

Instructor/Participant Guide



209: Escalator: Electrical Systems

Module 2: Escalator Electrical Power Systems



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Icons Used in This Guide

Throughout the Instructor's Guide, the following icons indicate the type of content presented.



Refer To



PowerPoint



Multimedia



Web based Training



Write



Ask



Individual Activity



Small Group Activity



Classroom Activity



Duration

Agenda

Topic No.	Topic Title	Duration
1	Introduction	5 minutes
2	Main Power Distribution	20 minutes
3	Auxiliary Power Distribution	20 minutes
4	Wiring Configurations	40 minutes
5	System Power Supplies	40 minutes
6	Electrical Measurement Techniques	30 minutes
7	Summary	5 minutes
Total Time:		2.5 hours



Overview

Purpose

The purpose of this module is to:

- Provide the participants with a basic knowledge of the electrical power distribution systems within a modern escalator.

Objectives

At the end of this chapter, the learner will be able to:

- Discuss escalator-specific power distribution systems
- Identify the different types of single phase transformers
- Identify the different connection methods of three-phase transformers
- Identify the major sections of a typical DC power supply
- Discuss the basic function of a power supply
- Utilize a schematic diagram, locate and discuss specific components in a system power supply
- Utilize a schematic diagram, identify and take measurements at specific circuit locations in a power supply using various types of electrical test equipment

Materials

Make sure you have the following:

- Laptop (one for leader)
- Participant Guides
- PowerPoint slide deck
- LCD projector

- A17.1 Safety Code for Elevators and Escalators
- A17.2 Guide for Inspection of Elevators, Escalators and Moving Sidewalks
- A17.3 Safety Code for Existing Elevators and Escalators
- Heavy Duty Transportation System Elevator Design Guidelines (APTA RT-RP-FS 008-03)
- Heavy Duty Transportation System Escalator Design Guidelines (APTA RT-RP-FS 007-02)
- Field Employees' Safety Handbook
- Transit Agency Handbook

Preparation

PREPARE flip charts with the following title:

- Class Expectations



Instructor's Notes

Escalator Electrical Power Systems

Overview

Main Power Distribution

- Responsible for providing the source voltage and current to the main drive control circuits, brake control circuits, and motor(s).
- Typical source for the power circuit is three phase 480VAC @ 60 Hz.

Auxiliary Power Distribution

- Provides power to the auxiliary lighting, heaters, communication, and annunciators.
- Powered by single phase 120VAC @ 60 Hz.

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Slide 3



REVIEW the overview of electrical power systems.



ASK the participants what the typical power source for the power circuit is.

Overview

What is the typical source for the power circuit?



Instructor's Notes

Escalator Electrical Power Systems

Circuit Breaker

- May include either thermal or magnetic overloads.
- Designed to automatically open at a predetermined current without damage to itself.
- Designed to introduce a delay in the tripping action.



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Slide 6



REVIEW slide 6 and discuss the details on circuit breakers.

CONTENT: Direct participants to describe in their own words the details of the main power distribution.

APPLICATION FEEDBACK: Now that we have discussed a little about the main power distribution, have the participants answer the following questions.



ASK participants to describe how wire numbers are determined.

Circuit Breaker

How are wire numbers determined?



Instructor's Notes

Escalator Electrical Power Systems

Heaters: Mode of Operation

- Specific configuration of the heaters varies by manufacturer.
- Thermostatically controlled resistive heating elements.
- May require 240VAC for operation.
- Some heaters may receive power from a separate 208VAC system.



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Slide 8



REVIEW slide 8 and review the methods of operating heaters.



ASK: How are heaters controlled?

Heaters: Mode of Operation

How are these heaters controlled?



Instructor's Notes

Escalator Electrical Power Systems

Lighting

- Lighting is controlled by the main controller when the escalator is in operation.
 - Direction indicators used to signal to the passengers
 - Step gap lighting
 - Combplate lighting
 - Skirt lighting

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Slide 9



REVIEW slide 9 and review the main types of lighting systems.



ASK the participants to describe the lighting system listed.

Lighting

Describe the following:

Direction Indicators:

Step Gap Lighting:

Combplate Lighting:

Skirt Lighting:



Instructor's Notes

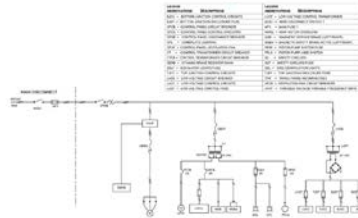
One-Line Diagrams

- A simplified notation for representing a three-phase power system.
- It is a form of block diagram graphically depicting the paths for power flow between elements of the system.
- Elements on the diagram do not represent the physical size or location of the electrical equipment.
- It is a common practice to organize the diagram with the same left-to-right, top-to-bottom sequence as the switchgear or other apparatus represented.
- Each object in the diagram is assigned a manufacturer specific nomenclature abbreviation.

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One-Line Diagrams



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Slide 12

Slide 13



REVIEW slides 12 and 13 to discuss the traits of the one-line diagram.



ASK the participants to list another name for the one-line diagram.

One-Line Diagram

What is another name for the one-line diagram?



