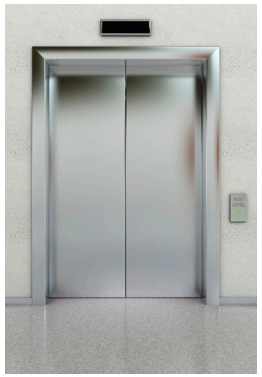
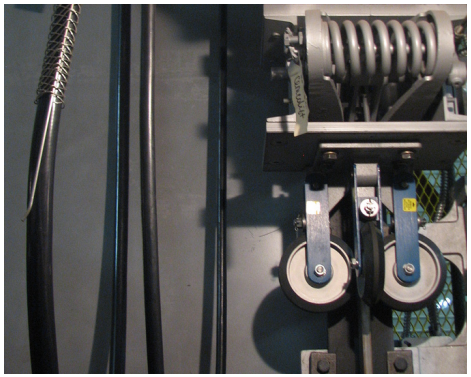
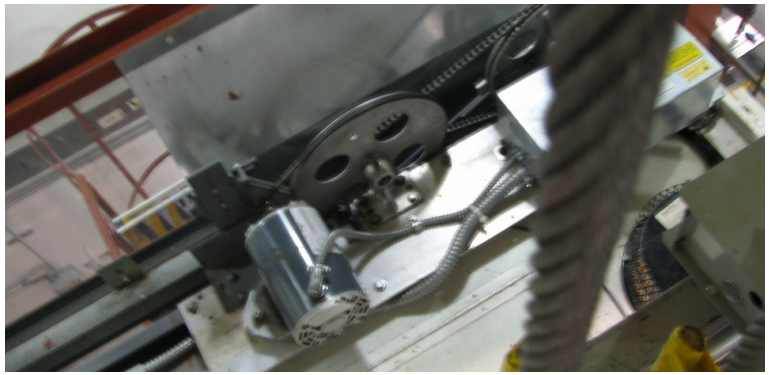
Instructor Guide







302: Advanced Electrical Printreading
Module 1: Multiple-Page Prints

TRANSIT ELEVATOR/ESCALATOR CONSORTIUM

Table of Contents

Icons Used In This Guide

REVIEW slides

INDIVIDUAL ACTIVITY

ASK

WRITE

CLASSROOM ACTIVITY

Multimedia

SMALL GROUP ACTIVITY

REFER participants to

Agenda

Topic #	Topic Title	Duration
1	Overview	30 Minutes
2	Principles of Multiple-Page Prints	20 Minutes
3	MCE Ladder Diagrams	20 Minutes
4	Safety Circuit	20 Minutes
5	Summary (including practice)	90 Minutes
	Total Time:	120 Minutes

Overview

Purpose The purpose of this module is to:

Provide the participant with an advanced approach to interpreting multiple-page electrical prints.

Objectives

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

- Explain multiple page prints
- Interpret an MCE ladder diagram
- Discuss function and location of all components in safety circuit (safety string)
- Explain functions of specific ladder rungs

Materials

Mandatory Make sure you have the following

- PowerPoint Presentation
- Coursebook
- Quizzes
- Pencils

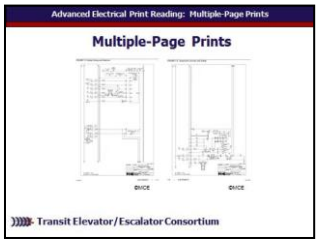
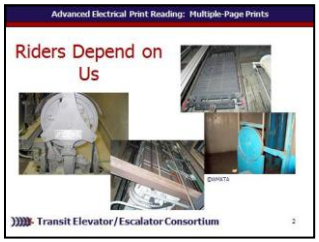
Optional You may also want the following for optional activities:

- Chalk board with chalk, large paper with marker, etc.
- Internet connection
- Lab, simulator or out of service elevator
- Additional examples of multiple page prints from your Transit Authority
- Appendix A printed on 11x17-sized paper (enough for participants)

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

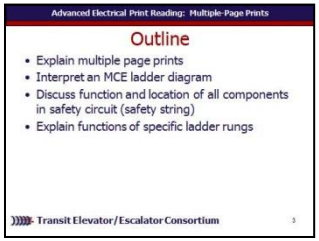
Module Length: 180 min | Time remaining: 180 min | This section: 30 min (5 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
REVIEW introduction slides **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Welcome to the first course in Advanced Electrical Print Reading and module Multiple-Page Prints. ***Advance*** Riders depend on us. ***ASK?*** What do all of these have in common electrically? ***Allow participants to discuss possible answers.*** ***Advance***	✓PPT slides 1, 2  

