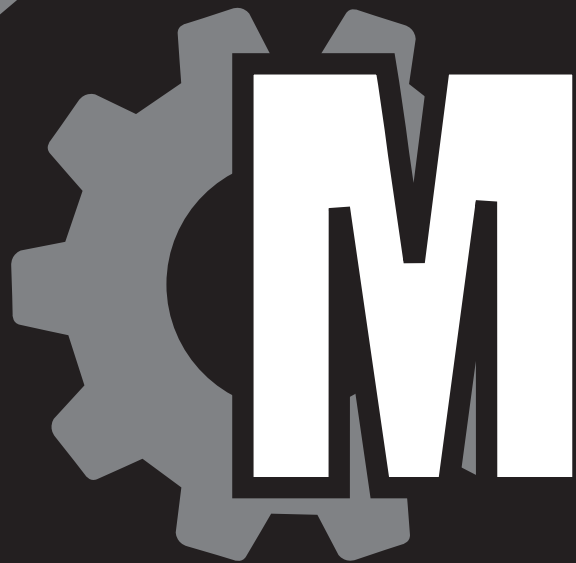


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**P&H**

# Shovel Mechanical eLearning Course Catalog



# Shovel Mechanical eLearning Course Catalog



Maintaining a skilled, knowledgeable workforce is a challenge everyone faces. With changing technologies and fluctuations within the mining industry, it can be especially daunting. Whether you need training for a new hire or a veteran, it can be difficult to find training that is engaging, technologically relevant and easy to fit into busy schedules. P&H Peak Services, the technical communication and training group within P&H Mining Equipment, strives to provide you with the knowledge, skills and competencies needed for your employees to achieve their highest performance potential.

Peak Services has identified eLearning as the primary delivery method for the knowledge components of Fundamental and Product Specific Training. eLearning provides several advantages over traditional training methods:

- eLearning content can be accessed on any computer that has Internet access by any individual who has the appropriate login and password credentials.
- Immediate availability of training content. Students receive the training they require right now, when the training is required most. This provides a quicker, more productive workforce.
- Reduces the cost of training by eliminating travel, living, and other expenses associated with Instructor Led Training.
- Provides students with the ability to learn at their own pace and in their own comfortable environment.
- Improved retention of technical and operational content.
- The training content can be delivered to a large contingent of people in varying locations and be technically consistent across the board.
- Training content can be tailored to an individual's personal strengths and weaknesses. This provides a targeted more effective training solution for today's workforce.
- When used as a prerequisite to Instructor Led Training, eLearning can level the playing field between novice and senior personal. This makes the Instructor Led Training more effective by allowing the Instructor to spend more time developing skills rather than knowledge based components.

This Course Catalog contains descriptions of the eLearning Lessons available to you through Peak Services.

## **Lesson Duration:**

Each eLearning Lesson is designed to be 45 minutes in duration. However, because eLearning is self-paced training, actual duration may vary per student.

## **Target Audience:**

Shovel Operators, Technicians, and Engineers who will operate and/or perform maintenance on P&H Mining Shovels.

## **Prerequisites:**

Students should have a basic working knowledge of computers, and fundamental understanding of electronics, mechanics, pneumatics, hydraulics, operation, etc., as it applies to the systems of a P&H Shovel.

## **Lesson Location:**

eLearning content can be accessed on any computer that has Internet access by any individual who has the appropriate login and password credentials.

## **Computer Requirements:**

It is recommended that all computers accessing eLearning content have the basic minimum requirements:

- Internet Explorer version 7 or better.
- Flash Player version 8 or better.
- Java version 1.5 or better.
- Latest version of Windows Media Player.
- Adobe Reader version 8 or better.

## Shovel Mechanical eLearning

### Module 4 General Assembly Procedures

Lesson 4.1	Pre-Assembly Cleaning
Lesson 4.2	Fasteners and Torqueing
Lesson 4.3	Interference Fit and Installation
Lesson 4.4	Bearings
Lesson 4.5	Shrink Fit Clearances Required for Assembly
Lesson 4.6	Lubrication During Assembly
Lesson 4.7	Shimming Shaft and Bearing Assemblies
Lesson 4.8	Sealing

### Module 5 General Inspection

Lesson 5.1	Predictive Diagnostics
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### Module 6 Maintenance Welding

Lesson 6.1	Welding Safety & Best Practices
Lesson 6.2	Weld Inspection
Lesson 6.3	Weld Repairs
Lesson 6.4	Welding Guidelines

### Module 7 Wire Rope

Lesson 7.1	Wire Rope Introduction
Lesson 7.2	The Basics
Lesson 7.3	Characteristics of Mining Rope
Lesson 7.4	Structural Strand Boom Pendants
Lesson 7.5	Receiving and Handling Wire Rope
Lesson 7.6	Inspecting Wire Rope, Sheaves and Drums
Lesson 7.7	Recommended Practices for Extending Wire Rope Life

### Module 8 Gears and Gear Cases

Lesson 8.1	Introduction to Gears
Lesson 8.2	Manufacturing
Lesson 8.3	Bushings
Lesson 8.4	Gearcase Sealing
Lesson 8.5	Gearcase Lubrication
Lesson 8.6	Gearcase Routine Maintenance
Lesson 8.7	Transmission Inspections
Lesson 8.8	Oil Analysis

### Module 9 Motor Alignment

Lesson 9.1	Motor Alignment
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### Module 10 Disc Brakes

Lesson 10.1	Introduction to Disc Brakes
Lesson 10.2	Brake System Operation
Lesson 10.3	Disc Brake Maintenance
Lesson 10.11	Disc Brake Burnish-In Procedure

## Shovel Mechanical eLearning (continued)

### Module 11 Propel System

Lesson 11.1	Propel System Overview
Lesson 11.2	Carbody and Side Frames
Lesson 11.3	Propel Motor
Lesson 11.4	Propel Motor Blower
Lesson 11.5	Propel Transmission
Lesson 11.6.1	Crawler Belt
Lesson 11.6.2-5	Crawler Assembly

### Module 12 House Assembly and Shovel Exterior Walkways

Lesson 12.1	Revolving Frame, Platforms, and Counterweight
Lesson 12.2	Machinery House Assembly
Lesson 12.3	Hatches and Covers
Lesson 12.4	House Pressurization and Filtration
Lesson 12.5	Shovel Exterior Walkways and Handrails
Lesson 12.6	Boarding Stairway and Pull-Down Ladder
Lesson 12.7	Mine Air Cooling System
Lesson 12.8	Sigma AC

### Module 13 Swing System

Lesson 13.1	Theory of Operation of Swing System
Lesson 13.2	Swing Motor
Lesson 13.3	Swing Motor Blower
Lesson 13.4	Swing Transmission
Lesson 13.5	Swing Shaft
Lesson 13.6	Swing Roller Path
Lesson 13.7	Roller Circle Assembly
Lesson 13.8	Swing Ring Gear
Lesson 13.9	Center Gudgeon

### Module 14 Hoist System

Lesson 14.1	Theory of Operation of Hoist System
Lesson 14.2	Remote Hoist Controller
Lesson 14.3	Hoist Ropes
Lesson 14.4	Tuggers
Lesson 14.5	Hoist Motor
Lesson 14.6	Hoist Brake
Lesson 14.7	Hoist Motor Blower
Lesson 14.8	Hoist Gear Case
Lesson 14.9	Hoist Limit Switch Sensor

### Module 15 Attachment Components

Lesson 15.1	Gantry Assembly
Lesson 15.2	Boom Assembly
Lesson 15.3	Boom Point Assembly
Lesson 15.4	Boom Suspension and Limits
Lesson 15.5	Dipper Trip System

## Shovel Mechanical eLearning (continued)

### Module 16 Crowd System

Lesson 16.1	Theory of Operation
Lesson 16.2	Crowd Drive Assembly
Lesson 16.4	Crowd Gearcase
Lesson 16.5	Shipper Shaft and Saddle Block System Components
Lesson 16.6.1.1	Shipper Shaft and Saddle Block Adjustments
Lesson 16.7	Crowd Limit Switch Sensor

### Module 17 Dipper Handles

Lesson 17.1	Dipper Handle Inspection
Lesson 17.2	Dipper Handle Removal and Installation
Lesson 17.3	Dipper Handle Procedures

### Module 18 Dippers

Lesson 18.1	Dipper Components and Operation
Lesson 18.2	Dipper Inspection (Walk around)
Lesson 18.3	Ground Engaging Equipment Maintenance
Lesson 18.4	Pitch Bracers and Dipper Angles
Lesson 18.5	Dipper Maintenance
Lesson 18.6	Dipper Change Out
Lesson 18.7	Snubbers

### Module 19 Compressed Air System

Lesson 19.1	Theory of Operation
Lesson 19.2	Sullair Type ES-8 Rotary Screw Compressor
Lesson 19.3	Sullair Type LS-10 Rotary Screw Compressor
Lesson 19.4	Quincy Rotary Screw
Lesson 19.5	Quincy Reciprocating (Piston Type) Air Compressor
Lesson 19.6	Membrane Air Dryer
Lesson 19.7	Desiccant Air Dryer
Lesson 19.8	Refrigerated Air Dryer
Lesson 19.9	Air System Control
Lesson 19.10	Air System Components
Lesson 19.11	Boarding Stairway Air System
Lesson 19.12	Champion Compressor

