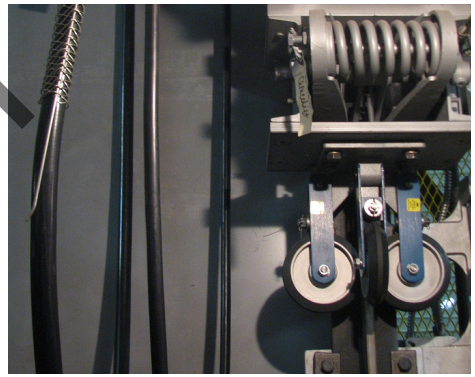
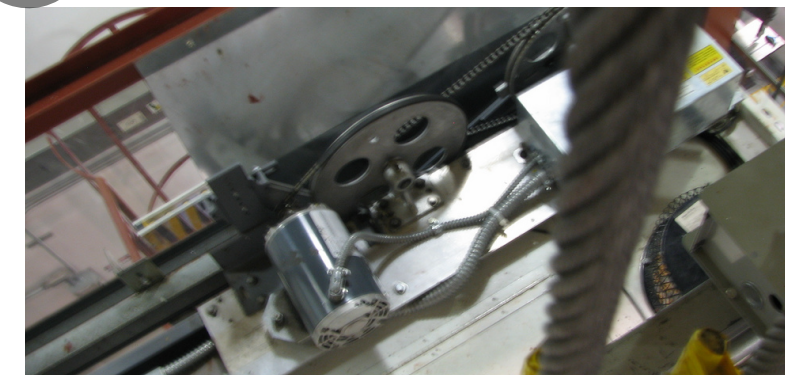
Instructor Guide





220: Elevator: Other Systems
Module 1: Rack-and-Pinion

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	Basic Operation	30 minutes
3	Components	60 minutes
4	Common Faults & Maintenance	30 Minutes
5	Summary	30 Minutes
	Total Time:	180 Minutes

Overview

Purpose The purpose of this module is to:

Provide participants with an overview of the basics of a passenger rack & pinion elevator in transit systems.

Objectives

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

- Describe the basic operation of a rack-and-pinion elevator.
- Define terminology associated with rack-and-pinion.
- Identify major components of rack-and-pinion elevators.
- Identify control systems and associated components.
- Identify safety devices specific to rack-and-pinion elevators.
- Describe the difference between the speed tracking system on a traction elevator as compared to a rack-and-pinion elevator.
- Identify maintenance requirements.
- Identify common faults.
- Identify code requirements specific to rack-and-pinion elevators.

Materials

Mandatory Make sure you have the following

- PowerPoint Presentation
- Coursebook
- Quizzes
- Pencils

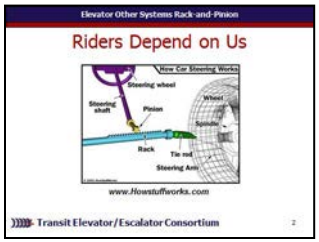
Optional You may also want the following for optional activities:

- Chalk board with chalk, large paper with marker, etc.
- Internet connection
- Lab, simulator or out of service elevator
- Authority specific procedures if applicable
- ASME Code A17.1
- Time for a field visit if applicable

Elevator – Other Systems Rack and Pinion

Instructor's Guide

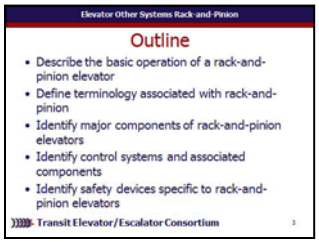
Module Length: 180 min Time remaining: 180 min This section: 30 min (6 slides) *Section start time:* _____ *Section End Time:* _____

DO	SAY	Materials Needed
REVIEW slide **Multimedia** **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** You may be most familiar or have heard of rack and pinion as used in steering systems in car. ***[Multi-media: click on illustration to website for more information on how rack and pinion works in car steering systems.]*** ***Advance***	✓PPT slide 2  ✓Internet connection

Elevator – Other Systems Rack and Pinion

Instructor's Guide

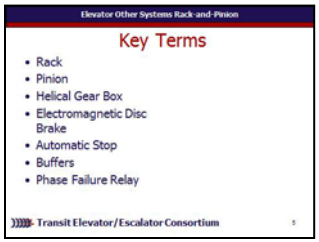
Module Length: 180 min Time remaining: 180 min This section: 30 min (6 slides) *Section start time:* _____ *Section End Time:* _____