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

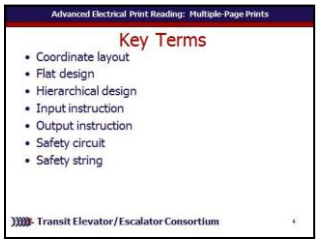
Module Length: 180 min | Time remaining: 180 min | This section: 30 min (5 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
REVIEW module objectives **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Today we will • Explain multiple page prints • Interpret an MCE ladder diagram • Discuss function and location of all components in safety circuit (safety string) • Explain functions of specific ladder rungs ***Advance***	✓PPT slide 3 

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

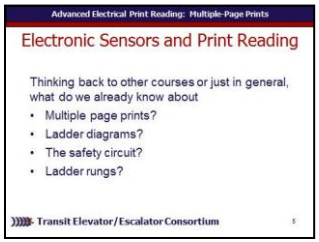
Module Length: 180 min | Time remaining: 180 min | This section: 30 min (5 slides) | *Section start time:* _____ | *Section End Time:* _____

DO	SAY	Materials Needed
REVIEW key terms **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Lets take a look at some of the key words we will be defining as move through this module: • Coordinate layout • Flat design • Hierarchical design • Input instruction • Output instruction • Safety circuit • Safety string ***Advance***	✓PPT slide 4 

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

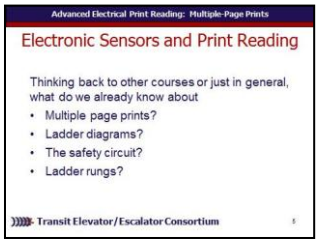
Module Length: 180 min | Time remaining: 180 min | This section: 30 min (5 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
ASK participants **SMALL GROUP ACTIVITY** **WRITE** **Instructor's Notes**	**In your own words:** Thinking back to other courses or just in general, what do we already know about • Multiple page prints? • Ladder diagrams? • The safety circuit? • Ladder rungs? ***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.*** A fundamental approach to troubleshooting elevator and escalator systems is accurately interpreting electrical prints.. ***Continued***	✓PPT slide 5  Advanced Electrical Print Reading: Multiple-Page Prints Electronic Sensors and Print Reading Thinking back to other courses or just in general, what do we already know about • Multiple page prints? • Ladder diagrams? • The safety circuit? • Ladder rungs? Transit Elevator/Escalator Consortium ✓ Paper and pencils ✓ Chalk board or similar

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

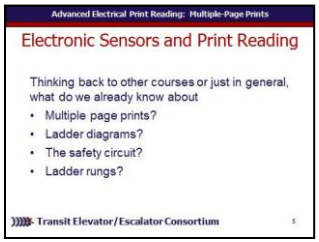
Module Length: 180 min | Time remaining: 180 min | This section: 30 min (5 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
ASK participants **SMALL GROUP ACTIVITY** **WRITE** **Instructor's Notes**	**In your own words:** Elevators and escalators are complex electrical systems and their wiring diagrams can span across several printed pages. This module examines multiple-page prints for a typical elevator and escalator electrical system in a transit environment. Many of the diagrams used in this module are from Motion Control Engineering, Inc. (MCE) which has contributed to many elevator wiring layouts in use in transit properties. The foundations for this module are found in two earlier courses in this series: Course 203 and Course 216 . This module recalls some basic information on ladder diagrams and presents new information on electrical printreading for the advanced apprentice working in on escalators and elevators in a transit environment. ***Continued***	✓PPT slide 5  ✓ Paper and pencils ✓ Chalk board or similar

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

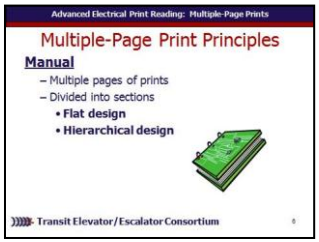
Module Length: 180 min | Time remaining: 180 min | This section: 30 min (5 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
ASK participants **SMALL GROUP ACTIVITY** **WRITE** **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Finally, this module helps the participant to analyze the safety circuit in an elevator and an escalator system using multiple electrical prints. ***Advance***	✓PPT slide 5  Advanced Electrical Print Reading: Multiple-Page Prints Electronic Sensors and Print Reading Thinking back to other courses or just in general, what do we already know about • Multiple page prints? • Ladder diagrams? • The safety circuit? • Ladder rungs? Transit Elevator/Escalator Consortium ✓ Paper and pencils ✓ Chalk board or similar

