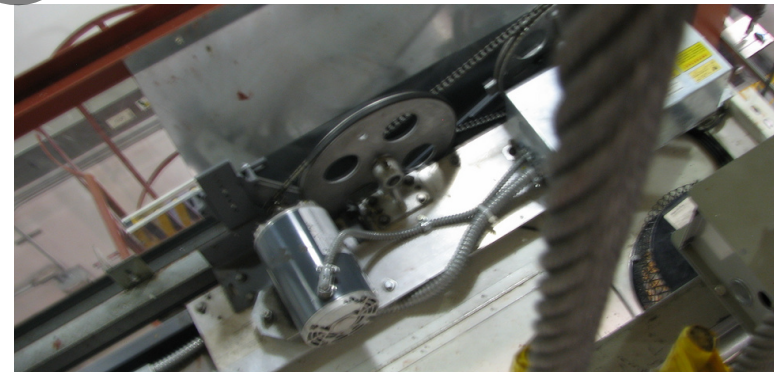
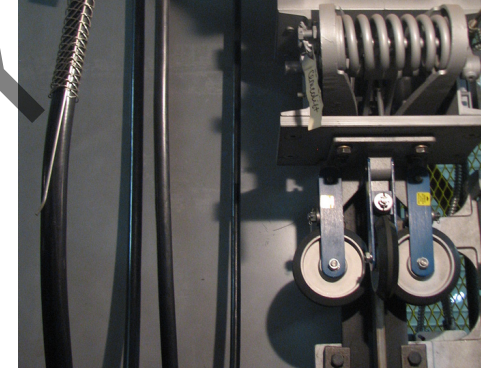


# Instructor Guide



## 218: Elevator: Hydraulic Elevator Module 2: Principles of Operation



**Table of Contents**

Overview.....4

Major Components.....11

Configurations – Cylinders, Pistons, and Packing Head .....45

Configurations – Cantilevered Elevators .....59

Hydraulic Fluid Properties.....66

Summary.....75

PREVIEW ONLY

# Elevator – Hydraulic Principles of Operation

*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	Major Components	60 minutes
3	Field Trip	40 minutes
4	Configurations	30 minutes
5	Field Trip	30 minutes
6	Configurations	20 Minutes
7	Hydraulic Fluid Properties	20 minutes
8	Summary	20 Minutes
	<b>Total Time:</b>	240 Minutes

# Elevator – Hydraulic Principles of Operation

## *Instructor's Guide*



### Overview

**Purpose** The purpose of this module is to:

- The purpose of this unit is to explain and discuss the principles Hydraulic Elevator Operations. The key concepts discussed will aid the trainee in their future applications of elevator concepts and terminology.

### **Objectives**

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

- **Define terminology associated with hydraulic elevator operation**
- **Identify major components of hydraulic elevators**
- **Describe the basic operation of a hydraulic elevator**
- **Identify different hydraulic lift configurations**
- **Identify control systems and associated components**
- **Identify safety features of hydraulic elevators**

### **Materials**

#### **Mandatory**

Make sure you have the following

- PowerPoint Presentation
- Course book
- Quizzes
- Pencils
- Paper
- Elevator's 101, by Zach McCain

#### **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
- Dual Cylinder Machine if applicable to your transit authority

# Elevator – Hydraulic Elevators

## Instructor's Guide



Module Length: 240 min    Time remaining: 240 min    This section: 20 min (7 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_



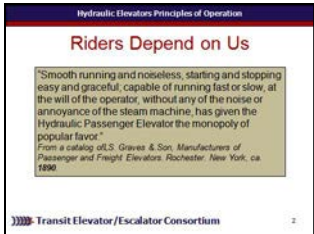
DO	SAY	Materials Needed
<div></div> <div><p><b>REVIEW</b> introduction slide</p></div> <div><p><b>Instructor's Notes</b></p></div> <div><hr/><hr/><hr/><hr/><hr/></div>	<p><b>In your own words:</b></p> <p>Welcome to the module for hydraulic elevators principles of operation.</p> <p><b>Advance.</b></p>	<p>✓ PPT slide 1</p> <div></div>



