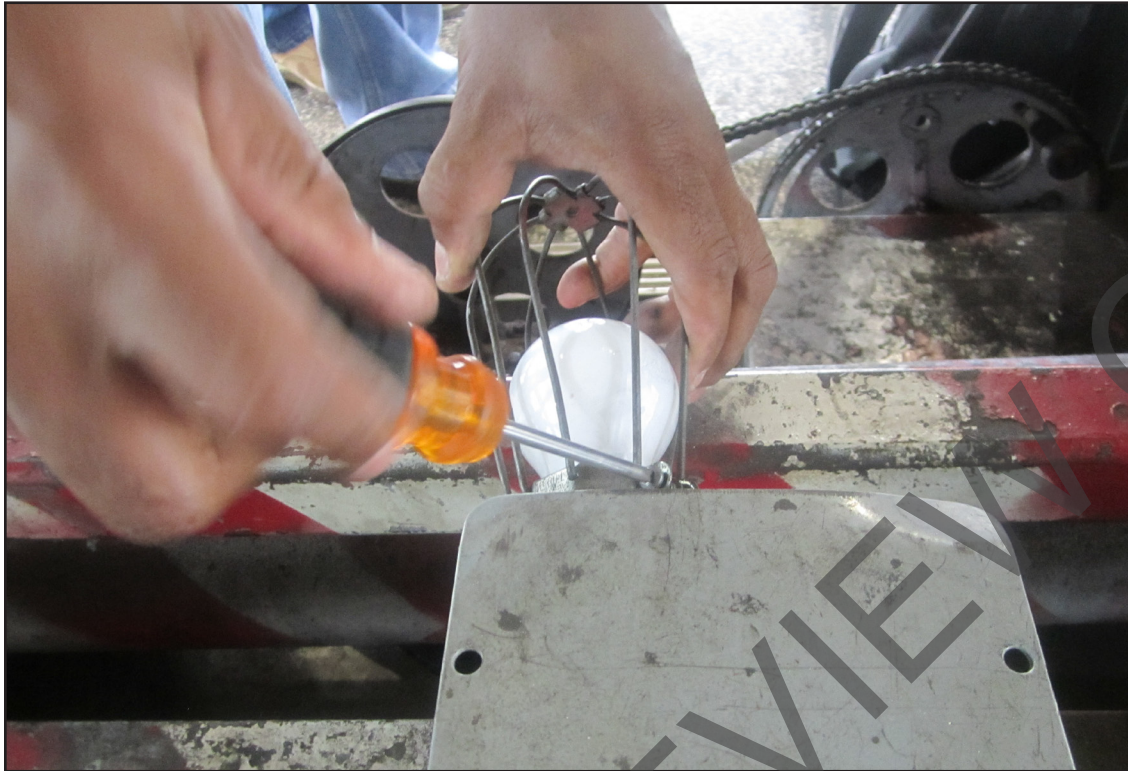


Instructor Guide



219: Elevator: Inspection and Basic Maintenance Module 9: Controller



Table of Contents

Overview.....	4
Sensory Inspection.....	10
Operational Inspection and Maintenance.....	17
Summary.....	35

Elevator – Controller

Instructor's Guide



Icons Used In This Guide

-  **REVIEW** slides
-  **ASK**
-  **CLASSROOM ACTIVITY**
-  **SMALL GROUP ACTIVITY**
-  **INDIVIDUAL ACTIVITY**
-  **WRITE**
-  **Multimedia**
-  **REFER** participants to

Agenda

Topic #	Topic Title	Duration
1	Overview	20 Minutes
2	Sensory Inspection	20 Minutes
3	Inspection and Maintenance	60 Minutes
4	Field Trip	120 Minutes
5	Summary	20 Minutes
	Total Time:	240 Minutes

Elevator – Controller

Instructor's Guide



Overview

Purpose The purpose of this module is to:

Provide the participant with an overview of the inspection and maintenance processes for controllers in elevator systems.