### Module 20 Lubrication

Lesson 20.1	Lubrication System Description
Lesson 20.2	Types of Lubricants
Lesson 20.3	Electric Motor Lubrication and Maintenance
Lesson 20.4	Hoist Gearcase Lubrication System
Lesson 20.5	Swing Gearcase Lubrication System
Lesson 20.6	Crowd Gearcase Lubrication System
Lesson 20.7	Lubrication System Components

### Module 21 Automatic Lubrication System

Lesson 21.1	Lubrication System Description and Controls
Lesson 21.2	Automatic Lubrication Hydraulic and Pneumatic System

## Shovel Mechanical Curriculums

### Instructor Led Training Pre-Work Mechanical Shovel

Lesson 3.1	Shovel Operation Overview ( <a href="#">Reference the General eLearning Course Catalog</a> )
Lesson 3.2	Shovel Orientation ( <a href="#">Reference the General eLearning Course Catalog</a> )
Lesson 4.3	Interference Fit and Installation
Lesson 4.5	Shrink Fit Clearances Required for Assembly
Lesson 4.6	Lubrication During Assembly
Lesson 4.8	Sealing
Lesson 11.1	Propel System Overview
Lesson 13.1	Theory of Operation of Swing System
Lesson 14.1-7	Theory of Operation of Hoist System, Remote Hoist Controller, Hoist Ropes, Tuggers, Hoist Motor, Hoist Brake, and Hoist Motor Blower
Lesson 16.1	Theory of Operation of Crowd System
Lesson 18.1	Dipper Components and Operation
Lesson 20.2	Types of Lubricants
Lesson 21.1	Lubrication System Description and Controls

### System Theory Shovel Mechanical Standard Curriculum

Lesson 3.1	Shovel Operation Overview ( <a href="#">Reference the General eLearning Course Catalog</a> )
Lesson 3.2	Shovel Orientation ( <a href="#">Reference the General eLearning Course Catalog</a> )
Lesson 3.3	Shovel Electrical Overview ( <a href="#">Reference the General eLearning Course Catalog</a> )
Lesson 4.1	Pre-Assembly Cleaning
Lesson 4.2	Fasteners and Torqueing
Lesson 4.3	Interference Fit and Installation
Lesson 4.4	Bearings
Lesson 4.5	Shrink Fit Clearances Required for Assembly
Lesson 4.6	Lubrication During Assembly
Lesson 4.7	Shimming Shaft and Bearing Assemblies
Lesson 4.8	Sealing
Lesson 10.1	Introduction to Disc Brakes
Lesson 11.1	Propel System Overview
Lesson 13.1	Theory of Operation of Swing System
Lesson 14.1	Theory of Operation of Hoist System
Lesson 16.1	Theory of Operation of Crowd System
Lesson 18.1	Dipper Components and Operation
Lesson 19.1	Theory of Operation of Compressed Air System
Lesson 20.1	Lubrication System Description
Lesson 20.2	Types of Lubricants
Lesson 21.1	Lubrication System Description and Controls

## Shovel Mechanical Curriculums (continued)

### System Detail Shovel Mechanical Standard Curriculum

Lesson 7.1-3	Wire Rope Introduction, The Basics, and Characteristics of Mining Rope
Lesson 7.4-5	Structural Strand Boom Pendants and Receiving and Handling Wire Rope
Lesson 7.6-7	Inspecting Wire Rope, Sheaves and Drums and Recommended Practices for Extending Wire Rope Life
Lesson 8.3	Bushings
Lesson 8.6	Gearcase Routine Maintenance
Lesson 8.8	Oil Analysis
Lesson 10.2	Brake System Operation
Lesson 10.3	Disc Brake Maintenance
Lesson 10.11	Disc Brake Burnish-In Procedure
Lesson 13.4	Swing Transmission
Lesson 13.5	Swing Shaft
Lesson 13.6	Swing Roller Path
Lesson 13.9	Center Gudgeon
Lesson 16.6.1.1	Shipper Shaft and Saddle Block Adjustments
Lesson 18.3	Ground Engaging Equipment Maintenance
Lesson 19.6-8	Membrane Air Dryer, Desiccant Air Dryer, and Refrigerated Air Dryer
Lesson 19.10	Air System Components

## Shovel Mechanical Lesson Descriptions

### Module 4 General Assembly Procedures

#### Lesson 4.1 Pre-Assembly Cleaning

**Lesson Description:**

The purpose of this Lesson is to establish methods for Pre-Assembly General Cleaning and Protection Covering (after cleaning but prior to assembly). This standard applies to assembly activities of P&H Mining Equipment. It is the responsibility of each mechanic to comply with the requirements of this standard to properly maintain P&H Mining machinery.

**Objectives:**

Upon completion of this Lesson the student will:

- Discuss methods used for general cleaning of components prior to assembly.
- Identify protective coverings applied by P&H to preserve components that will be stored for a period of time before being assembled.

**Lesson Outline:**

- Topic 1 General Cleaning
- Topic 2 Protective Covering

#### Lesson 4.2 Fasteners and Torqueing

**Lesson Description:**

The purpose of this Lesson is to establish methods used to obtain proper fastener torque. This standard applies to assembly activities of P&H Mining Equipment. It is the responsibility of each mechanic to comply with the requirements of this standard to properly maintain P&H Mining machinery.

This Lesson applies to all fasteners for final assemblies that have torque requirements. Only calibrated torque wrenches with capacity to achieve the specified torque values should be used.

**Objectives:**

Upon completion of this Lesson the student will:

- Analyze the theory and factors that affect bolted joint pre-load principles.
- Examine fastener coatings and lubrication and their effect on bolt torque.
- Review P&H Mining recommended torque values for various grade fasteners.
- Relate fastener torque procedures to be used on P&H Mining equipment.
- Describe the basic design, operation and maintenance of hydraulic torque wrenches.
- Explore the concept and methods of bolt tensioning used to assemble P&H Mining equipment.
- Review the design and application of the SuperNut™ bolt fastener tensioning system.
- Differentiate the design and application of the TorqueRite™ clamping system.

**Lesson Outline:**

- Topic 1 Bolted Joint Preload Principles
- Topic 2 Types of Fasteners
- Topic 3 Fastener Coatings



- Topic 4 Hydraulic Torque Wrenches
- Topic 5 Pneumatic Torque Wrenches
- Topic 6 Hydraulic Bolt Tensioner
- Topic 7 Applying Torque to Fasteners
- Topic 8 SuperNuts™
- Topic 9 TorqueRite™ Clamps

## Lesson 4.3 Interference Fit and Installation

### Lesson Description:

Bearings, bushings, couplings, dowel pins, gears, keys, pins, and splines are frequently installed using interference fits. Procedures defined in this Lesson apply to assembly activities of P&H Mining Equipment and are recommended for all users.

### Objectives:

Upon completion of this Lesson the student will:

- Review procedures on interference fit and installation of various types of component assemblies, such as bushings, couplings, dowel pins, gears, keys, splines and coupling bolts.

### Lesson Outline:

- Topic 1 Introduction
- Topic 2 Bushings
- Topic 3 Couplings
- Topic 4 Dowels
- Topic 5 Gears
- Topic 6 Keys
- Topic 7 Pins
- Topic 8 Splines
- Topic 9 Coupling (Body Fit) Bolts

## Lesson 4.4 Bearings

### Lesson Description:

Bearings are precision parts. To retain their accuracy and reliability they must be handled with care. They should be protected against corrosion, kept clean from contamination from foreign materials, and should not be subjected to sharp and heavy impacts. This Lesson provides information on how this is accomplished.

### Objectives:

Upon completion of this Lesson the student will:

- Outline the proper method of handling and storing bearings.
- Describe the preparation and methods to be followed when installing interference fit bearing assemblies.
- Compare the concept of press fit versus sliding fit.

### Lesson Outline:

- Topic 1 Bearing Handling
- Topic 2 Types of Bearing Assemblies

## Lesson 4.5 Shrink Fit Clearances Required for Assembly

### Lesson Description:

This Lesson covers the clearances required for assembly based on Running or Sliding Fits Class RC4. Clearances required for Close Fit or Shrink Fit Assemblies using Liquid Nitrogen or Dry Ice will also be defined.

### Objectives:

Upon completion of this Lesson the student will:

- Determine how to compute shrink fit clearance required for assembly.
- Solve examples illustrating calculation procedure to determine shrink fit clearance required for assembly.
- Discuss procedure used to shim bearing retainer caps that clamp bearing outer races in housing bores.
- Review procedure used to shim bearing retainer caps that provide clearance to bearing outer races in housing bores.
- Define procedure used to shim shaft end plates that clamp bearing inner races on shaft shoulders.
- Identify procedure used to shim to seat an inner bearing race or member with clearance against a shaft shoulder.