# Elevator – Hydraulic Elevators

## Instructor's Guide

Module Length: 240 min    Time remaining: 240 min    This section: 20 min (7 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_

DO	SAY	Materials Needed
<div> <b>REVIEW</b> introduction slide</div> <div> <b>Multimedia</b></div> <div><h3>Instructor's Notes</h3><div></div><div></div><div></div><div></div><div></div><div></div></div>	<p><b>In your own words:</b></p> <p>“Smooth running and noiseless, starting and stopping easy and graceful; capable of running fast or slow, at the will of the operator, without any of the noise or annoyance of the steam machine, has given the Hydraulic Passenger Elevator the monopoly of popular favor.” <i>From a catalog of L.S. Graves &amp;.Son, Manufacturers of Passenger and Freight Elevators. Rochester. New York, ca. 1890.</i></p> <p>Hydraulic elevators have been around for some time.</p> <p><b>[Click on the box and briefly share some of early diagrams of hydraulic elevators to participants.]</b></p> <p><b>Advance.</b></p>	<p>✓PPT slide 2</p> <div></div> <p>✓Internet connection</p>

# Elevator – Hydraulic Elevators

## Instructor's Guide



Module Length: 240 min    Time remaining: 240 min    This section: 20 min (7 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_


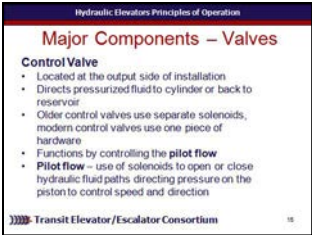
DO	SAY	Materials Needed
<div></div> <div> <p><b>REVIEW</b> module objectives</p> </div> <div> <h3>Instructor's Notes</h3> </div> <div> <hr/><hr/><hr/><hr/><hr/> </div>	<div> <h3>In your own words:</h3> </div> <div> <p>We will also...</p> <ul style="list-style-type: none"> <li>-Compare and contrast the different types of hydraulic pistons</li> <li>-Describe a compound piston</li> <li>-Describe viscosity of hydraulic fluid and how it relates to the operation of a hydraulic elevator</li> </ul> <p><b>Advance.</b></p> </div>	<div> <p>✓PPT slide 4</p> </div> <div> </div>

# Elevator – Hydraulic Elevators

## Instructor's Guide

Module Length: 240 min    Time remaining: 220 min    This section: 60 min (41 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_



DO	SAY	Materials Needed
<div> <b>REVIEW</b> slide</div> <div><h3>Instructor's Notes</h3><div></div><div></div><div></div><div></div><div></div><div></div></div>	<p><b>In your own words:</b></p> <p>Valves are another major component of a hydraulic system. <b>Advance.</b> The <b>control valve</b> is located at the output side of the installation <b>Advance.</b> And it directs the pressurized fluid either to the cylinder or back to the reservoir. <b>Advance.</b> Modern control valves are unified in one piece of hardware as opposed to previous systems when the up and down directions had separate solenoids and up and down lines. <b>Advance.</b></p>	<p>✓PPT slide 15</p> <div></div>


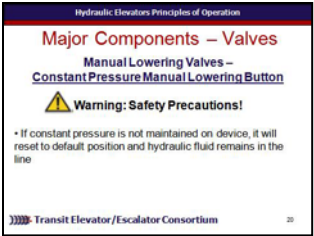


# Elevator – Hydraulic Elevators

## Instructor's Guide

Module Length: 240 min    Time remaining: 220 min    This section: 60 min (41 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_