Objectives

At the end of this lesson, the transit elevator/escalator trainee will be able to:

- Perform sensory inspection of relays
- Perform sensory inspection of contacts
- List unacceptable conditions for controller wires
- Check controller wires for unacceptable conditions
- Perform operational inspection
- Check torque on all main terminals
- Perform voltage test
- Check amperage on fuses

Materials

Mandatory Make sure you have the following

- PowerPoint Presentation
- Coursebook
- Quizzes
- Pencils
- Paper

Optional

You may also want the following for optional activities:

- Chalk board with chalk, large paper with marker, etc.
- Internet connection
- Lab, simulator or out of service elevator

Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 240 min This section: 20 min (9 slides) Section start time: _____ Section End Time: _____

DO

 **REVIEW** introduction slides

Instructor's Notes

SAY

In your own words:

Welcome to the course on controllers.
Advance

Here is a photo of an old controller from Elevator Bob

“A front view of a very old Otis controller equipped with wooden knobs...”

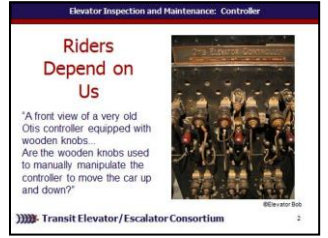
Are the wooden knobs used to manually manipulate the controller to move the car up and down?”

Has anyone seen or better yet, had to work on a controller like this one before?

Advance

Materials Needed

✓ PPT slides 1, 2



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 240 min This section: 20 min (9 slides) Section start time: _____ Section End Time: _____

DO

 **REVIEW** module objectives

Instructor's Notes

SAY

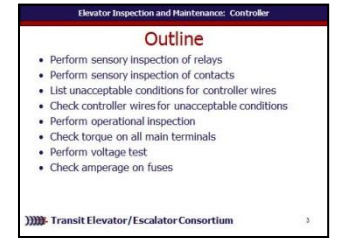
In your own words:

- Today we will
- Perform sensory inspection of relays
 - Perform sensory inspection of contacts
 - List unacceptable conditions for controller wires
 - Check controller wires for unacceptable conditions
 - Perform operational inspection
 - Check torque on all main terminals
 - Perform voltage test
 - Check amperage on fuses

Advance

Materials Needed

✓ PPT slide 3



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 240 min This section: 20 min (9 slides) Section start time: _____ Section End Time: _____

DO



REVIEW key terms

Instructor's Notes

SAY

In your own words:

Lets take a look at some of the key words we will be defining as move through this module:

- Amperage
- Cooling Fan
- Corrosion
- Data Plate
- Door Interlocks
- Fasteners
- Fuses
- Indicator Lights
- Infrared (IR) Scanner
- Led Lights
- Multi-Pin Connectors
- Physical Senses
- Raceways
- Ribbons
- Sensory Inspection
- Snap Locks
- Thermal Imaging Technology
- Torque
- Voltage Test
- Wire Ties
- Wires
- Wiring Terminals

Advance

Materials Needed

✓ PPT slide 4



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 240 min This section: 20 min (9 slides) Section start time: _____ Section End Time: _____

DO	SAY	Materials Needed
<div></div> <p>ASK participants what they remember about safety and elevators</p> <div></div> <p>SMALL GROUP ACTIVITY</p> <div></div> <p>WRITE</p> <h3>Instructor's Notes</h3> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	<p>In your own words:</p> <p>Thinking back to other courses or just in general, what do we already know about controllers?</p> <p>Maintenance of controllers?</p> <p><i>Allow participants to think for a minute and perhaps discuss with a partner ideas as well as write down any ideas. Discuss participant responses and if possible list them on a chalk board or similar.</i></p> <p>Advance</p>	<p>✓ PPT slide 5</p> <div> </div> <ul style="list-style-type: none"> ✓ <u>Chalk board or large paper</u> ✓ <u>Blank Paper</u> ✓ <u>Writing instruments</u>

Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 240 min This section: 20 min (9 slides) Section start time: _____ Section End Time: _____

DO

SAY

Materials Needed



REVIEW slides

Instructor's Notes

In your own words:

Here is our diagram of the elevator. You will recall the controller is located in the machine room

Advance

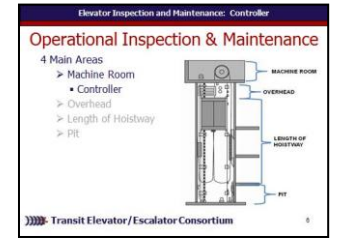
Controllers are the brain of all transit elevators. It is important that the controller be inspected and maintained on a regular basis. Overall operation should be tested and the following components should be inspected:

- Data Plate
- Controller Wires, including terminations
- Relays
- Fuses
- Circuit Boards

Before working on the system, make sure to disconnect the main connect and perform proper LOTO procedures.