### Lesson Outline:

- Topic 1 Determination of Shrink Fit Clearances
- Topic 2 Clearance Examples

## Lesson 4.6 Lubrication During Assembly

### Lesson Description:

This Lesson addresses lubrication recommendations for assembly operations. This standard applies to assembly activities of P&H Mining Equipment, and is recommended procedure for all users. It is the responsibility of each mechanic to comply with the requirements of this standard to properly maintain P&H Mining machinery.

### Objectives:

Upon completion of this Lesson the student will:

- Relate lubrication recommendations for assembling components.

### Lesson Outline:

- Topic 1 Assembly Lubrication Recommendations

## Lesson 4.7 Shimming Shaft and Bearing Assemblies

### Lesson Description:

This Lesson applies to assembly activities on P&H Mining Equipment. These procedures are meant to define the proper method for shimming shaft and bearing assemblies for clamping or end-play allowance. The Lesson discusses the types of shims and their uses as well as the procedures to properly shim various assemblies.

### Objectives:

Upon completion of this Lesson the student will:

- Examine the proper method of shimming shaft and bearing assemblies to clamp and/or set the proper end play allowance.
- Describe the various types and application of shims used on P&H Mining Equipment.

# Shovel Mechanical eLearning Course Catalog



## Lesson Outline:

- Topic 1 General Principles and Practices
- Topic 2 Types of Shims and Use
- Topic 3 Shimming Bearing Retainer Caps (Clamping)
- Topic 4 Shimming Bearing Retainer Caps (Clearance)
- Topic 5 Shimming End Plates (Clamping)
- Topic 6 Shimming End Plates (Clearance)

## Lesson 4.8 Sealing

### Lesson Description:

This Lesson applies to the P&H Mining Equipment assembly activity to establish methods of proper application, installation, and assembly of seals and sealants.

### Objectives:

Upon completion of this Lesson the student will:

- Relate the procedure and precautions to be observed when working with metal-to-metal joints.
- Describe the procedure used for the proper installation and assembly of O-rings.
- State the installation guidelines required to assure proper installation and function of a labyrinth seal assembly.
- Discuss the proper procedures to be used when assembling the two types of lip seals used on P&H Mining equipment.
- Identify the proper method of assembling threaded pipe joints.

### Lesson Outline:

- Topic 1 Metal-to-Metal Joints
- Topic 2 Installation and Assembly of O-Rings
- Topic 3 Assembly of Labyrinth Seals
- Topic 4 Installation and Assembly of Lip Seals
- Topic 5 Threaded Pipe Joints

## Module 5 General Inspection

### Lesson 5.1 Predictive Diagnostics

#### Lesson Description:

This Lesson provides information about Predictive Diagnostics based on a brief orientation of the subject, predictive technique applications through examples obtained from P&H shovels, P&H Drills and LT loaders, and finally, the actual format of the predictive report will be explained.

#### Objectives:

Upon completion of this Lesson the student will:

- Understand the basics of vibration analysis as it applies to P&H equipment.
- Understand the basics of oil analysis as it applies to P&H equipment.
- Understand the basics of thermography analysis as it applies to P&H equipment.
- Be able to apply the information through the predictive reports.

#### Lesson Outline:

- Topic 1 Introduction
- Topic 2 Thermography
- Topic 3 Vibration Analysis
- Topic 4 Oil Analysis
- Topic 5 Final Report

## Module 6

### Lesson 6.1 Welding Safety & Best Practices

**Lesson Description:**

In this Lesson you will learn about welding, how to inspect welds and how to properly evaluate welds.

**Objectives:**

Upon completion of this Lesson the student will:

- Be capable of understanding and applying welding techniques under the concept of best working practices, which will allow you to perform welding both efficiently and safely.

**Lesson Outline:**

- Topic 1 Safety in Welding
- Topic 2 Best Practices in Welding

### Lesson 6.2 Weld Inspection

**Lesson Description:**

In this Lesson you will learn about welds, how to inspect them and how to properly evaluate them.

**Objectives:**

Upon completion of this Lesson the student will:

- Have an understanding of Welding Inspections.

**Lesson Outline:**

- Topic 1 Introduction
- Topic 2 Scheduled Inspections
- Topic 3 Unscheduled Inspections
- Topic 4 Creating Hatches and Openings
- Topic 5 Repair Evaluation

### Lesson 6.3 Weld Repairs

**Lesson Description:**

In this Lesson you will learn about preparing and repairing materials and/or cracks by applying proper welding techniques.

**Objectives:**

Upon completion of this Lesson the student will:

- When completing this Lesson you will be capable of identifying, understanding and performing welding repairs properly and safely.

**Lesson Outline:**

- Welding Repairs

## Lesson 6.4 Welding Guidelines

### Lesson Description:

This Lesson provides information for Maintenance Personnel responsible for performing welding procedures on P&H Mining Equipment.

### Objectives:

Upon completion of this Lesson the student will:

- Have a thorough understanding of the terminology associated with welding.
- Have an in depth understanding of P&H Mining Equipment Inc. guidelines associated with Fillet Welds.
- Understand the definition of Porosity, how to detect it, the company policy associated with acceptance criteria, and how to repair it.
- Understand the definition of Incomplete Fusion and Slag Inclusions, how to detect it, the company policy associated with acceptance criteria, and how to repair it.
- Understand the definition of Incomplete Joint Penetration, how to detect it, the company policy associated with acceptance criteria, and how to repair it.
- Understand the definition of Undercut / Wash, how to detect it, the company policy associated with acceptance criteria, and how to repair it.
- Understand the definition of Overlap, how to detect it, the company policy associated with acceptance criteria, and how to repair it.
- Understand the definition of Cracks, how to detect it, the company policy associated with acceptance criteria, and how to repair it.
- Understand the definition of Fillet Weld Size, how to detect it, the company policy associated with acceptance criteria, and how to repair it.
- Understand the definition of Concavity and Convexity, how to detect it, the company policy associated with acceptance criteria, and how to repair it.
- Understand the definition of Blend, how to detect it, the company policy associated with acceptance criteria, and how to repair it.
- Understand the definition of Groove Weld Profile, how to detect it, the company policy associated with acceptance criteria, and how to repair it.
- Understand the definition of Weld Cleaning - Spatter, how to detect it, the company policy associated with acceptance criteria, and how to repair it.
- Be introduced to and have an understanding of the basic welding symbols associated with Fillet Welds, Groove Welds, and Plug or Slot Welds.
- Be able to interpret the weld symbols used by P&H Mining Equipment Inc.

### Lesson Outline:

- Topic 1 Welding Definitions
- Topic 2 Fillet Weld Guidelines
- Topic 3 Porosity
- Topic 4 Incomplete Fusion and Slag Inclusions
- Topic 5 Incomplete Joint Penetration
- Topic 6 Undercut / Wash
- Topic 7 Overlap
- Topic 8 Cracks
- Topic 9 Fillet Weld Size
- Topic 10 Concavity and Convexity

# Shovel Mechanical eLearning Course Catalog



- Topic 11 Blend
- Topic 12 Groove Weld Profile
- Topic 13 Weld Cleaning - Spatter
- Topic 14 Introduction to Weld Symbols
  - Subtopic 1 Fillet Weld Symbol
  - Subtopic 2 Groove Weld Symbols
  - Subtopic 3 Plug or Slot Weld Symbol
- Topic 15 Welding Symbol Interpretation

## Module 7 Wire Rope

### Lesson 7.1-3 Wire Rope Introduction, The Basics, and Characteristics of Mining Rope

#### Lesson Description:

In these Lessons you will learn and understand the basic components of wire ropes, as well as identify the advantages of each type of rope.

#### Objectives:

Upon completion of this Lesson the student will:

- Understand the basics of wire rope.
- Identify the components of wire rope.
- Understand the construction of wire rope.
- Understand the classifications of wire rope.
- Identify the main characteristics of mining rope.
- Identify effects of abrasion and fatigue resistance.

#### Lesson Outline:

- Lesson 1 Wire Rope Introduction
- Lesson 2 The Basics
  - Topic 1 Wire Rope Components
  - Topic 2 Construction
  - Topic 3 Classifications
- Lesson 3 Characteristics of Mining Rope

### Lesson 7.4-5 Structural Strand Boom Pendants and Receiving and Handling Wire Rope

#### Lesson Description:

In these Lessons you will be introduced to structural strand construction as well as how to properly receive and handle wire rope.

#### Objectives:

Upon completion of this Lesson the student will:

- Understand structural strand construction and the importance in the operation of booms and pendants.
- Understand the proper receiving and handling techniques of wire rope.

#### Lesson Outline:

- Lesson 4 Structural Strand Boom Pendant
- Lesson 5 Receiving and Handling Wire Rope



## Lesson 7.6-7 Inspecting Wire Rope, Sheaves, and Drums and Recommended Practices for Extending Wire Rope Life

### Lesson Description:

In these Lessons you will understand the inspection process for wire rope, sheaves and drums, as well as how to extend the life of wire rope.

### Objectives:

Upon completion of this Lesson the student will:

- Understanding the inspecting preparation process.
- Identify inspection methods.
- Understanding rope retirement criteria.
- Understanding the basics of inspecting sheaves and drums.
- Understanding recommended practices for extending wire rope life.
- Understanding the wire rope life expectancy.
- Understanding the wear of wire rope on shovels.
- Understanding the wear of wire ropes on draglines.