DO	SAY	Materials Needed
REVIEW module objectives **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Today we will look at rack and pinion in elevator systems. In doing so, we will: - Describe the basic operation of a rack-and-pinion elevator - Define terminology associated with rack-and-pinion - Identify major components of rack-and-pinion elevators - Identify control systems and associated components - Identify safety devices specific to rack-and-pinion elevators ***Advance.***	✓PPT slide 3 

Elevator – Other Systems Rack and Pinion

Instructor's Guide

Module Length: 180 min Time remaining: 180 min This section: 30 min (6 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: Rack Pinion Helical Gear Box Electromagnetic Disc Brake Automatic Stop Buffers Phase Failure Relay ***Advance***	✓PPT slide 5 

Elevator – Other Systems Rack and Pinion

Instructor's Guide

Module Length: 180 min Time remaining: 150 min This section: 30 min (11 slides) *Section start time:* _____ *Section End Time:* _____

DO	SAY	Materials Needed
REVIEW slides	**In your own words:** Both the rack-and-pinion have teeth, which mate together. A motor is attached to the pinion. When the motor is electrically energized the pinion or rack will move. ***Advance*** ***[Discuss photo with participants pointing out the rack component and the pinion component.]*** ***Advance***	✓PPT slides 10, 11

Instructor's Notes

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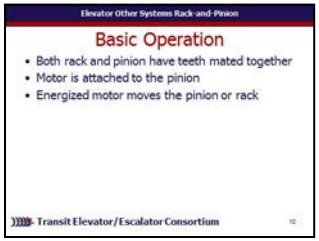
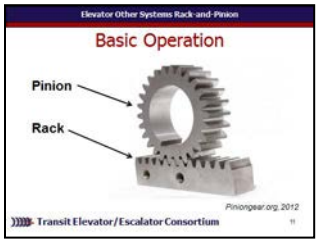
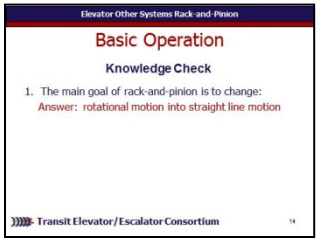
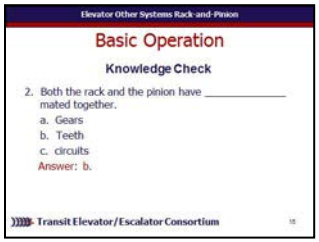




Elevator – Other Systems Rack and Pinion

Instructor's Guide

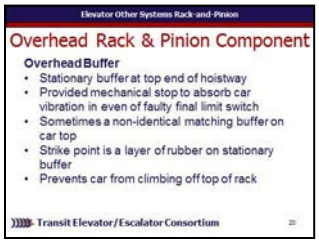
Module Length: 180 min Time remaining: 150 min This section: 30 min (11 slides) *Section start time:* _____ *Section End Time:* _____

DO	SAY	Materials Needed
ASK **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Lets see what we have learned so far: The main goal of rack-and-pinion is to change: ***Call on participants for answer*** ***Advance once given the correct answer*** Answer: rotational motion into straight line motion ***Advance*** Both the rack and the pinion have _____ mated together. a. Gears b. Teeth c. circuits ***Call on participants for answer*** ***Advance once given the correct answer*** Answer: b. ***Advance***	✓PPT slides 14, 15  

Elevator – Other Systems Rack and Pinion

Instructor's Guide

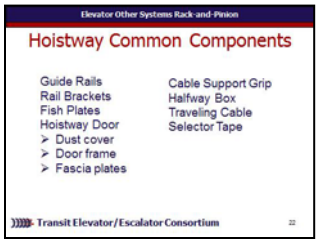
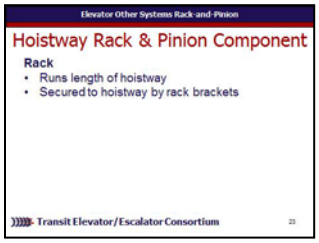
Module Length: 180 min Time remaining: 120 min This section: 60 min (26 slides) *Section start time:* _____ *Section End Time:* _____

DO	SAY	Materials Needed
REVIEW slide **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** In addition to the common overhead components in a rack-and-pinion system is a stationary overhead buffer. ***Advance*** In the case of a faulty final limit switch which does not fully stop the car before it reaches the end of the hoistway, this buffer is a mechanical stop meant to absorb the vibration of the car with the end of the hoistway as to not directly strike the overhead structure. ***Advance*** A matching, but not identical buffer is also attached to the car top which is lined up to meet the car buffer in some instances. The buffer in the overhead differs from the one on the car because unlike the one on the car the overhead buffer is not made completely of metal. ***Advance***	✓PPT slides 20 