Do Not Advance

✓ PPT slides 6, 7



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 240 min This section: 20 min (9 slides) Section start time: _____ Section End Time: _____

DO

SAY

Materials Needed



REVIEW slides

Instructor's Notes

In your own words:

Make sure to follow all safety procedures and read all labels. Remember, that even when power is cut off to the system, some circuits remain energized.

Advance

Here is a photo of someone performing LOTO prior to working on the controller. Notice he is not off to the side as he moves the handle of the mainline disconnect switch from on to off.

Advance

Remember, that even when power is cut off to the system, some circuits remain energized.

Advance

✓ PPT slides 7, 8, 9



Elevator – Brakes

Instructor's Guide



Module Length: 240 min Time remaining: 220 min This section: 20 min (8 slides) Section start time: _____ Section End Time: _____

DO



REVIEW slide

ASK

Instructor's Notes

SAY

In your own words:

Lets take a look at sensory inspections and controllers.

Advance

Ask

What may indicate a problem with a controller as indicated by sight?

Discuss possible answers

Advance for sample answers

- Burn marks on wires
- Loose wire connections/hardware
- Burn/arcing marks on the relay tips
- Evidence of arcing
- Dangling or tangled wiring harness
- Evidence of wildlife (nesting, waste, etc.)
- Indentations on wires
- Damaged insulation
- Pitting on contacts

Advance

Materials Needed

✓ PPT slide 10, 11



Elevator – Brakes

Instructor's Guide



Module Length: 240 min Time remaining: 220 min This section: 20 min (8 slides) Section start time: _____ Section End Time: _____

DO



REVIEW slide



ASK

Instructor's Notes

SAY

In your own words:

Ask

What may indicate a problem with controller as indicated by smell? **Discuss possible answers**

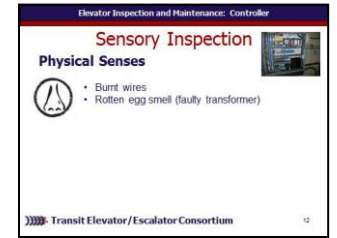
Advance for sample answers

- Burnt wires
- Rotten egg smell (faulty transformer)

Advance

Materials Needed

✓ PPT slide 12



Elevator – Brakes

Instructor's Guide



Module Length: 240 min

Time remaining: 220 min

This section: 20 min (8 slides)

Section start time: _____

Section End Time: _____

DO



REVIEW slide



ASK

Instructor's Notes

SAY

In your own words:

Ask

What may indicate a problem with controller as indicated by hearing or listening?

Discuss possible answers

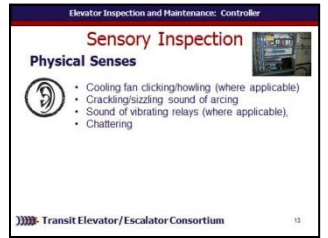
Advance for sample answers

- Cooling fan clicking/howling (where applicable)
- Crackling/sizzling sound of arcing
- Sound of vibrating relays (where applicable),
- Chattering

Advance

Materials Needed

✓ PPT slide 13



Elevator – Brakes

Instructor's Guide



Module Length: 240 min

Time remaining: 220 min

This section: 20 min (8 slides)

Section start time: _____

Section End Time: _____

DO

SAY

Materials Needed



REVIEW slide



ASK

Instructor's Notes

In your own words:

Ask

What may indicate a problem with controller as indicated by touch?