DO	SAY	Materials Needed
<div> <b>REVIEW</b> slide</div> <div><h3>Instructor's Notes</h3><hr/><hr/><hr/><hr/><hr/><hr/></div>	<p><b>In your own words:</b></p> <p>If constant pressure is not maintained on the device, it resets to its default position and the hydraulic fluid remains in the hydraulic line. If the manual lowering valve was not automatically reset with its release the possibility of injury to the passenger(s) or mechanic would increase. If the elevator becomes bound in the hoistway, the weight of the elevator and piston will be put on the rails or some other obstruction rather than the hydraulic fluid. It is possible that the hydraulic fluid could return to the reservoir through the open solenoids. This would cause a situation that once the elevator is unbound in the hoistway the piston would fall at an accelerated rate until the suspension means was met causing catastrophic injury to the mechanic or passengers.</p> <p><b>Advance.</b></p>	<p>✓PPT slide 20</p> <div></div>

# Elevator – Hydraulic Elevators

## Instructor's Guide



Module Length: 240 min    Time remaining: 220 min    This section: 60 min (41 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_

DO	SAY	Materials Needed
<div></div> <div>REVIEW slide</div> <div>Instructor's Notes</div> <div><hr/><hr/><hr/><hr/><hr/></div>	<p><b>In your own words:</b></p> <p>A muffler dampens the flow of hydraulic fluid as it leaves and returns to the power unit and also <b>Advance</b>. absorbs the pulsation created by the pump output and evens the flow of hydraulic fluid to the cylinder.</p> <p><b>Advance.</b> The size of the muffler is determined by the amount of hydraulic fluid flow. There are two types of hydraulic mufflers used in the hydraulic elevator industry.</p> <p><b>Advance.</b></p>	<p>✓PPT slide 28</p> <div></div>

# Elevator – Hydraulic Elevators

## Instructor's Guide

Module Length: 240 min    Time remaining: 220 min    This section: 60 min (41 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_





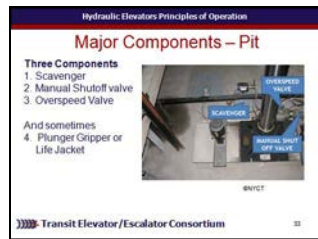
DO	SAY	Materials Needed
<div></div> <div><p>REVIEW slide</p></div> <div><h3>Instructor's Notes</h3><hr/><hr/><hr/><hr/><hr/><hr/></div>	<p><b>In your own words:</b></p> <p>Isolation couplings are used to electrically isolate the piston from the power unit. The hydraulic cylinder and the hydraulic line are metal and conductive and the cylinder acts as a giant grounding rod for all stray voltages and for all static electricity produced by the power unit itself. <b>Advance.</b> Placing an isolation coupling in the hydraulic circuit keeps these voltages from oxidizing the cylinder. <b>Advance.</b> This coupling provides a non-conductive connection in the hydraulic system. <b>Advance.</b> It also acts as a noise reduction filter providing a non-metallic connection between the power unit and the hydraulic cylinder. <b>Advance.</b></p>	<p>✓PPT slide 31</p> <div></div>

# Elevator – Hydraulic Elevators

## Instructor's Guide



Module Length: 240 min    Time remaining: 220 min    This section: 60 min (41 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_

DO	SAY	Materials Needed
<div>  <b>REVIEW</b> slides         </div> <div> <h3>Instructor's Notes</h3> <hr/><hr/><hr/><hr/><hr/><hr/> </div>	<div> <p><b>In your own words:</b></p> <p>Here is an Isolation coupling installed between the power unit and the hydraulic cylinder again from a New York City Transit system.</p> <p><b>Advance.</b></p> <p>There are three components that exist in the pit of all hydraulic elevators that are not on traction elevators. They are:</p> <ul style="list-style-type: none"> <li>Scavenger</li> <li>Manual Shutoff valve</li> <li>Overspeed Valve</li> </ul> <p>Some systems will utilize a plunger gripper also known as <i>life jacket</i>.</p> <p><b>Advance.</b></p> </div>	<div> <p>✓PPT slides 32, 33</p> </div> <div>  </div> <div>  </div>