### Lesson Outline:

- Lesson 6 Inspecting Wire Rope, Sheaves, and Drums
- Lesson 7 Recommended Practices for Extending Wire Rope Life

## Module 8 Gears and Gear Cases

### Lesson 8.1 Introduction to Gears

#### Lesson Description:

In this Lesson you will learn where typical gearcases, or transmissions, are located for a P&H Electric Mining Shovel.

#### Objectives:

Upon completion of this Lesson the student will:

- Identify and locate the transmission assemblies used for each of the primary shovel motions.
- Discuss the various types of gearing used on P&H shovels.

#### Lesson Outline:

- Topic 1 Locations and Descriptions
- Topic 2 Gearing

### Lesson 8.2 Manufacturing

#### Lesson Description:

This Lesson provides information on the manufacturing process used to create P&H Gearcases, Gears, and Pinions.

#### Objectives:

Upon completion of this Lesson the student will:

- Describe how P&H Gears, Pinions, and Gearcases are manufactured.

#### Lesson Outline:

- Topic 1 Gearcases
- Topic 2 Gears
- Topic 3 Pinions

### Lesson 8.3 Bushings

#### Lesson Description:

This Lesson describes the purpose, installation issues, and lubrication requirements for P&H manufactured Bushings.

#### Objectives:

Upon completion of this Lesson the student will:

- Explain the purpose and handling of P&H bushings.

#### Lesson Outline:

- Topic 1 Purpose
- Topic 2 Handling
- Topic 3 Lubrication

## Lesson 8.4 Gearcase Sealing

### Lesson Description:

This Lesson describes the purpose and requirements for sealing P&H Mining Equipment Gearcases.

### Objectives:

Upon completion of this Lesson the student will:

- Examine the various types of sealing used on P&H Transmission assemblies and their purpose.

### Lesson Outline:

- Topic 1 Purpose
- Topic 2 Types of Sealing

## Lesson 8.5 Gearcase Lubrication

### Lesson Description:

This Lesson describes the purpose and requirements for Lubrication used on P&H Mining Equipment Gearcases.

### Objectives:

Upon completion of this Lesson the student will:

- Describe how the gearing, bearings and bushings are lubricated in P&H transmissions.
- Review the external Lubrication Systems available for the Hoist, Swing and Crowd Transmissions.

### Lesson Outline:

- Topic 1 Gearcases
- Topic 2 Bearings
- Topic 3 Bushings
- Topic 4 External Lubrication Systems

## Lesson 8.6 Gearcase Routine Maintenance

### Lesson Description:

This Lesson describes the Daily, 250 Hour, Semi-Annual, and Annual Maintenance Checks required on P&H Electric Mining Shovels.

### Objectives:

Upon completion of this Lesson the student will:

- Identify the recommended routine maintenance inspection schedule for the Hoist, Crowd, Swing, and Propel Transmissions.

### Lesson Outline:

- Topic 1 Daily Checks
- Topic 2 250 Hour Checks
- Topic 3 Semi-Annual Checks
- Topic 4 Annual Checks

## Lesson 8.7 Transmission Inspections

## Lesson Description:

This Lesson provides detailed information on how to inspect the gears associated with P&H Electric Mining Shovel Transmissions and gear sets.

## Objectives:

Upon completion of this Lesson the student will:

- Understand the importance and periodicity requirements of transmission inspections on P&H Mining Equipment.
- Have a thorough understanding of what is involved and required in a visual inspection of P&H transmissions and gearcases.
- Understand the conditions associated with gear wear.
- Understand the conditions associated with plastic flow.
- Understand the conditions associated with surface fatigue.
- Understand the conditions associated with breakage.
- Understand the different gear failure conditions associated with the process.
- Have a thorough understanding of the process required to make a contact pattern check.
- Understand how to make a basic diagnosis based on a contact pattern check.

## Lesson Outline:

- Introduction
- Topic 1 Visual Inspection
- Topic 2 Wear
- Topic 3 Plastic Flow
- Topic 4 Surface Fatigue
- Topic 5 Breakage
- Topic 6 Failures Associated with the Process
- Topic 7 Contact Patterns

## Lesson 8.8 Oil Analysis

### Lesson Description:

This Lesson provides detailed information on how to take an oil sample when performing an inspection on the gears associated with P&H Electric Mining Shovel Transmissions and gear sets.

### Objectives:

Upon completion of this Lesson the student will:

- Identify typical oil sampling points for P&H Transmissions.

### Lesson Outline:

- Topic 1 Oil Analysis
- Topic 2 General Procedure

## Module 9 Motor Alignment

### Lesson 9.1 Motor Alignment

#### Lesson Description:

This Lesson provides information about motor coupling alignment as it applies to P&H Mining Equipment.

#### Objectives:

Upon completion of this Lesson the student will:

- Have a thorough understanding of the two components of shaft misalignment, angular and offset.
- Have a thorough understanding of the two planes of potential misalignment, horizontal and vertical.
- Understand the dangers of motor/shaft misalignment.
- Have a basic understanding of the steps required to align a typical P&H motor shaft.

#### Lesson Outline:

- Topic 1 Shaft Alignment
- Topic 2 Typical Alignment Procedure

## Module 10 Disc Brakes

### Lesson 10.1 Introduction to Disc Brakes

#### Lesson Description:

This Lesson describes the component functions and system operation of the disc brakes on P&H electric mining shovels and crawler draglines.

#### Objectives:

Upon completion of this Lesson the student will:

- Understand the terms set and release, and how they apply to disc brakes.
- Identify the location of the discs brakes on the mining shovel.
- Understand the difference between static and dynamic braking.
- Identify brake components that must be correctly oriented when the disc brake is assembled.
- Recognize how disc brake assemblies must be rotated correctly for orientation when installed.
- Identify and locate the various components of the disc brake system.
- Have a working knowledge of how disc brake components fit together to create a disc brake assembly.
- Identify correct reference sources to find brake assembly part numbers and become familiar with how P&H brake assembly part numbers are found.
- Describe the concept of stored mechanical energy and some of the hazards caused by it.
- Describe how to remove stored mechanical energy from a mechanical drive train before maintenance will be performed on it.

#### Lesson Outline:

- Topic 1 Disc Brake Overview
- Topic 2 Disc Brake Components
- Topic 3 Brake Orientation
- Topic 4 Stored Energy in Brake Safety
- Topic 5 Identification of Brakes

### Lesson 10.2 Brake System Operation

#### Lesson Description:

This Lesson provides information on the brake systems associated with the P&H Electric Mining Shovel and how they operate.

#### Objectives:

Upon completion of this Lesson the student will:

- Identify the operator's controls and displays used for the brake system.
- Describe how the operator's controls are used to release and set the brakes and what the indicators display.
- Describe how the operator's controls are used to transfer between dig mode and propel mode and what the indicators display.
- Identify the situations that cause a brake hold mode.
- Identify the effects of each situation that causes a brake hold mode.
- Identify the action that must be taken to bring the shovel out of each brake hold mode.
- Identify the number and location of the brake system transducers.

- Describe the function of the transducers in the brake system.
- Identify the programmed set points for the air pressure for brakes in the shovel's logic control system.
- Identify the limit switches.
- Understand the function of the limit switches.
- Describe the sequence of events that occurs as the brake releases and sets.
- Describe what makes a brake that is set provide friction for braking.
- Identify the brake system alarms.
- Recognize the logic that is generating the alarms.
- Identify the input devices, transducers and limit switches that provide the signals that generate the alarms.

## Lesson Outline:

- Topic 1 Operator Controls
- Topic 2 Brake Hold Mode
- Topic 3 Brake System Transducers
- Topic 4 Brake Limit Switches
- Topic 5 Brake System Alarms
- Topic 6 How Disc Brakes Work

## Lesson 10.3 Disc Brake Maintenance

### Lesson Description:

This Lesson provides information on the inspection and maintenance issues related with the disc brakes on P&H equipment.

### Objectives:

Upon completion of this Lesson the student will:

- Reference the maintenance manual for detailed information to accompany this Lesson.
- Identify which inspections are visual inspections, mechanical inspections, and operational inspections.
- Understand which inspections are performed on disc brakes.
- Identify the 3 field maintenance tasks routinely performed on disc brakes.
- Describe how each of the 3 maintenance tasks are performed.

### Lesson Outline:

- Topic 1 Disc Brake Inspection
- Topic 2 Disc Brake Field Maintenance

## Lesson 10.11 Disc Brake Burnish-In Procedure

### Lesson Description:

This Lesson provides information for the hoist, crowd, swing, and propel motion burnish-in procedure for disc brakes.

### Objectives:

Upon completion of this Lesson the student will:

- Understand the burnish-in procedure for the disc brakes on P&H equipment.
- Understand how to verify static holding torque for the disc brakes on P&H equipment.
- Understand how to verify dynamic braking torque for the disc brakes on P&H equipment.