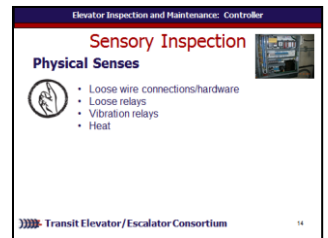
Discuss possible answers

Advance for sample answers

- Loose wire connections/hardware
- Loose relays
- Vibration relays
- Heat

Advance

✓ PPT slide 14



Elevator – Controller

Instructor's Guide



Module Length: 240 min

Time remaining: 220 min

This section: 20 min (8 slides)

Section start time: _____

Section End Time: _____

DO

SAY

Materials Needed



ASK

Instructor's Notes

In your own words:

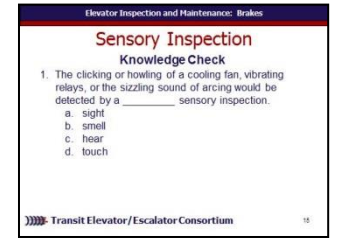
Lets see what we have learned so far:
 The clicking or howling of a cooling fan, vibrating relays, or the sizzling sound of arcing would be detected by a _____ sensory inspection.

- a. sight
- b. smell
- c. hear
- d. touch

Call on participants for answer
Advance once given the correct answer
Answer: c. hear

Advance

✓PPT slide 15



Elevator – Controller

Instructor's Guide



Module Length: 240 min

Time remaining: 220 min

This section: 20 min (8 slides)

Section start time: _____

Section End Time: _____

DO

SAY

Materials Needed



ASK

Instructor's Notes

In your own words:

Burnt wires or a rotten egg smell would be detected by a _____ sensory inspection.

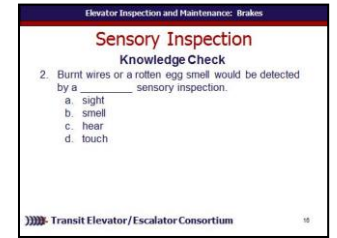
- a. sight
- b. smell
- c. hear
- d. touch

Call on participants for answer
Advance once given the correct answer

Answer: b. smell

Advance

✓PPT slide 16



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 220 min This section: 20 min (8 slides) Section start time: _____ Section End Time: _____

DO	SAY	Materials Needed
<div> </div> <div> <p>ASK</p> </div> <div> <h3>Instructor's Notes</h3> </div> <hr/> <hr/> <hr/> <hr/> <hr/>	<p>In your own words: Describe a possible problem with the controller which would be indicated by sight.</p> <p>Call on participants for answer Advance once given the correct answer</p> <p>Possible Answers: Burn marks on wires, loose wire connections/hardware, burn/arcng marks on the relay tips, evidence of arcing, dangling wires, tangled wiring harness, evidence of wildlife (nesting, waste, etc.), indentations on wires, damaged insulation, pitting on contacts</p> <p>Advance</p>	<p>✓PPT slide 17</p> <div> </div>

Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO

SAY

Materials Needed



REVIEW slides

Instructor's Notes

In your own words:
 Lets take a look at operational inspection and maintenance of controllers.

Advance

On newer systems, start by checking the **display** on the front of the controller before even opening the controller to see if any faults are noted.

Advance

If present **door interlocks** are present, make sure they are operating correctly.

If available, use an **Infrared (IR) scanner** to identify any hot areas which indicate problems areas such as loose connections and worn contacts. If not available, all connections should be inspected manually as outlined next.

Advance

✓ PPT slides 18, 19, 20



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO

SAY

Materials Needed



REVIEW slide

Instructor's Notes

In your own words:

After opening the controller,

Advance

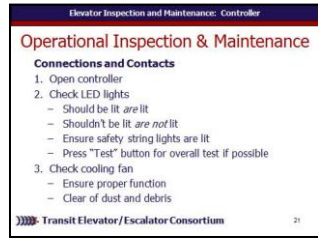
Make sure all **LED lights** that are lit should be, and none are lit that should not be. Pay particular attention to make sure the lights on the safety string are lit. An overall test of the LED lights can be done by pressing the "test" button, where applicable.