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

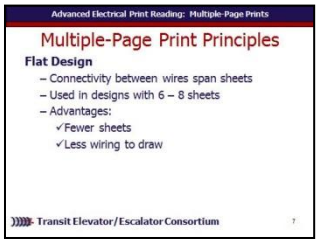
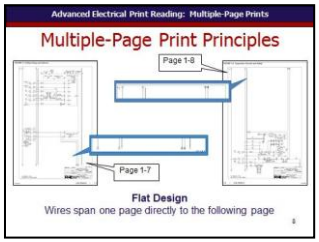
Module Length: 180 min Time remaining: 150 min This section: 20 min (6 slides) *Section start time: _____* *Section End Time: _____*

DO	SAY	Materials Needed
REVIEW slide **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** It is not possible to print all the wiring information for an elevator or escalator on one sheet of paper – at least, not effectively for a field technician! Electrical prints are printed across several sheets of paper and are generally collated by the installer or manufacturer. Frequently, EL/ES technicians refer to this compilation as the " manual ." The prints are separated into different divisions to allow for quick and easy access of information. Of course, there must be a logical system of page numbering or referencing that allows the technician to access particular prints. Essentially there are two approaches to structuring multiple-page wiring diagrams: either **flat design**, or **hierarchical design** Prints, print manual, or in back of electrical manual. ***Advance***	✓PPT slide 6 

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

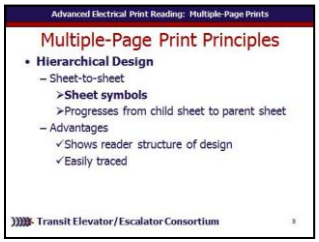
Module Length: 180 min | Time remaining: 150 min | This section: 20 min (6 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
REVIEW slides **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** While a flat design is acceptable for a design with a small number of sheets and nets, perhaps six sheets, it becomes unwieldy when the design is larger. If the electrical prints are for a particular circuit, such as the safety string, which may span a few pages, then flat design diagrams are typically used. The advantage of the flat design is that there are normally fewer sheets, and less wiring to draw. Ideally six to eight sheets. ***Advance*** You can see an example of flat design here where wires span one page directly to the following page. ***Advance***	✓PPT slides 7, 8  

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

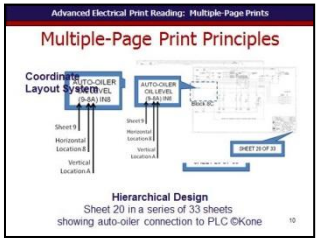
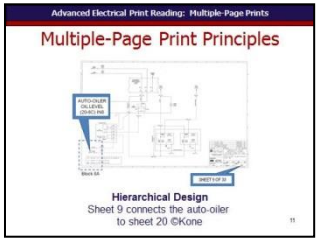
Module Length: 180 min | Time remaining: 150 min | This section: 20 min (6 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
REVIEW slides **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** A hierarchical (a system of ranking) design is one where the structure – or sheet-to-sheet relationships – in the design is represented. This is done by symbols, known as **sheet symbols**, which represent lower sheets in the design hierarchy. The sheet symbol may not refer to the consecutive sheet number but to another sheet below that may be several pages from the parent sheet. The advantage of the hierarchical design is that it shows the reader the structure of design, and that the connectivity is completely predicable and easily traced, since it is always from the child sheet up to the sheet symbol on the parent sheet. ***Advance***	✓PPT slide 9 

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

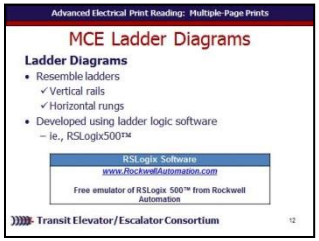
Module Length: 180 min | Time remaining: 150 min | This section: 20 min (6 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
REVIEW slides **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** This is schematic of a Kone escalator at a New York City transit station and is sheet 20 in a series of 33 sheets. It shows where the auto-oiler oil level is wired to the input block of the controller. In Block 8C – line 8, column C – of this diagram information on the auto-oiler is shown to continue on Sheet 9 in block 8A. ***Advance*** Many wiring diagrams use this system of **coordinate layout** so that the technician can quickly locate specific components and circuits. ***Advance*** You can see here sheet 9 connects the auto-oiler to sheet 20. ***Advance***	✓PPT slides 10, 11  