# Shovel Mechanical eLearning Course Catalog



## Lesson Outline:

- Topic 1 Procedure
- Topic 2 Static Holding Torque Test
- Topic 3 Dynamic Braking Torque Test



## Module 11 Propel System

### Lesson 11.1 Propel System Overview

#### Lesson Description:

This Lesson provides a brief overview of the propel system components associated with P&H Electric Mining Shovels.

#### Objectives:

Upon completion of this Lesson the student will:

- Be able to identify the major assemblies and components of the Propel System.
- Be able to describe the function of the major assemblies and components of the Propel System.
- Explain the basic theory of operation of the Propel System on P&H Electric Mining Shovels.
- Describe the differences between older Propel Drive System and the newer Delta Drive System.

#### Lesson Outline:

- Topic 1 Propel System Components
- Topic 2 Propel System Component Detail

### Lesson 11.2 Carbody and Side Frames

#### Lesson Description:

Lesson provides information on periodic inspections of the carbody and side frames, as well as how to use three different side frame fasteners:

- Standard side frame nuts.
- SuperNut™
- HYTORC™ Clamps

#### Objectives:

Upon completion of this Lesson the student will:

- Understand the steps required to periodically inspect the carbody and side frames.
- Understand how to maintain proper lubrication to the carbody and side frames.
- Understand how to properly install side frame rod bolts using standard side frame nuts.
- Understand how to properly install side frame rod bolts using SuperNuts™.
- Understand how to properly install side frame rod bolts using HYTORC™ Clamps.

#### Lesson Outline:

- Topic 1 Carbody and Side Frame Inspection
- Topic 2 Bolted Joint Preload Principle
- Topic 3 Installing Side Frame Rod Bolts
- Topic 4 Types of Side Frame Fasteners

## Lesson 11.3 Propel Motor

### Lesson Description:

In this Lesson the student will learn how to properly inspect, maintain, remove, install, and align the propel motor.

### Objectives:

Upon completion of this Lesson the student will:

- Understand the proper inspection procedures required for the propel motor.
- Understand the proper lubrication procedures required for the propel motor.
- Be able to describe the proper steps required to remove the propel motor.
- Be able to describe the steps required to install the propel motor.
- Understand the steps required to measure Shaft-to-Shaft Clearance (Facial Gap).
- Understand the steps required to measure Angular Misalignment (Parallelism).
- Understand the steps required to measure Offset Misalignment (Vertical and Horizontal).
- Be able to describe the steps required to adjust Shaft-to-Shaft Clearance (Facial Gap).
- Be able to describe the steps required to adjust Horizontal Angularity.
- Be able to describe the steps required to adjust Horizontal Offset.
- Be able to describe the steps required to adjust Vertical Parallelism.
- Be able to describe the steps required to adjust Vertical Offset.

### Lesson Outline:

- Topic 1 Propel Motor Inspection
- Topic 2 Propel Motor Maintenance
- Topic 3 Propel Motor Removal
- Topic 4 Propel Motor Repair
- Topic 5 Propel Motor Installation
- Topic 6 Propel Motor Coupling and Alignment

## Lesson 11.4 Propel Motor Blower

### Lesson Description:

In this Lesson the student will learn how to properly inspect, maintain, remove, and install the propel motor blower.

### Objectives:

Upon completion of this Lesson the student will:

- Understand the proper inspection and maintenance procedures required for the propel motor blower.
- Be able to describe the proper steps required to remove the propel motor blower.
- Be able to describe the steps required to install the propel motor blower.

### Lesson Outline:

- Topic 1 Inspection
- Topic 2 Maintenance
- Topic 3 Removal
- Topic 4 Repair
- Topic 5 Installation

## Lesson 11.5 Propel Transmission

### Lesson Description:

This Lesson provides information on the inspection, maintenance, removal, repair, assembly, and installation of the Propel Planetary Transmission.

### Objectives:

Upon completion of this Lesson the student will:

- Identify and explain the planetary type gearing used on the Planetary Propel Transmission.
- Understand the inspection and maintenance activities associated with the Planetary Propel Transmission.
- Describe the procedure for removal and installation of the Planetary Propel Transmission.

### Lesson Outline:

- Introduction
- Topic 1 Inspection
- Topic 2 Maintenance
- Topic 3 Removal
- Topic 4 Repair and Assembly
- Topic 5 Installation

## Lesson 11.6.1 Crawler Belt

### Lesson Description:

This Lesson provides information on the inspection, maintenance, and repair of the Crawler Assembly.

### Objectives:

Upon completion of this Lesson the student will:

- Discuss inspection criteria used to evaluate Crawler Track tension.
- Explain inspection criteria used to evaluate proper pitch match of Crawler Assemblies equipped with a "Lug" Drive Propel System.
- Explain inspection criteria used to evaluate proper pitch match of Crawler Assemblies equipped with a "Sprocket" Drive Propel System.
- Review inspection, maintenance, and repair practices associated with Crawler Assembly components.

### Lesson Outline:

- Topic 1 Crawler Belt
  - Subtopic 1 Crawler Assembly Inspection
  - Subtopic 2 Crawler Assembly Maintenance
  - Subtopic 3 Crawler Assembly Repair

## Lesson 11.6.2-5 Crawler Assembly

### Lesson Description:

This Lesson provides information on the inspection, maintenance, and repair of the Crawler Assembly.

### Objectives:

Upon completion of this Lesson the student will:

- Be able to identify the components of the Lower Roller Assembly.
- Understand the proper Inspection, Lubrication, Repair, Removal and Disassembly, Assembly and Installation procedures associated with the Lower Roller Assembly.
- Be able to identify the components of the Front Idler Roller Assembly.
- Understand the proper Inspection, Adjustment, Lubrication, Repair, Standard Removal, Removal using the Bearing Block Removal Kit, and Assembly and Installation procedures associated with the Front Idler Roller Assembly.
- Be able to identify the components of the Rear Idler Roller Assembly.
- Understand the proper Inspection, Lubrication, Repair, Removal and Disassembly, Assembly and Installation procedures associated with the Rear Idler Roller Assembly.
- Be able to identify the components of the Tumbler Drive Shaft Assembly.
- Understand the proper Inspection, Lubrication, Repair, Removal and Disassembly, Assembly and Installation procedures associated with the Tumbler Drive Shaft Assembly.

### Lesson Outline:

- Topic 2 Lower Roller Assembly
- Topic 3 Front Idler Roller Assembly
- Topic 4 Rear Idler Roller Assembly
- Topic 5 Tumbler Drive Shaft Assembly

## Module 12 House Assembly and Shovel Exterior Walkways

### Lesson 12.1-6 Revolving Frame, Platforms, and Counterweight, Machinery House Assembly, Hatches and Covers, House Pressurization and Filtration, Shovel Exterior Walkways and Handrails, and Boarding Stairway and Pull-Down Ladder

#### Lesson Description:

These Lessons provide a description of the House Assembly, Hatches and Covers, House Pressurization and Filtration components, Shovel Exterior Walkways and Handrails, and Boarding Stairway and Pull-Down Ladder and the inspection and maintenance criteria associated with them.

#### Objectives:

Upon completion of this Lesson the student will:

- Provide an overview of the construction of the Revolving Frame, Platforms and Counterweight Boxes.
- Identify the Platforms that are attached to the Revolving Frame and describe how they are attached.
- Describe the steps required to make a Stability Check of the Shovel.
- Identify the major structures of the Machinery House Assembly.
- Review the process of removing and installing Roof Sections, Hatches and Covers.
- Review the operation, inspection, and maintenance of the Machinery House Pressurization and Filtration Systems.
- Describe the operation, inspection, maintenance of the Air Filters associated with the Machinery House Pressurization and Filtration System.
- Describe the procedure to adjust the pitch setting of the Blower Fan Blades.
- Identify the Shovel Exterior Walkways and Handrails.
- Describe the operation of the Shovel Boarding Stairway and Pull-Down Ladder.

#### Lesson Outline:

- Lesson 1 Revolving Frame, Platforms, and Counterweight
- Lesson 2 Machinery House Assembly
- Lesson 3 Hatches and Covers
- Lesson 4 House Pressurization and Filtration
- Lesson 5 Shovel Exterior Walkways and Handrails
- Lesson 6 Boarding Stairway and Pull-Down Ladder

## Lesson 12.7 Mine Air Cooling System

#### Lesson Description:

This Lesson provides detailed information on the units provided by Mine Air Systems.

#### Objectives:

Upon completion of this Lesson the student will:

- Describe the benefits associated with the purchase of a Mine Air System.
- Describe the features associated with the different products provided by Mine Air Systems.
- Describe the theory of operation in regards to a typical roof mounted Mine Air System.
- Describe the different Control Panels that are associated with the various Mine Air Systems.
- Understand the maintenance practices associated with the Mine Air Systems provided on P&H Mining Equipment Shovels.

- Describe the steps required for changing the filters associated with the Mine Air System.
- Describe the steps required for cleaning the Condenser and Evaporator Coils on the Mine Air System.
- Understand different troubleshooting techniques associated with the Mine Air Systems provided on P&H Mining Equipment Shovels.