Advance

Next, make sure that the **cooling fan inside** the controller is functioning correctly and that it is clear of dust and debris. Commonly dust will collect on the backside of the fan, this should be cleaned.

Advance

✓PPT slide 21



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO

SAY

Materials Needed



REVIEW slide

In your own words:

Once these items are found to be operational, perform a **voltage test** to make sure the proper power is coming into the unit and is then being reduced down to the proper size by the transformers.

Advance

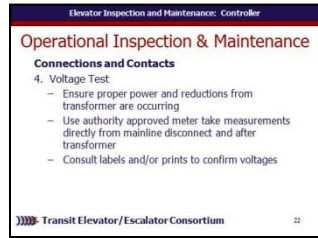
Take measurements using your authority approved meter directly from mainline disconnect and then after the transformer, which reduces the voltage.

Advance

Both the disconnect and transformers will have labels saying what their output should be. You can also consult the prints as they will indicate what voltage should be at any location in the board.

Advance

✓ PPT slide 22



Instructor's Notes

Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO



REVIEW slides

Instructor's Notes

SAY

In your own words:

Use the photo and review the voltage test once more –

Take measurements using your authority approved meter directly from mainline disconnect and then after the transformer, which reduces the voltage. Both the disconnect and transformers will have labels saying what their output should be. You can also consult the prints as they will indicate what voltage should be at any location in the board.

Advance

Lets take a look at inspection and maintenance of the various part of a controller. We will look at Data plate, Fuses, Relays, Circuit boards, Controller wires including terminations.

Advance

Materials Needed

✓ PPT slides 23, 24



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO



REVIEW slides

Instructor's Notes

SAY

In your own words:

Lets start with the data plate.
Advance

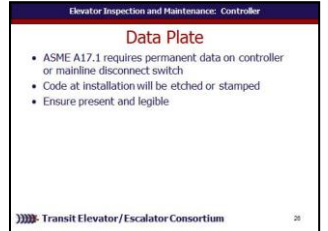
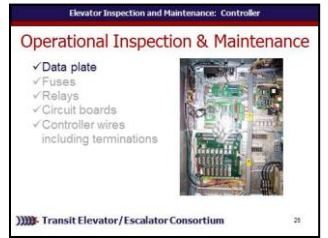
ASME A17.1 requires that a **data plate** is permanently attached to the controller or mainline disconnect. This can be inside or outside of the controller. On this data plate shall be etched or stamped the code under which the machine was installed. Make sure it is present and legible.

Advance

Here is a photo of a data plate.
Advance

Materials Needed

✓ PPT slides 25, 26, 27



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO



REVIEW slides

Instructor's Notes

SAY

In your own words:

Lets move on to fuses.

Advance

Fuses are used to protect equipment from an overload. When inspecting the electrical enclosure,

Advance look carefully at any fuses mounted in the enclosure.

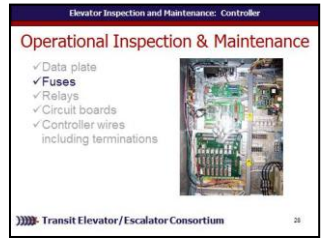
Advance The fuses should be clean and free of powdery buildup.

Advance Look at the fuse end and the fuse holder for discoloration (this may be caused by heat). If a discoloration is noted, follow-up is needed to insure that the fuse or holder is not creating a potential problem. This can easily be checked using modern **thermal imaging technology** such as an IR scanner. Replace defective components.

Advance

Materials Needed

✓ PPT slides 28, 29



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO



REVIEW slides

Instructor's Notes

SAY

In your own words:

On each inspection, check that fuses are the right size and value and that their labels are clear. Once the correct **Amperage** is determined (shown on the fuse below as 30 amps), check with the appropriate meter as per your authorities recommendations.

Advance

Here is an example of a damaged fuse next to a new fuse. Notice the discoloration of the damaged fuse.

Advance

Lets take a look at relays.

Advance

Materials Needed

✓ PPT slides 29, 30, 31



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO

SAY

Materials Needed



REVIEW slides

Instructor's Notes

In your own words:

As outlined above, perform a sensory inspection of the relays to make sure there are no burn/arcng marks and that there are no indications that relays are vibrating.