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

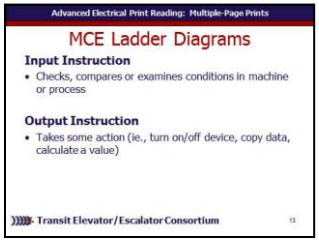
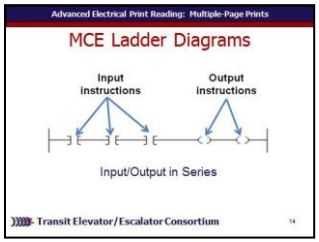
Module Length: 180 min | Time remaining: 130 min | This section: 20 min (7 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
REVIEW slide **ASK** **Multimedia** **Instructor's Notes**	**In your own words:** ***ASK:*** What do we remember about ladder diagrams? ***Allow participants to share thoughts.*** ***Advance*** Ladder diagrams resemble ladders with vertical rails and horizontal rungs. Ladder diagrams are developed using ladder logic software such as RSLogix500™ which is developed by Rockwell Automation, the parent company for Allen-Bradley products. ***Optional Instructional Activity –*** ***You may want to start with demonstration of ladder logic programming software on a computer. You can also download a free emulator of RSLogix 500™ from Rockwell Automation at www.RockwellAutomation.com*** ***Advance***	✓PPT slide 12  Advanced Electrical Print Reading: Multiple-Page Prints MCE Ladder Diagrams Ladder Diagrams • Resemble ladders ✓Vertical rails ✓Horizontal rungs • Developed using ladder logic software – ie., RSLogix500™ RSLogix Software www.RockwellAutomation.com Free emulator of RSLogix 500™ from Rockwell Automation Transit Elevator/Escalator Consortium ✓ Optional – download software: RSLogix 500™

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

Module Length: 180 min | Time remaining: 130 min | This section: 20 min (7 slides) | *Section start time:* _____ | *Section End Time:* _____

DO	SAY	Materials Needed
REVIEW slides **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Ladder logic programming, though outside the scope of this course, warrants a discussion here as far as helping the participant understand that the two basic types of instructions arranged on a ladder diagram: **Input instruction**: An instruction that checks, compares, or examines specific conditions in the machine or process. **Output instruction**: An instruction that takes some action, such as turn on a device, turn off a device, copy data, or calculate a value. ***Advance*** Here is an example of input and output instructions in a series. ***Advance***	✓PPT slides 13, 14  

Elevator–Escalator – Multiple-Page Prints

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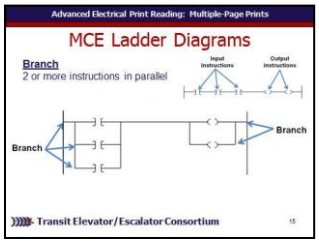
DO	SAY	Materials Needed
REVIEW slides	**In your own words:** Two or more instructions in parallel comprise a **branch**. Each branch may have several branch levels and large rungs with complex, nested branches result in having to span multiple pages. ***Advance***	✓PPT slides 15



Instructor's Notes

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Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

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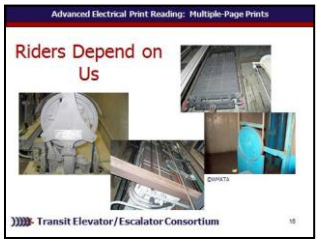
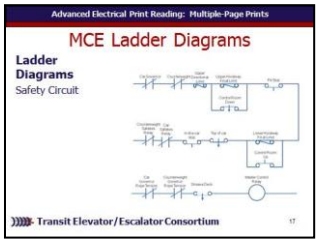
DO	SAY	Materials Needed
REVIEW slides **ASK** **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** ***Recall – ASK:*** What did we say all of these have in common electrically? ***Allow participants to share previous answers.*** ***Advance*** The participant should recall that a safety circuit is so named because, when maintained properly, its components will prevent the elevator from moving with power when any obvious safety concern has been violated. The safety system in an electric traction elevator system include components such as the governor, counterweight, limits, buffer, compensating speed, pit stop, emergency stop, door, gate, safety clamp, rope gripper, brakes, and many others. ***Continued***	✓PPT slides 16, 17  