## Lesson Outline:

- Topic 1 Introduction
- Topic 2 Features
- Topic 3 Theory of Operation
- Topic 4 Controls
- Topic 5 Maintenance
- Topic 6 Troubleshooting

## Lesson 12.8 Sigma AC

### Lesson Description:

This Lesson provides information for the Maintenance Technician responsible for understanding and maintaining the Sigma AC System.

### Objectives:

Upon completion of this Lesson the student will:

- Be able to describe the components associated with the Sigma AC Unit.
- Understand the theory of operation associated with the components of the Sigma AC unit.
- Understand the correct procedure for starting and stopping the Sigma AC Unit.
- Describe the function of the Indicator Lights associated with the Pilot Control Box.
- Have a thorough understanding of the maintenance associated with the Sigma AC Unit and when it should be scheduled.
- Understand the steps required for replenishing the refrigerant.
- Understand the steps required for adding oil to the compressor.
- Understand the steps required for evacuating the compressor before replacement or inspection of refrigerant circuit components.
- Have a basic understanding of some troubleshooting techniques associated with the Sigma AC Unit.

### Lesson Outline:

- Topic 1 Description of Equipment
- Topic 2 Theory of Operation
- Topic 3 Operating Instructions
- Topic 4 Maintenance
- Topic 5 Troubleshooting

## Module 13 Swing System

### Lesson 13.1 Theory of Operation of Swing System

**Lesson Description:**

This Lesson provides information on the theory of operation for the Swing System.

**Objectives:**

Upon completion of this Lesson the student will:

- Have a thorough understanding of the theory of operation of the swing system.

**Lesson Outline:**

- Topic 1 Theory of Operation

### Lesson 13.2 Swing Motor

**Lesson Description:**

In this Lesson the student will learn how to properly inspect, maintain, remove, and install the swing motor.

**Objectives:**

Upon completion of this Lesson the student will:

- Understand the proper inspection procedures required for the swing motor.
- Understand the proper lubrication procedures required for the swing motor.
- Be able to describe the proper steps required to remove the swing motor.
- Be able to describe the steps required to install the swing motor.

**Lesson Outline:**

- Topic 1 Inspection
- Topic 2 Maintenance
- Topic 3 Removal
- Topic 4 Repair
- Topic 5 Installation

### Lesson 13.3 Swing Motor Blower

**Lesson Description:**

This Lesson describes the Inspection, Maintenance, Removal, Repair, and Installation requirements for the Swing Motor Blower.

**Objectives:**

Upon completion of this Lesson the student will:

- Understand the proper Inspection requirements for the Swing Motor Blower.
- Understand the proper Maintenance requirements for the Swing Motor Blower.
- Understand the proper Removal procedure associated with the Swing Motor Blower.
- Understand the proper Repair procedure associated with the Swing Motor Blower.
- Understand the proper Installation procedure associated with the Swing Motor Blower.

## Lesson Outline:

- Topic 1 Inspection
- Topic 2 Maintenance
- Topic 3 Removal
- Topic 4 Repair
- Topic 5 Installation

## Lesson 13.4 Swing Transmission

### Lesson Description:

This Lesson provides information on the inspection, maintenance, removal, repair, assembly, and installation of the Swing Transmission.

### Objectives:

Upon completion of this Lesson the student will:

- Provide an overview of the planetary type gearing used on the Swing Transmission.
- Review the inspection and maintenance activities associated with the Swing Transmission.
- Describe the procedure for removal and installation of the Swing Transmission.

### Lesson Outline:

- Introduction
- Topic 1 Inspection
- Topic 2 Maintenance
- Topic 3 Removal
- Topic 4 Repair and Assembly
- Topic 5 Installation

## Lesson 13.5 Swing Shaft

### Lesson Description:

This Lesson provides information on the inspection, maintenance, removal, disassembly, repair, assembly, and installation of the Swing Shaft.

### Objectives:

Upon completion of this Lesson the student will:

- Provide an overview of the components used to make up the Swing Shaft Assembly.
- Review the inspection and maintenance activities associated with the Swing Shaft.
- Describe the procedure for removal and installation of the Swing Shaft.
- Describe the procedure for disassembly and assembly of the Swing Shaft.

### Lesson Outline:

- Introduction
- Topic 1 Inspection
- Topic 2 Maintenance
- Topic 3 Removal
- Topic 4 Disassembly
- Topic 5 Repair



- Topic 6 Assembly
- Topic 7 Installation

## Lesson 13.6 Swing Roller Path

### Lesson Description:

This Lesson provides information on inspection procedures for the swing roller path, the maintenance and repair procedures of the swing roller path for P&H Electrical Shovels.

### Objectives:

Upon completion of this Lesson the student will:

- Be able to identify the swing roller path inspection principles.
- Be able to identify the maintenance and repair principle for the swing roller path.

### Lesson Outline:

- Topic 1 General
- Topic 2 Swing Roller Path Inspections

## Lesson 13.7 Roller Circle Assembly

### Lesson Description:

This Lesson provides information about the main features of the inspection of swing roller circle, and maintenance and repair of the swing roller circle for P&H Electrical Shovels.

### Objectives:

Upon completion of this Lesson the student will:

- Be able to identify the swing roller circle inspection principles.
- Be able to identify the maintenance and repair principle for the swing roller circle.

### Lesson Outline:

- Topic 1 General Information
- Topic 2 Swing Roller Circle Inspections

## Lesson 13.8 Swing Ring Gear

### Lesson Description:

This Lesson provides information on the inspection and repair of the Swing Ring Gear.

### Objectives:

Upon completion of this Lesson the student will:

- Understand the operation, inspection and tensioning of the Swing Ring Gear, allowing you to work with it properly and safely.

### Lesson Outline:

- Introduction
- Topic 1 Swing Ring Gear Inspection
- Topic 2 SuperNuts™ Tensioning

# Shovel Mechanical eLearning Course Catalog



- Topic 3 Swing Ring Gear Repair

## Lesson 13.9 Center Gudgeon

### Lesson Description:

In this Lesson you will learn to perform inspections and adjustments to the center gudgeon of P&H Electrical Shovels.

### Objectives:

Upon completion of this Lesson the student will:

- Be able to inspect and correctly adjust the center gudgeon.

### Lesson Outline:

- Topic 1 Swing System Description
- Topic 2 Center Gudgeon Inspection
- Topic 3 Center Gudgeon Adjustment

## Module 14 Hoist System

### Lesson 14.1-7 Theory of Operation of Hoist System, Remote Hoist Controller, Hoist Ropes, Tuggers, Hoist Motor, Hoist Brake, and Hoist Motor Blower

#### Lesson Description:

These Lessons provide information on the theory of operation of the Hoist System, operation of the Remote Hoist Controller, proper Hoist Rope Reeving, operation and maintenance of the Hoist Rope Tuggers and information regarding inspection and maintenance of the Hoist Motors and Hoist Motor Blowers.

#### Objectives:

Upon completion of this Lesson the student will:

- Describe the major assemblies and components of the Hoist System.
- Review the operation of the major assemblies and components of the Hoist System.
- Discuss the Remote Hoist Controller and the procedure for remote operation of the Hoist System.
- Provide an overview of the ropes used on the shovel Hoist System.
- List the items to check when inspecting the shovel Hoist Ropes.
- Outline the steps recommended for attaching the Hoist Ropes.
- Describe the operation and maintenance issues associated with using the Hoist Rope Tuggers.
- Outline Hoist Motor inspection and maintenance practices
- Review the recommended procedure for removal and installation of the Hoist Motor.
- Describe the different types of Motor misalignment and the methods used to align the Hoist Motor to the Hoist Transmission First Reduction shaft.
- Outline general guidelines concerning the inspection, removal and installation of the Hoist Motor Blower.

#### Lesson Outline:

- Lesson 1 Theory of Operation of Hoist System
- Lesson 2 Remote Hoist Controller
- Lesson 3 Hoist Ropes
- Lesson 4 Tuggers
- Lesson 5 Hoist Motor
- Lesson 6 Hoist Brake
- Lesson 7 Hoist Motor Blower

### Lesson 14.8-9 Hoist Gear Case and Hoist Limit Switch Sensor

#### Lesson Description:

These Lessons provide information on the Hoist Gear Case Mounting and Inspection and discusses the Hoist Limit Switch Sensor.

#### Objectives:

Upon completion of this Lesson the student will:

- Identify the major components of the Hoist Gear Case Assembly.
- Describe the Hoist Gear Case mounting.
- Review inspection and maintenance practices for the Hoist Gear Case components.
- Describe the theory of operation and components of the Hoist Limit Switch Sensor.

# Shovel Mechanical eLearning Course Catalog



## Lesson Outline:

- Lesson 8 Hoist Gear Case
- Lesson 9 Hoist Limit Switch Sensor

## Module 15 Attachment Components

### Lesson 15.1-4 Gantry Assembly, Boom Assembly, Boom Point Assembly, and Boom Suspension and Limits

#### Lesson Description:

These Lessons describe the Inspection and Repair of the Gantry Assembly, Boom Assembly, Boom Point Assembly, and Boom Suspension and Limits.