Elevator – Other Systems Rack and Pinion

Instructor's Guide

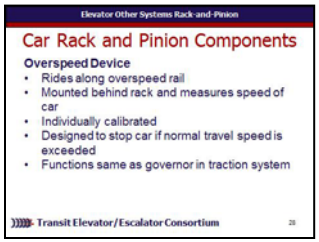
Module Length: 180 min Time remaining: 120 min This section: 60 min (26 slides) *Section start time:* _____ *Section End Time:* _____

DO	SAY	Materials Needed
REVIEW slides **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Common length of hoistway components in all elevator systems include guide rails, rail brackets, fish plates, hoistway door covers including dust covers, door frames, and fascia plates. Cable support grips, halfway boxes, traveling cables, and selector tapes are all common in all hoistways as well. ***Advance*** The only component that runs the length of the rack-and-pinion hoistway that is not present on hydraulic or traction elevators is the rack. The rack is secured to the hoistway by use of rack brackets which are attached to the hoistway. ***Advance***	✓PPT slides 22, 23  

Elevator – Other Systems Rack and Pinion

Instructor's Guide

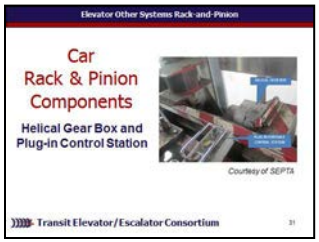
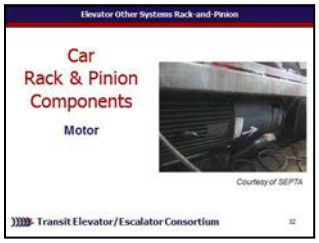
Module Length: 180 min Time remaining: 120 min This section: 60 min (26 slides) *Section start time:* _____ *Section End Time:* _____

DO	SAY	Materials Needed
REVIEW slide **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Mounted to the pinion is a unique overspeed device. The roller on the overspeed device rides along the overspeed rail ***Advance*** which is mounted behind the rack, measuring the speed of the car as it is moving along the hoistway. ***Advance*** Each overspeed safety device is individually calibrated for that particular elevator. ***Advance*** The overspeed device is designed to stop the car if the normal travel speed is exceeded. ***Advance*** The overspeed device in rack-and-pinion elevators functions the same way the governor does in traction elevators. ***Advance***	✓PPT slide 28 

Elevator – Other Systems Rack and Pinion

Instructor's Guide

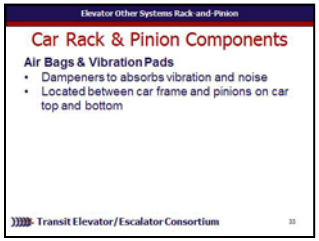
Module Length: 180 min Time remaining: 120 min This section: 60 min (26 slides) *Section start time: _____* *Section End Time: _____*

DO	SAY	Materials Needed
REVIEW slides **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Here is a photo of a helical gear box and plug-in control station attached to a rack and pinion car. ***Advance*** And here is a photo of a motor attached to a rack and pinion car. ***Advance***	✓PPT slides 31, 32  

Elevator – Other Systems Rack and Pinion

Instructor's Guide

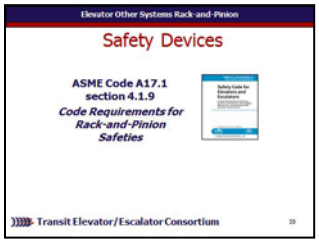
Module Length: 180 min Time remaining: 120 min This section: 60 min (26 slides) *Section start time:* _____ *Section End Time:* _____

DO	SAY	Materials Needed
REVIEW slides **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** In rack-and-pinion elevators, air bags and/or vibration pads are installed to absorb the vibration and associated noises caused by the movement of the pinion along the rack. These dampeners are located between the car frame and the pinions - both on the car top and bottom. ***Advance*** Here you can see the airbag located between the car and crosshead. ***Advance***	✓PPT slides 33, 34  

Elevator – Other Systems Rack and Pinion

Instructor's Guide

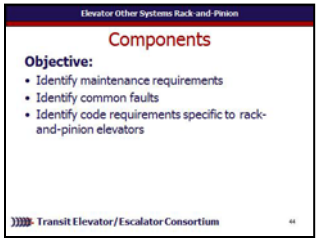
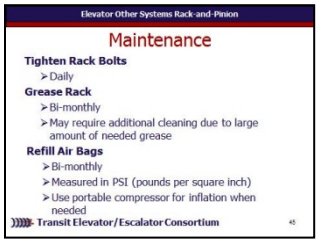
Module Length: 180 min Time remaining: 120 min This section: 60 min (26 slides) *Section start time:* _____ *Section End Time:* _____