Advance Additionally, make sure all relays are properly labeled as per the print and that the labels are secure and legible.

Advance If the participant cannot see through the plastic on the front of the relay, the cover may need to be removed to check for burn marks, etc. Make sure to replace these covers after inspection.

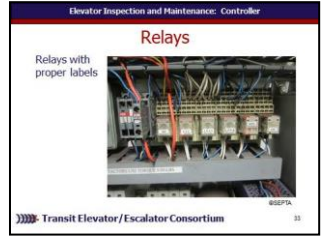
Advance If a relay must be replaced, make sure to use the correct size and type of relay.

Advance

Here is a photo of relays with proper labels.

Advance

✓ PPT slides 32, 33



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO



REVIEW slides

Instructor's Notes

SAY

In your own words:

Moving on to circuit boards...

Advance

There are many components on the circuit board which require attention during a preventative maintenance inspection. Start by making sure that the board itself is seated correctly and securely.

Advance Look for any damage to the board including cracks, burn marks or oxidation.

Advance Insure the board is clean.

As with other components, check that **indicator lights** are operating correctly.

Advance

Check **torque** on all main terminals. Also make sure that the **ribbons** are connected correctly by way of properly functioning **snap locks**.

Advance

Materials Needed

✓ PPT slides 34, 35



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO



REVIEW slides

Instructor's Notes

SAY

In your own words:

Warning: Always make sure to wear proper PPE including a grounding belt/strap when working with circuit boards.

Advance

Here is a photo of a circuit board. You can see the ribbons, snap locks, and indicator lights.

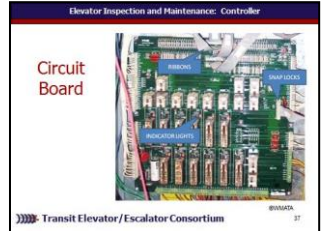
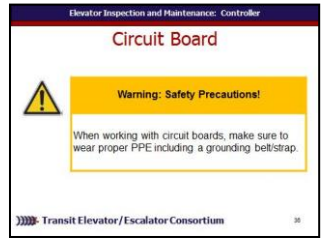
Advance

Lastly, we will look at controller wires including terminations.

Advance

Materials Needed

✓ PPT slides 36, 37, 38



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO



REVIEW slide

Instructor's Notes

SAY

In your own words:

Make sure to inspect all **wires** and the **fasteners**. Wiring can suffer from corrosion and excessive heating. **Corrosion** can be seen as a buildup of oxides or salts of the metal forming on the wiring. Excessive heating is frequently noted in darkened insulation or hard, cracked insulation.

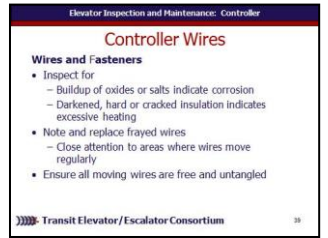
Advance Also note and replace any fraying wires. Pay specific attention to areas where wires may move on a regular basis.

Advance Additionally, make sure that all wires are able to move freely and have not become tangled.

Advance

Materials Needed

✓ PPT slide 39



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO

SAY

Materials Needed



REVIEW slides

Instructor's Notes

In your own words:

Each time the unit is maintained, a careful inspection of the **wiring terminals** and their electrical connection must be made. Transit elevators are subject to vibration from the rumble of trains as they pass thru the stations. Transit elevators are also exposed to all weather conditions. The combination of vibration and extreme conditions can lead to deterioration of electrical components.

Advance

Correctly secured and covered wiring is less susceptible to vibration and moisture.

Advance Inspect wiring bundles and make sure the **wire ties** are tight and secured.

Advance Check **raceways** and all wiring covers to make sure they are tight and cover the wires and connections as designed.

Advance

✓ PPT slides 40, 41



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO

SAY

Materials Needed



REVIEW slide

Instructor's Notes

In your own words:

A check of the electrical fasteners is needed to make sure that the electrical connections are securely attached. Connections that vibrate or work loose can overheat due to increased resistance or even come completely loose shorting power to ground or disabling the unit due to an open circuit. Fasteners should be checked according to Transit Authority procedures;

Advance This may require simply wiggling the wires and looking for movement.