#### Objectives:

Upon completion of this Lesson the student will:

- Identify the various attachment components found on P&H Mining Shovels.
- Identify the different components that make up the Gantry Assembly.
- Describe the recommended inspection and repair procedures for the Gantry Assembly.
- Identify the various components that make up the Boom Assembly.
- Describe the recommended inspection and repair procedures for the Boom Assembly.
- Identify the Boom Wear Boxes and describe its function.
- Describe the recommended inspection procedures as they apply to the Boom Wear Boxes.
- Identify the components associated with the Boom Foot Pin Assembly.
- Describe the recommended procedure for inspection of the Boom Foot Pins.
- Describe and identify the different components that make up the Boom Point Assembly.
- Describe the recommended removal, disassembly, inspection, assembly, and installation steps as required for the Boom Point Assembly.
- Describe the recommended procedure for inspection of the Boom Point Assembly Sheaves.
- Provide guidelines on items to check when conducting a visual inspection of Boom Suspension Cables.
- Identify the replacement criteria for the Boom Suspension Cables.
- Describe the recommended removal and replacement procedures for the Boom Suspension Cables.
- Describe the recommended procedure for visual inspection of the Cable Guide.
- Describe the purpose and function of the Boom Resolver Assembly.
- Describe the recommended inspection and repair procedures for the Boom Resolver Assembly.

#### Lesson Outline:

- Introduction
- Lesson 1 Gantry Assembly
  - Topic 1 Inspection
  - Topic 2 Repair
- Lesson 2 Boom Assembly
  - Topic 1 Inspection
  - Topic 2 Repair
  - Topic 3 Boom Wear Boxes
- Lesson 3 Boom Point Assembly
  - Topic 1 Removal
  - Topic 2 Disassembly
  - Topic 3 Inspection
  - Topic 4 Assembly
  - Topic 5 Installation

- Lesson 4 Boom Suspension and Limits
  - Topic 1 Boom Suspension Cables
  - Topic 2 Cable Guide
  - Topic 3 Boom Resolver Assembly

## Lesson 15.5 Dipper Trip System

### Lesson Description:

This Lesson describes the components associated with the opening of the Dipper Door, called the Dipper Trip System.

### Objectives:

Upon completion of this Lesson the student will:

- Identify the components associated with the Dipper Trip System on P&H Mining Shovels.
- Describe the Theory of Operation as it relates to the Dipper Trip System.
- Identify the components associated with the Motor, Transmission, and Drum Assemblies on Previous Dipper Trip Systems and/or the TripRite Dipper Trip System.
- Describe the recommended, removal, disassembly, inspection, repair, assembly, and installation procedures for the Motor, Transmission, and Drum Assemblies on Previous Dipper Trip Systems and/or the TripRite Dipper Trip System.
- Identify the components associated with the Sheave Assemblies on the Dipper Trip System.
- Identify the components associated with the Latch Bar Assemblies on Previous Dipper Trip Systems and/or the LatchRite Dipper Trip System.
- Describe the Theory of Operation as it relates to the Latch Bar Assemblies on Previous Dipper Trip Systems and/or the LatchRite Dipper Trip System.
- Describe the recommended inspection and adjustment procedures on Previous Dipper Trip Systems.
- Describe the recommended inspection, lubrication, maintenance, and troubleshooting techniques used on the LatchRite Dipper Trip System.

### Lesson Outline:

- Topic 1 Description
- Topic 2 Motor, Transmission, and Drum
  - Subtopic 1 Previous Dipper Trip System
  - Subtopic 2 TripRite
- Topic 3 Sheave Assemblies
- Topic 4 Latch Bar Assembly
  - Subtopic 1 Previous Dipper Trip System
  - Subtopic 2 LatchRite

## Module 16 Crowd System

### Lesson 16.1 Theory of Operation

#### Lesson Description:

This Lesson describes the major assemblies and components and explains the basic theory of operation of the Crowd System on P&H Electric Mining Shovels.

#### Objectives:

Upon completion of this Lesson the student will:

- Identify the major components which comprise the crowd system,
- Locate where the major components associated with the crowd system reside on the boom,
- Relate the basic theory of operation of the crowd system.

#### Lesson Outline:

- Topic 1 Theory of Operation

### Lesson 16.2 Crowd Drive Assembly

#### Lesson Description:

This Lesson describes the major components and recommended inspection, repair and adjustment procedures of the Crowd Drive Assembly on P&H Electric Mining Shovels.

#### Objectives:

Upon completion of this Lesson the student will:

- Be able to recognize, locate, and describe the different components that make up the Crowd Drive Assembly.
- Understand the basic concepts associated with inspecting the Crowd Drive Assembly.
- Have a basic understanding of the ventilation requirements associated with the Crowd Motor.
- Understand the steps required for the removal and installation of the Crowd Motor.
- Understand the steps required for the removal and installation of the Crowd Motor Sheave.
- Be able to recognize, locate, and describe the different components that make up the Power Band Drive Assembly.
- Understand the theory of operation associated with the Hydraulic Power Unit, Hydraulic Solenoid Manifold and Electrical Panel, Hydraulic Cylinder, and Hydraulic Rod Lock.
- Understand the steps required for the adjustment of the Relief Valve.
- Understand the steps associated with the Auto Tensioning System - Auto Control.
- Understand the steps associated with the Auto Tensioning System - Manual Control.
- Understand the steps required for the removal and installation of the Crowd Belts.

#### Lesson Outline:

- Topic 1 Crowd Drive Assembly
- Topic 2 Inspection
- Topic 3 Repair
- Topic 4 Crowd Motor
- Topic 5 Power Band Drive Assembly
- Topic 6 Auto Tensioning System - Manual Control

- Topic 7 Auto Tensioning System - Auto Control
- Topic 8 Replacement of Crowd Belts

## Lesson 16.4 Crowd Gearcase

### Lesson Description:

This Lesson describes the components associated with the Crowd Gearcase and how to inspect, remove, disassemble, assemble, and install them.

### Objectives:

Upon completion of this Lesson the student will:

- Identify the major components associated with the Crowd Gearcase Assembly.
- Describe the recommended inspection procedure for the Crowd Gearcase and the components associated with the Crowd Gearcase.
- Describe the recommended repair practices related to the Crowd Gearcase.
- Describe the procedure to remove the Crowd Gearcase.
- Describe the procedure used to remove the components associated with the 1st Reduction Assembly of the Crowd Gearcase.
- Describe the procedure used to remove the components associated with the 2nd Reduction Assembly of the Crowd Gearcase.
- Describe the procedure used for the disassembly of components associated with the 1st Reduction Assembly of the Crowd Gearcase.
- Describe the procedure used for the disassembly of components associated with the 2nd Reduction Assembly of the Crowd Gearcase.
- Describe the procedure used to assemble the components associated with the 1st Reduction Assembly of the Crowd Gearcase.
- Describe the procedure used to assemble the components associated with the 2nd Reduction Assembly of the Crowd Gearcase.
- Describe the steps required for the installation of components associated with the 1st Reduction Assembly of the Crowd Gearcase.
- Describe the steps required for the installation of components associated with the 2nd Reduction Assembly of the Crowd Gearcase.
- Describe the steps required for the installation of the Crowd Gearcase.

### Lesson Outline:

- Introduction
- Topic 1 Inspection
- Topic 2 Repair
- Topic 3 Removal
  - Subtopic 1 Crowd Gearcase
  - Subtopic 2 1st Reduction Assembly
  - Subtopic 3 2nd Reduction Assembly
- Topic 4 Disassembly
  - Subtopic 1 1st Reduction Assembly
  - Subtopic 2 2nd Reduction Assembly
- Topic 5 Assembly
  - Subtopic 1 1st Reduction Assembly



- Subtopic 2 2nd Reduction Assembly
- Topic 6 Installation
  - Subtopic 1 1st Reduction Assembly
  - Subtopic 2 2nd Reduction Assembly
  - Subtopic 3 Crowd Gearcase

## Lesson 16.5 Shipper Shaft and Saddle Block System Components

### Lesson Description:

This Lesson describes the components associated with the Shipper Shaft and Saddle Block Assemblies and provides information on maintenance rebuild strategies. Also described are the upgrade kits associated with these assemblies.

### Objectives:

Upon completion of this Lesson the student will:

- Identify the major components of the Shipper Shaft and Saddle Block system.
- Provide a basic understanding of the function of the Shipper Shaft and Saddle Block system.
- Discuss current Shipper Shaft and Saddle Block Maintenance Rebuild Strategy.
- Review recent Shipper Shaft and Saddle Block Upgrade Kits and Conversions to improve reliability and maintenance.

### Lesson Outline:

- Topic 1 Component Overview
- Topic 2 Maintenance Rebuild Strategy
- Topic 3 Inspection
- Topic 4 Hydraulic Adjustment Kit
- Topic 5 Lateral Wear Plates
- Topic 6 Rework Kit
- Topic 7 Lube Kit

## Lesson 16.6.1.1 Shipper Shaft and Saddle Block Adjustments

### Lesson Description:

In this Lesson you will learn how to perform the Shipper Shaft Axial Clearance and Saddle Block Upper and Lower Wear Plate Adjustments for the Electric Mining Shovels.