DO	SAY	Materials Needed
REVIEW slide **REFER** participants to ASME Code A17.1 Section 4.1.9 **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Here is a car top switch on a rack and pinion system. ***Advance*** See A17.1 - 2010 Section 4.1.9 for a detailed review of code requirements for rack-and-pinion safeties ***[If possible, have participants turn to ASME Code A17.1 Section 4.1.9. Review those pages together.]*** ***Advance.***	✓PPT slide 38, 39   ✓ ASME Code A17.1

Elevator – Other Systems Rack and Pinion

Instructor's Guide

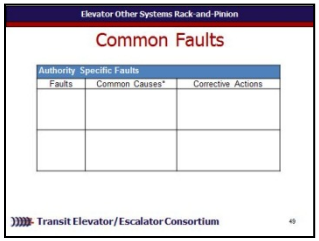
Module Length: 180 min Time remaining: 60 min This section: 30 min (9 slides) *Section start time:* _____ *Section End Time:* _____

DO	SAY	Materials Needed
REVIEW slides **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Lets start move on by taking a look at rack and pinion maintentance requirements, common faults, and code requirements. ***Advance*** Rack-and-pinion elevators are much more intensive when it comes to maintenance than either traction or hydraulic elevators. In addition to the maintenance required for other systems, the following items should be done: ***Advance*** Tighten rack bolts - Because of the vibration associated with rack-and-pinion elevators, racks must be inspected on a daily basis to ensure that all bolts are securely attached to the hoistway. ***Advance***	✓PPT slides 44, 45  

Elevator – Other Systems Rack and Pinion

Instructor's Guide

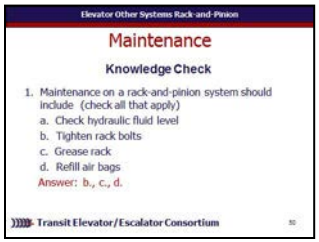
Module Length: 180 min Time remaining: 60 min This section: 30 min (9 slides) *Section start time:* _____ *Section End Time:* _____

DO	SAY	Materials Needed
REVIEW slide **REFER** participants to Course Book **WRITE** **Instructor's Notes**	**In your own words:** ***[Note any other transit authority known common faults with rack and pinion systems as well as any specific related procedures.]*** ***Advance***	✓PPT slide 49  ✓ Course book ✓ Authority Specific Procedures if possible

Elevator – Other Systems Rack and Pinion

Instructor's Guide

Module Length: 180 min Time remaining: 60 min This section: 30 min (9 slides) *Section start time:* _____ *Section End Time:* _____

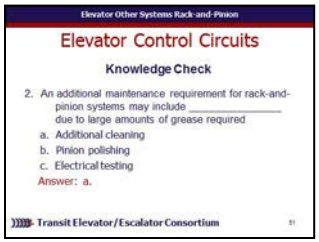
DO	SAY	Materials Needed
ASK **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** Maintenance on a rack-and-pinion system should include (check all that apply) a. Check hydraulic fluid level b. Tighten rack bolts c. Grease rack d. Refill air bags ***Call on participants for answer*** ***Advance once given the correct answer*** Answer: b., c., d. ***Advance***	✓PPT slide 50 

Elevator – Other Systems Rack and Pinion

Instructor's Guide

Module Length: 180 min Time remaining: 60 min This section: 30 min (9 slides) *Section start time:* _____ *Section End Time:* _____

DO	SAY	Materials Needed
ASK	**In your own words:** An additional maintenance requirement for rack-and- pinion systems may include _____ due to large amounts of grease required a. Additional cleaning b. Pinion polishing c. Electrical testing ***Call on participants for answer*** ***Advance once given the correct answer*** Answer: a. ***Advance***	✓PPT slide 51



Instructor's Notes

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Elevator – Other Systems Rack and Pinion

Instructor's Guide

Module Length: 180 min Time remaining: 30 min This section:30 min (4 slides) *Section start time: _____* *Section End Time: _____*

DO	SAY	Materials Needed
CLASSROOM ACTIVITY **INDIVIDUAL ACTIVITY** **Instructor's Notes** _____ _____ _____ _____ _____	**In your own words:** ***Administer quizzes.***	✓PPT slide 56 ✓Quizzes ✓ Pencils