Elevator–Escalator – Multiple-Page Prints

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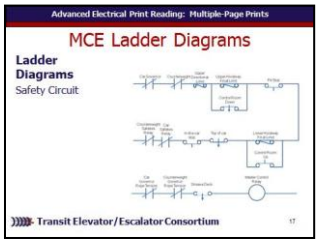
DO	SAY	Materials Needed
REVIEW slides **ASK**	**In your own words:** The electrical contacts of the most critical safety devices are typically connected in series to provide power to the elevator control system. This series of electrical contacts is usually referred to as the "safety circuit". An elevator **safety circuit** or **safety string**, for example, may have ladder diagrams spanning several pages. ***Advance***	✓PPT slide 17



Instructor's Notes

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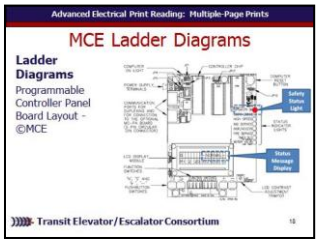
Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

Module Length: 180 min | Time remaining: 130 min | This section: 20 min (7 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
REVIEW slide **REFER** participants **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** ***REFER participants to the course book*** Here, the status message displays "NORMAL" on the LCD panel in this controller which means that the elevator is operating normally (elevator and controller are operating normally). For this MCE controller, status messages relating to the safety circuit will indicate specific locations within the safety circuit that may need to be addressed by an elevator technician. For example, if ***CAR SAFT*** message is displayed, this means that a car safety device has been activated (e.g., emergency exit contact, safety clamp switch, car-top emergency stop switch) and the technician should respond by checking all car safety devices and, of course, referring to the controller wiring prints for applicable devices. ***Advance***	✓PPT slide 18  ✓ Course Book

Elevator–Escalator – Multiple-Page Prints

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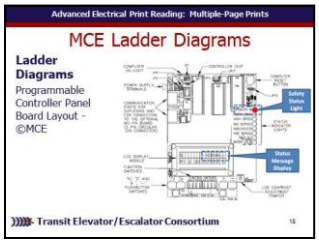
DO	SAY	Materials Needed
REVIEW slide **REFER** participants	**In your own words:** ***REFER participants to the course book.*** Samples of some common safety circuit messages that can occur on a programmable controller are shown in the following table. ***Advance***	✓PPT slide 18  ✓ Course Book

Instructor's Notes

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Elevator–Escalator – Multiple-Page Prints

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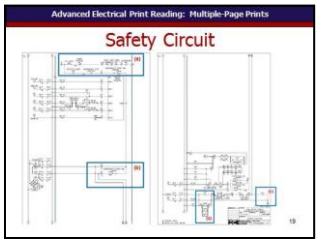
Module Length: 180 min | Time remaining: 110 min | This section: 20 min (5 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
REVIEW slide **REFER** participants **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** ***REFER participants to the course book.*** In this course, participants examine two prints that are part of an elevator's safety circuit. The prints are from MCE's design for a traction elevator and show the Safety String and Selector (Figure 6) and the Inspection Circuits and Safety (Figure 7). To make it easier on the eyes, participants can print these diagrams found in Appendix A on 11x17-sized paper. ***Optional -*** ***DISTRIBUTE: Appendix A printed on 11x17-sized paper.*** ***Advance***	✓PPT slide 19  ✓ Course Book ✓ Optional: Appendix A printed on 11x17-sized paper

Elevator–Escalator – Multiple-Page Prints

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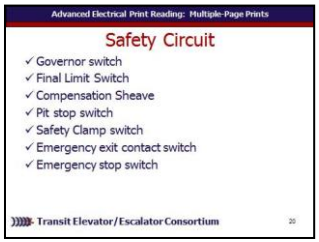
DO	SAY	Materials Needed
REVIEW slide **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** The **safety circuit**, sometimes called the **safety string**, is designed to prevent the elevator from moving when a safety concern has been breached. The safety circuit is comprised of a number of contacts and switches including: ✓ Governor switch normally located at the top of the hoistway; ✓ Final limits switches located near the top and bottom of the hoistway; ✓ Compensation sheave switches located in the pit; ✓ Pit stop switch located in the elevator pit; ✓ Safety clamp switch located under the elevator car attached to the rail; ✓ Emergency exit contact switch on top of car; and ✓ Emergency stop switch in the car on its operating panel. ***Advance***	✓PPT slide 20 

