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

*Instructor’s Guide*

### Icons Used In This Guide

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

### Agenda

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<th>Topic #</th>
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<td>1</td>
<td>Overview</td>
<td>30 minutes</td>
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<td>2</td>
<td>Basic Operation</td>
<td>30 minutes</td>
</tr>
<tr>
<td>3</td>
<td>Components</td>
<td>60 minutes</td>
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<td>4</td>
<td>Common Faults &amp; Maintenance</td>
<td>30 Minutes</td>
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<tr>
<td>5</td>
<td>Summary</td>
<td>30 Minutes</td>
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**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:**

<table>
<thead>
<tr>
<th>DO</th>
<th>SAY</th>
<th>Materials Needed</th>
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</table>
| REVIEW slide | 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 |

**Instructor’s Notes**

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### 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:**

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<th><strong>DO</strong></th>
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<th><strong>Materials Needed</strong></th>
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<tbody>
<tr>
<td>REVIEW</td>
<td>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</td>
<td>✓ PPT slide 3</td>
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**Instructor’s Notes**

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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: 

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<thead>
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</table>
| REVIEW key terms | **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

Instructor’s Notes

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
**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*
### Elevator – Other Systems Rack and Pinion

**Instructor’s Guide**

<table>
<thead>
<tr>
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</table>
| ![Question Icon](image) **ASK**  | **In your own words:**  
Let’s 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**  |

**Instructor’s Notes**

- ___________________________________________________________________
- ___________________________________________________________________
- ___________________________________________________________________
- ___________________________________________________________________
- ___________________________________________________________________
- ___________________________________________________________________

**Materials Needed**

- ✓ PPT slides 14, 15
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
**Materials Needed**

- PPT slides 22, 23

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**Instructor’s Notes**

- 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**

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

**Section End Time:**
In your own words: Mounted to the pinion is a unique overspeed device. The roller on the overspeed device rides along the overspeed rail which is mounted behind the rack, measuring the speed of the car as it is moving along the hoistway.

Each overspeed safety device is individually calibrated for that particular elevator.

The overspeed device is designed to stop the car if the normal travel speed is exceeded.

The overspeed device in rack-and-pinion elevators functions the same way the governor does in traction elevators.

Advance
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**
Elevator – Other Systems Rack and Pinion

Instructor’s Guide

<table>
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</table>
| REVIEW slides | **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**

- Checklist: PPT slides 33, 34
**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.**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>✓ PPT slide 38, 39</td>
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<tr>
<td>✓ ASME Code A17.1</td>
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</tbody>
</table>

**Instructor's Notes**

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**DO**

- REVIEW slide
- REFER participants to ASME Code A17.1 Section 4.1.9
**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:**  

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</table>
| **REVIEW slides** | **In your own words:** Let's start move on by taking a look at rack and pinion maintenance 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 |

**Instructor’s Notes**

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- [ ]
- [ ]

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**Advance**

**Maintenance**

- **Tighten Rack Bolts**
  - **Daily**
  - **Grease Rack**
  - **Bimonthly**
  - May require additional cleaning due to large amount of needed grease
  - **Refill Air Bag**
  - **Bimonthly**
  - Measured in PSI (pounds per square inch)
  - Use portable compressor for inflation when needed

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**Advance**

**Components**

- Objective:
  - Identify maintenance requirements
  - Identify common faults
  - Identify code requirements specific to rack and pinion elevators
### Elevator – Other Systems Rack and Pinion

#### Instructor’s Guide

**Module Length:** 180 min  
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**This section:** 30 min (9 slides)  
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</table>
| REVIEW slide | 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 |
| REFER participants to Course Book |  
| WRITE |  
Instructor’s Notes | ✓ Course book  
✓ Authority Specific Procedures if possible |

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Transit Elevator/Escalator Consortium
### Materials Needed

- PPT slide 50

### 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
**Materials Needed**

- **PPT slide 51**

**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. Additional cleaning

**Advance**
## Elevator – Other Systems Rack and Pinion

### Instructor’s Guide

Module Length: 180 min  
Time remaining: 30 min  
This section: 30 min (4 slides)

### DO

**CLASSROOM ACTIVITY**

**INDIVIDUAL ACTIVITY**

### SAY

In your own words:

*Administer quizzes.*

### Materials Needed

- PPT slide 56
- Quizzes
- Pencils

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**Instructor’s Notes**

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