Instructor's Notes

Escalator Electrical Power Systems

Pictorial Layout Diagrams

- Uses simple images or graphic diagrams of components to display their physical approximation within the system.
- Could be used for a system device such as the main controller.
- Could include a layout of the entire truss system in order to show the location of the components.

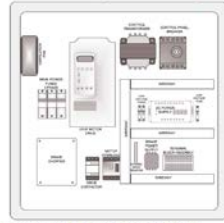
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Slide 18

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Pictorial Layout Diagrams



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Slide 19



REVIEW slides 18 and 19 and discuss pictorial layout diagrams.



ASK the participants to describe what system devices the pictorial layout diagrams depict.

Pictorial Layout Diagrams

What common system devices do these layouts typically depict?



Instructor's Notes

Escalator Electrical Power Systems

Wye-Delta Wiring Configuration

- Method of starting the drive motors.
 - also known as the *star/delta method*
- This is a starting method that reduces the starting current and starting torque.
- The device normally consists of several contactors, an overload protection relay, and a timer for setting the time in the wye position.

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Slide 22

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Wye-Delta Start Circuit

- If the main disconnect is closed, power is fed to the control circuit through the step-down control transformer to the control circuit.
- If the emergency stop button is closed and no one is pushing the stop button, when the start button is depressed the M1 contactor on line one will close.

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Slide 24



REVIEW slides 22 to 24 and discuss the wye-delta configurations.

CONTENT: Direct participants to describe in their own words the differences between wiring configurations.

APPLICATION FEEDBACK: Now that we have discussed a little about wiring configurations, have the participants answer the following questions.



ASK the participants to describe the differences between the listed methods.

Wye-Delta Configurations

Describe the differences between the following methods:

Wye-Delta Wiring Configuration:

Wye-Delta Winding Configuration:



Instructor's Notes

Escalator Electrical Power Systems

VVVF Power Conversion

- The three-phase bridge rectifier converts the three-phase incoming line feed to a fixed level DC voltage.
- The set of six drive transistors with diodes in the switching section of the drive are controlled by the microprocessor.
 - It is in the switching section where the DC power is converted to a "synthesized AC power" which is then fed to the induction motor.

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Slide 29



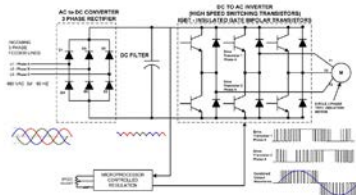
REVIEW slides 20 thru 30 and discuss VVVF Power Conversion.



ASK the participants to describe what insulated gate bi-polar transistors are.

Escalator Electrical Power Systems

VVVF Power Conversion



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Slide 30

VVVF Power Conversion

What are insulated gate bi-polar transistors?




Instructor's Notes

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Digital Multimeters

- Voltage measurements (AC and DC)
- Continuity testing (using the Ohmmeter function)
- Diode testing
- Resistance measurements
- Current measurements (clamp-on function)



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Slide 32



REVIEW slide 32 and discuss the details using the digital multimeter.



ASK the participants to describe why PPE is required when using a DMM.

Digital Multimeters

What type of PPE is required when using the DMM?



Instructor's Notes

Escalator Electrical Power Systems

Clamp-on Ammeter

- The meter pick-up coil is clamped around the conductor in order to measure the current.
- When measuring current in a three-phase system, always measure the current through each individual conductor.
- Never clamp the meter pick-up around two or more conductors at the same time.



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Slide 35



REVIEW slide 35 and discuss the details of the clamp-on ammeter.



ASK the participants to describe why you should never clamp the meter pick-up around two or more conductors.

Clamp-on Ammeter

Why should you never clamp the meter pick-up around two or more conductors?




Instructor's Notes

Escalator Electrical Power Systems


Phase Sequence Indicators


- An electromagnetic or induction instrument used to indicate the phase sequence in three-phase electric circuits.
- The meter shows the "R" indication in positive test and "L" indication in the opposite case.



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Slide 38

 **REVIEW** slide 38 and discuss the details of phase sequence indicators.

 **ASK** the participants to describe what indicates a positive or negative test on the meter.

Phase Sequence Indicators

What indicates a positive or negative test on the meter?



Instructor's Notes

Escalator Electrical Power Systems

Megohmmeter

- Insulation continuity tester that functions as a specialized ohmmeter.
- Two sets of ranges.
 - Low resistance continuity testing.
 - High resistance-high voltage insulation testing.



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Slide 40

Escalator Electrical Power Systems

Megohmmeter

- Used to test the insulation of electrical devices, such as motors, to make sure the integrity of the insulation is good and that there is no breakdown of the electrical insulation between a conductor and ground.
- If there is a breakdown or ground fault, the meter will show a low resistance possibly all the way to zero if there is a hard fault to ground.

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Slide 41



REVIEW slides 40 and 41 and discuss the use of a megohmmeter.

CONTENT: Direct participants to describe in their own words the different electrical measurement techniques.

APPLICATION FEEDBACK: Now that we have discussed a little about electrical measurement techniques, have the participants answer the following questions.



ASK the participants to describe what the purpose of this device is.

Megohmmeter

What is the purpose of this device?