Advance It may require verifying the torque on some connections, particularly power leads to the disconnect and other large gauge cables. Consult OEM manuals for proper torque.

Advance Note: over tightening fasteners can be much more detrimental than having fasteners being too loose. **Advance**

✓ PPT slide 42



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO

SAY

Materials Needed



REVIEW slide

Instructor's Notes

In your own words:

Multi-pin connectors will have to be checked to

Advance make sure that they have not worked loose. A loose multi-pin connector can be difficult to troubleshoot when a problem arises since some of the circuits that go through the connector will be working properly and others may not.

Use particular care to check the ground connections.

Advance Proper grounding is critical for safety as well as for protecting the equipment. These connections should be checked to make sure they are tight, torque according to manufacturer's specifications, and free from corrosion.

Advance

✓ PPT slide 43



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO

SAY

Materials Needed



REVIEW slide

In your own words:

If repairs cannot be made at the time of the inspection, you must carefully note what repairs are needed and the location of the defective components in the notes portion of your paperwork/computer files.

Advance

✓ PPT slide 44



Instructor's Notes

Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO

SAY

Materials Needed



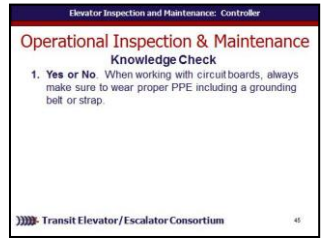
Instructor's Notes

In your own words:
 Lets see what we have learned so far:
Yes or No. When working with circuit boards, always make sure to wear proper PPE including a grounding belt or strap.

Call on participants for answer
Advance once given the correct answer
Answer: Yes.

Advance

✓PPT slide 45



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 200 min This section: 60 min (29 slides) Section start time: _____ Section End Time: _____

DO

SAY

Materials Needed



Instructor's Notes

In your own words:
 Name four prior steps for checking connections and contacts.

Call on participants for answer
Advance once given the correct answer

Answer:

1. Open controller
2. Check LED lights
3. Check cooling fan
4. Complete a voltage test

Advance

✓ PPT slide 46



Elevator – Controller

Instructor's Guide



Module Length: 240 min

Time remaining: 140 min

This section: 120 min

Section start time: _____

Section End Time: _____

DO

SAY

Materials Needed



ASK



CLASSROOM
ACTIVITY

Instructor's Notes

In your own words:

Take time to visit the field to provide an example demonstration and opportunities for participants to perform the following tests:

- Sensory Inspection
- Perform operational inspection including
 - Check controller wires for unacceptable conditions
 - Check torque on all main terminals
 - Perform voltage test
 - Check amperage on fuses

Advance

✓PPT slide 47



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 20 min This section: 20 min (3 slides) Section start time: _____ Section End Time: _____

DO

SAY

Materials Needed



CLASSROOM ACTIVITY

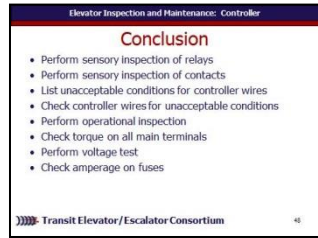
Instructor's Notes

In your own words:
[Read slide. For each objective, briefly review what was learned in this module or ask participants to share what they have learned for each learning objective and briefly discuss as a class.]
Advance.

Lets take a look at some of the key words we have defined as moved through this module.
Read slide. Discuss definitions as a group.
Advance.

Read slide. Discuss definitions as a group.
Advance.

✓PPT slides 48, 49



Elevator – Controller

Instructor's Guide



Module Length: 240 min Time remaining: 20 min This section: 20 min (3 slides) Section start time: _____ Section End Time: _____

DO



**CLASSROOM
ACTIVITY**



INDIVIDUAL ACTIVITY

Instructor's Notes

SAY

In your own words:

Administer quizzes.

Materials Needed

- ✓ PPT slides 50
- ✓ Quizzes
- ✓ Pencils