# Elevator – Hydraulic Elevators

## Instructor's Guide



Module Length: 240 min    Time remaining: 220 min    This section: 60 min (41 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_

DO	SAY	Materials Needed
<div></div> <div><p>REVIEW slide</p></div> <div><p>Instructor's Notes</p></div> <div><hr/><hr/><hr/><hr/><hr/></div>	<p><b>In your own words:</b></p> <p>And a safety precaution to always remember would be to never perform maintenance on a valve under pressure.</p> <p>Also, hydraulic systems are very flexible in that the power unit does not have to be in close proximity of the cylinder. In fact the power unit could be hundreds of feet from the cylinder. This is important to transit applications where space is often at a premium. However, with every foot in length, the possibility of line failure increases.</p> <p><b>Advance.</b></p>	<p>✓PPT slide 39</p> <div></div>



# Elevator – Hydraulic Elevators

## Instructor's Guide



Module Length: 240 min    Time remaining: 220 min    This section: 60 min (41 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_

DO	SAY	Materials Needed
<div></div> <div> <p><b>REVIEW</b> slide</p> </div> <div> <h3>Instructor's Notes</h3> </div> <div> <hr/><hr/><hr/><hr/><hr/><hr/> </div>	<div> <h4>In your own words:</h4> </div> <div> <p>To provide protection from loss of hydraulic pressure that would allow the elevator to descend at a catastrophic rate the industry created the overspeed valve also known as a <i>rupture valve</i> which automatically shuts the flow of hydraulic fluid back to the tank in cases when the main hydraulic line is breached/broken.</p> </div> <div> <p><b>Advance.</b></p> </div>	<div> <p>✓PPT slide 40</p> </div> <div> </div>

# Elevator – Hydraulic Elevators

## Instructor's Guide

Module Length: 240 min    Time remaining: 220 min    This section: 60 min (41 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_



DO	SAY	Materials Needed
<div></div> <div>REVIEW slide</div> <div>Instructor's Notes</div> <div><hr/><hr/><hr/><hr/><hr/></div>	<p><b>In your own words:</b></p> <p>Additionally, installation of a plunger gripper and add-on plunger gripper controller are crucial for safety. <b>Advance.</b> Together, they stop the uncontrolled descent of an elevator. <b>Advance.</b> The controller works with the input of an encoder that provides descent speeds to the control board. <b>Advance.</b> If the elevator should descend at a rate faster than contract speed the life jacket will stop the elevator.</p> <p><b>Advance.</b> This feature protection in case of catastrophic suspension means failure and elevator overspeed in the down direction. <b>Advance.</b> Overspeed can be caused by failure of the hydraulic line connection or if the cylinder should lose its structural integrity through electrolysis. <b>Advance.</b></p>	<p>✓PPT slide 42</p> <div><p>Hydraulic Elevators Principles of Operation Major Components – Pit</p><p>Plunger Gripper and Plunger Gripper Controller</p><ul style="list-style-type: none"><li>• Together stop the uncontrolled descent of an elevator</li><li>• Controller works with the input of an encoder</li><li>• Encoder provides descent speeds to control board</li><li>• If elevator descends at rate faster than contract speed, life jacket will stop elevator</li><li>• Protection against catastrophic suspension due to failure and elevator overspeed in the downward direction</li><li>• Overspeed can be caused by failure of hydraulic line connection or electrolysis</li></ul><p>Transit Elevator/ Escalator Consortium</p></div>

# Elevator – Hydraulic Elevators

## Instructor's Guide



Module Length: 240 min    Time remaining: 220 min    This section: 60 min (41 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_

DO	SAY	Materials Needed
<div> <b>ASK</b></div> <div><b>Instructor's Notes</b> <hr/><hr/><hr/><hr/><hr/><hr/></div>	<p><b>In your own words:</b></p> <p>Major components of the pit include the</p> <ul style="list-style-type: none"><li>a. Scavenger</li><li>b. Overspeed Valve</li><li>c. Isolation Couplings</li><li>d. Manual Shutoff Valve</li></ul> <p><b>Call on participants for answer.</b> <b>Advance for correct answer.</b> <b>Answer: a., b., d.</b> <b>Advance</b></p>	<p>✓PPT slide 45</p> <div></div>