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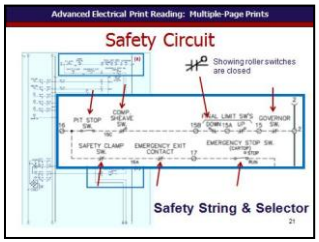
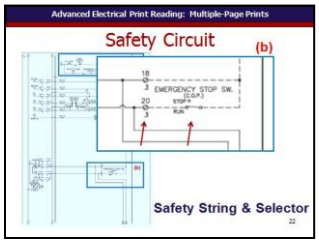
Module Length: 180 min | Time remaining: 110 min | This section: 20 min (5 slides) | *Section start time:* _____ | *Section End Time:* _____

DO	SAY	Materials Needed
REVIEW slide **REFER** participants **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** ***REFER participants to the course book.*** In section (a) we see that the governor safety switch is closed and the final up and down limit safety switches are closed – these are roller switches denoted by this symbol: ***Advance*** Section (a) also shows that compensating sheave safety, pit stop, safety clamp, emergency exit, and emergency stop contacts and switches are closed. Note that the pit stop switch is in the "go/run" (not "stop") position and the emergency stop switch for the car top is in the "run" position. Elsewhere on the safety circuit for this traction elevator are the specifics for the emergency stop on the panel inside the car, the safety string input relay, and the brake.. ***Advance***	✓PPT slide 21  ✓ Course Book ✓ Optional: Appendix A printed on 11x17-sized paper

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

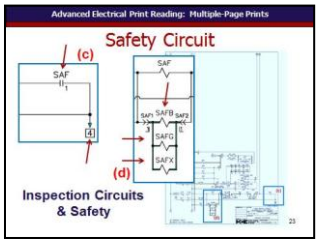
Module Length: 180 min | Time remaining: 110 min | This section: 20 min (5 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
REVIEW slide **REFER** participants **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** ***REFER participants to the course book.*** We can see in (b) that the emergency stop switch in the car operating panel is closed (in the "run" position) and is controlled at terminal 20. If any one of these switches is open, the safety circuit interrupted and the safety string input relay will deactivate. ***Advance***	✓PPT slide 22  ✓ Course Book ✓ Optional: Appendix A printed on 11x17-sized paper

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

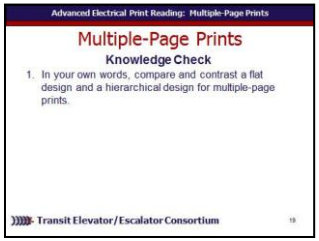
Module Length: 180 min | Time remaining: 110 min | This section: 20 min (5 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
REVIEW slide **REFER** participants **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** ***REFER participants to the course book.*** In (c), we see SAF represents the safety string input replay which, when deactivated, causes the brake, SAFB in (d), to drop and the elevator to come to a halt. Once the safety string is enabled, SAF closes and provides the 4-bus (120VAC) power used to control other components of the elevator circuit such as the doors. ***Advance*** The detailed view of the end of the safety circuit is shown in (d). ***Advance*** ***Advance*** Once the SAF safety coil is energized, SAFB, SAFG, SAFX are simultaneously activated. ***Advance***	✓PPT slide 23  ✓ Course Book ✓ Optional: Appendix A printed on 11x17-sized paper

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

Module Length: 180 min | Time remaining: 90 min | This section: 90 min (9 slides) | *Section start time: _____* | *Section End Time: _____*

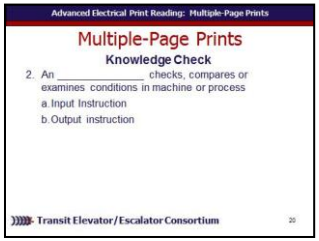
DO	SAY	Materials Needed
ASK **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Lets see what we have learned so far: In your own words, compare and contrast a flat design and a hierarchical design for multiple-page prints. ***Call on participants for answer.*** ***Advance for the correct answer.*** Answer: <u>Flat Design</u> • Connectivity between wires span sheets • Used in designs with 6 – 8 sheets • Advantages: ✓Fewer sheets ✓Less wiring to draw <u>Hierarchical Design</u> • Sheet-to-sheet ➢**Sheet symbols** ➢Progresses from child sheet to parent sheet • Advantages ✓Shows reader structure of design ✓Easily traced ***Advance***	✓PPT slide 24 

Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

Module Length: 180 min | Time remaining: 90 min | This section: 90 min (9 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
ASK	**In your own words:** An _____ checks, compares or examines conditions in machine or process a.Input Instruction b.Output instruction ***Call on participants for answer.*** ***Advance for the correct answer.*** Answer: a. ***Advance***	✓PPT slide 25



Instructor's Notes

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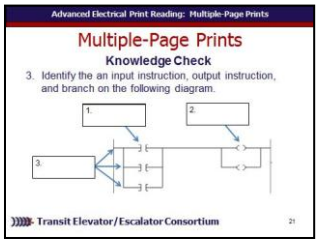
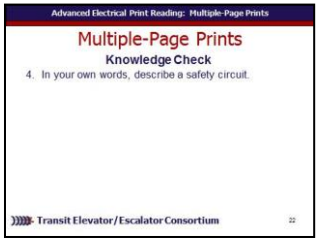
Elevator–Escalator – Multiple-Page Prints

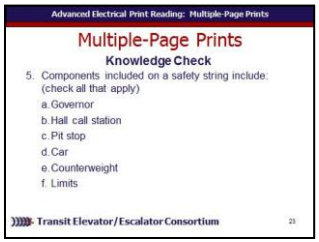
Instructor's Guide

Module Length: 180 min | Time remaining: 90 min | This section: 90 min (9 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
ASK **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Identify the an input instruction, output instruction, and branch on the following diagram. ***Call on participants for answer.*** ***Advance for the correct answer.*** Answer: 1. Input 2. Output 3. Branch ***Advance***	✓PPT slide 26 

DO	SAY	Materials Needed
ASK **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** In your own words, describe a safety circuit. ***Call on participants for answer.*** ***Advance for the correct answers.*** Answer: A safety circuit is so named because, when maintained properly, its components will prevent the elevator from moving with power when any obvious safety concern has been violated. The electrical contacts of the most critical safety devices are typically connected in series to provide power to the elevator control system. This series of electrical contacts is usually referred to as the "safety circuit". ***Advance***	✓PPT slide 27 

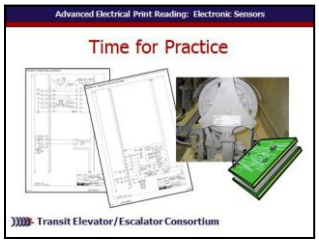
Module Length: 180 min | Time remaining: 90 min | This section: 90 min (9 slides) | *Section start time: _____* | *Section End Time: _____*

DO	SAY	Materials Needed
ASK **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Components included on a safety string include: (check all that apply) a. Governor b. Hall call station c. Pit stop d. Car e. Counterweight f. Limits ***Call on participants for answer.*** ***Advance for the correct answers.*** Answer: a., c., e., f. ***Advance***	✓PPT slide 28 

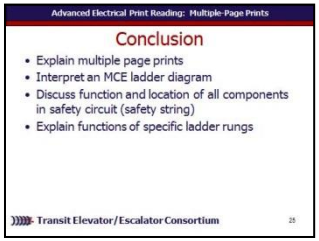
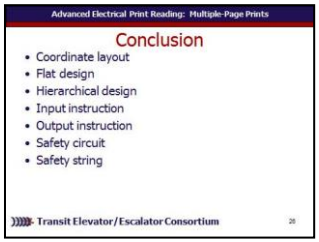
Elevator–Escalator – Multiple-Page Prints

Instructor's Guide

Module Length: 180 min | Time remaining: 90 min | This section: 90 min (9 slides) | *Section start time:* _____ | *Section End Time:* _____

DO	SAY	Materials Needed
ASK **CLASSROOM ACTIVITY** **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** ***At instructor's discretion, take time to inspect and compare additional examples of transit authority specific multiple-page prints as well as prints related to the safety circuit.*** ***Participants should be able to identify the type of design, input and output instructions, and related safety circuit information.*** ***Advance.***	✓PPT slide 29 

Module Length: 180 min | Time remaining: 90 min | This section: 90 min (9 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***	✓PPT slides 30, 31  

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DO	SAY	Materials Needed
CLASSROOM ACTIVITY **INDIVIDUAL ACTIVITY** **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** ***Administer quizzes.***	✓PPT slides 32 ✓Quizzes ✓ Pencils