# Elevator – Hydraulic Elevators

## Instructor's Guide



Module Length: 240 min    Time remaining: 220 min    This section: 60 min (41 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_



DO	SAY	Materials Needed
<div> <b>ASK</b> </div> <div> <b>Instructor's Notes</b> </div> <div> <hr/><hr/><hr/><hr/><hr/> </div>	<div> <p><b>In your own words:</b></p> <p>The _____ will stop the elevator from descending at a rate faster than contract speed.</p> <ol style="list-style-type: none"> <li>Life Jacket</li> <li>Plunger Gripper</li> <li>Plunger Gripper Controller</li> </ol> <p><b>Call on participants for answer.</b></p> <p><b>Advance for correct answer.</b></p> <p><b>Answer: a., b., c., review following slide</b></p> <p><b>Advance.</b></p> <p><b>[Review previously shared slide.]</b></p> <p><b>Advance.</b></p> </div>	<div> <p>✓PPT slides 47, 48</p> </div> <div> </div> <div> </div>

# Elevator – Hydraulic Elevators

## Instructor's Guide

Module Length: 240 minutes    Time remaining: 160 minutes    This section: 40 minutes    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_



DO	SAY	Materials Needed
<div> <b>CLASSROOM ACTIVITY</b></div> <div><b>Instructor's Notes</b>          </div>	<p><b>In your own words:</b> Okay, now it's time to see how this works in the real world. Please get your stuff together for a trip to the lab. <i><b>[At instructor's discretion, take time to visit the field and look for hydraulic elevator major components and related information.]</b></i> <b>Advance.</b></p>	<p>✓ PPT slide 50</p> <div></div>



# Elevator – Hydraulic Elevators

## Instructor's Guide



Module Length: 240 min    Time remaining: 120 min    This section: 30 min (18 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_


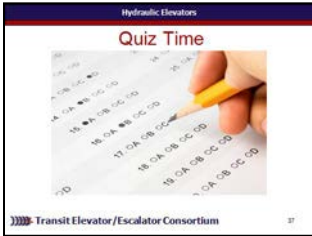
DO	SAY	Materials Needed
<div></div> <div>REVIEW slide</div> <div>Instructor's Notes</div> <div><hr/><hr/><hr/><hr/><hr/></div>	<p><b>In your own words:</b></p> <p>The packing head is located at the top of the cylinder where the piston exits the cylinder.</p> <p><b>Advance.</b> The cylinder has a flange that accepts the packing head which is also flanged. <b>Advance.</b> In the packing head is the piston packing. <b>Advance.</b> The cylinder and the piston needs a pliable seal that can expand and contract with the changing temperatures of the hydraulic fluid, this seal must also withstand the system pressure.</p> <p><b>Advance.</b> Provided that the cylinder is installed correctly and the elevator and the rails are installed correctly a piston seal will provide years of service. <b>Advance.</b> Even if the seal is installed perfectly, it will still allow a tiny bit of hydraulic fluid to escape. Above the packing seal is a rubber wiper ring which collects this excess hydraulic fluid.</p> <p><b>Advance.</b></p>	<p>✓PPT slide 64</p> <div></div>

# Elevator – Hydraulic Elevators

## Instructor's Guide



Module Length: 240 min    Time remaining: 20 min    This section: 20 minutes (4 slides)    Section start time: \_\_\_\_\_    Section End Time: \_\_\_\_\_

DO	SAY	Materials Needed
<div> <b>CLASSROOM ACTIVITY</b></div> <div><b>Instructor's Notes</b></div> <div><hr/><hr/><hr/><hr/><hr/></div>	<p>In your own words:</p> <p><i>Administer quiz.</i></p>	<p>✓ PPT slide 88</p> <div></div>