### Objectives:

Upon completion of this Lesson the student will:

- Be able to identify the components of the Shipper Shaft Assembly.
- Be able to identify the components of the Saddle Block Assembly.
- Understand what inspection criteria is required to complete a 250-hour and 500-hour PM Inspection.
- Understand the steps required to adjust the Shipper Shaft Axial Clearance to within specified parameters.
- Understand the steps required to adjust the Saddle Block Upper Wear Plate to within specified parameters.
- Understand the steps required to adjust the Saddle Block Lower Wear Plate to within specified parameters.

### Lesson Outline:

- Topic 1 Introduction

- Topic 2 Shipper Shaft and Saddle Block Inspection
- Topic 3 Shipper Shaft Axial Clearance Adjustment
- Topic 4 Saddle Block Upper Wear Plate Adjustment
- Topic 5 Saddle Block Lower Wear Plate Adjustment

## Lesson 16.7 Crowd Limit Switch Sensor

### Lesson Description:

This Lesson describes the theory of operation of the Crowd Limit Switch Sensor and how to properly replace the Resolver, and remove and install the Crowd Limit Switch Sensor Assembly.

### Objectives:

Upon completion of this Lesson the student will:

- Understand the basic Theory of Operation of the Crowd Limit Switch Sensor.
- Understand the steps required to remove and replace the Resolver.
- Understand the steps required to remove the Crowd Limit Switch Sensor Assembly.
- Understand the steps required to install the Crowd Limit Switch Sensor Assembly.

### Lesson Outline:

- Topic 1 Crowd Limit Theory
- Topic 2 Resolver Replacement
- Topic 3 Removal
- Topic 4 Installation

## Module 17 Dipper Handles

### Lesson 17.1 Dipper Handle Inspection

**Lesson Description:**

This Lesson describes how to properly inspect the dipper handles on P&H Mining Equipment Shovels.

**Objectives:**

Upon completion of this Lesson the student will:

- Understand the proper inspection procedures required for visually inspecting the dipper handles.
- Understand the proper inspection procedures required for inspecting the welds on the dipper handles.
- Understand the proper inspection procedures required for dimensionally inspecting the dipper handles.

**Lesson Outline:**

- Topic 1 Visual Inspection
- Topic 2 Weld Inspection
- Topic 3 Dimensional Inspection

### Lesson 17.2 Dipper Handle Removal and Installation

**Lesson Description:**

This Lesson describes how to properly remove and install the dipper handles on P&H Mining Equipment Shovels.

**Objectives:**

Upon completion of this Lesson the student will:

- Understand the proper removal procedures associated with the dipper handles on P&H Mining Shovels.
- Understand the proper installation procedures associated with the dipper handles on P&H Mining Shovels.

**Lesson Outline:**

- Topic 1 Removal
- Topic 2 Installation

### Lesson 17.3 Dipper Handle Procedures

**Lesson Description:**

This Lesson describes the proper methods for repairing dipper handle cracks and removing the dipper handle racks.

**Objectives:**

Upon completion of this Lesson the student will:

- Understand the proper procedures required for repairing cracks on the dipper handles.
- Understand the proper procedures required for removing the dipper handle racks.

**Lesson Outline:**

- Topic 1 Repairing Dipper Handle Cracks
- Topic 2 Removing Dipper Handle Racks

## Module 18 Dippers

### Lesson 18.1 Dipper Components and Operation

#### Lesson Description:

In this Lesson the student will identify the components of the Dipper and learn what the purpose of each component is.

#### Objectives:

Upon completion of this Lesson the student will:

- Understand the different locations of dipper components.
- Understanding the different types of dippers.

#### Lesson Outline:

- Topic 1 Dipper Components and Operations
- Topic 2 Dipper Types

### Lesson 18.2 Dipper Inspection (Walk around)

#### Lesson Description:

This Lesson will help you to understand the walk around inspection for the dipper.

#### Objectives:

Upon completion of this Lesson the student will:

- Have a better understanding of Dipper inspection as it relates to Structural Integrity, Wear Liners, Pins and Bushings, Dipper Door, Latch Keeper (Dutchman), Shims, and Weld Maintenance.

#### Lesson Outline:

- Topic 1 Structural Integrity
- Topic 2 Wear Liners
- Topic 3 Pin and Bushing
- Topic 4 Door
- Topic 5 Dutchman
- Topic 6 Shims
- Topic 7 Weld Maintenance

### Lesson 18.3 Ground Engaging Equipment Maintenance

#### Lesson Description:

In this Lesson you will learn about different types of wear element systems, their names and how to install and maintain each one of them.

#### Objectives:

Upon completion of this Lesson the student will:

- Be able to describe different items of the wear elements.
- Understand the installation procedures required for each of the wear elements.
- Be able to maintain and get maximum performance out of the wear elements.

## Lesson Outline:

- Topic 1 General Overview and Description of Wear Elements
- Topic 2 Shovels
- Topic 3 Loaders
- Topic 4 Recommendations to Optimize Wear Element Lifetime

## Lesson 18.4 Pitch Bracers and Dipper Angles

### Lesson Description:

This Lesson provides information on Pitch Bracers and Dipper Angles.

### Objectives:

Upon completion of this Lesson the student will:

- Understand the importance of Pitch Brace Length, Tooth Angle, and Rake Angle.
- Understand what happens when Pitch Brace is too long.
- Understand what happens when Pitch Brace is too short.
- Understand how to optimize Rake Angle.

### Lesson Outline:

- Topic 1 Pitch Brace Length, Tooth Angle, and Rake Angle
  - Subtopic 1 Pitch Brace Too Long
  - Subtopic 2 Pitch Brace Too Short
- Topic 2 Optimizing Rake Angle

## Lesson 18.5 Dipper Maintenance

### Lesson Description:

This Lesson describes the components of the dipper assembly, and provides recommended inspection and service procedures.

### Objectives:

Upon completion of this Lesson the student will:

- Be able to describe the proper maintenance to be performed on the Primary Wear Areas, General Outside Wear Plates, Inside Wear Liners, Latch Mechanism Wear Areas, Dipper Door Latch Mechanism, Lip Rebuilding and Restoration, Pins and Bushings, of the Dipper used on P&H Mining Equipment Electric Mining Shovels.

### Lesson Outline:

- Introduction
- Topic 1 Primary Wear Areas
- Topic 2 General Outside Wear Plates
- Topic 3 Inside Wear Liners
- Topic 4 Latch Mechanism Wear Areas
- Topic 5 Dipper Door Latch Mechanism
- Topic 6 Lip Rebuilding and Restoration
- Topic 7 Pins and Bushings

## Lesson 18.6 Dipper Change Out

### Lesson Description:

This Lesson helps provide an efficient means of replacing or installing Dippers. Since different mines use different methods, the procedures discussed in this Lesson are offered only as a guideline.

### Objectives:

Upon completion of this Lesson the student will:

- Know what tools are required for removing and installing the Dipper.
- Have a basic understanding of the steps required for removing the Dipper.
- Have a basic understanding of the steps required for installing the Dipper.

### Lesson Outline:

- Introduction
- Topic 1 Dipper Removal
- Topic 2 Dipper Installation

## Lesson 18.7 Snubbers

### Lesson Description:

This Lesson describes how to perform inspections and adjustments to the dipper door snubbers.

### Objectives:

Upon completion of this Lesson the student will:

- Inspect the dipper door snubbers.
- Adjust the dipper door snubbers.

### Lesson Outline:

- Topic 1 Dipper Door Snubbers

## Module 19 Compressed Air System

### Lesson 19.1 Theory of Operation

#### Lesson Description:

This Lesson provides information on the major components and theory of operation of the Compressed Air System.

#### Objectives:

Upon completion of this Lesson the student will:

- Describe the major components of the Compressed Air System.
- Describe the operation of the major components of the Compressed Air System.
- Discuss the theory of operation of the Compressed Air System.

#### Lesson Outline:

- Topic 1 Components of the Compressed Air System
- Topic 2 Air System Operation

### Lesson 19.2 Sullair Type ES-8 Rotary Screw Compressor

#### Lesson Description:

This Lesson provides information on component identification, theory of operation, maintenance, and troubleshooting of the Sullair Type ES-8 Rotary Screw Compressor used on P&H Electric Mining Shovels.

#### Objectives:

Upon completion of this Lesson the student will:

- Identify the major components associated with the Sullair Type ES-8 Rotary Screw Compressor.
- Discuss the Theory of Operation for the Sullair Type ES-8 Rotary Screw Compressor.
- Identify the operator controls associated with the Supervisor II Controller of the Sullair Type ES-8 Rotary Screw Compressor.
- Understand the function of the buttons used on the Supervisor II Controller of the Sullair Type ES-8 Rotary Screw Compressor.
- Describe the different modes of operation of the Sullair Type ES-8 Rotary Screw Compressor.
- Understand what maintenance is required to keep the Sullair Type ES-8 Rotary Screw Compressor operating at optimal performance.
- Understand possible causes and remedies associated with different failures of the Sullair Type ES-8 Rotary Screw Compressor.

#### Lesson Outline:

- Topic 1 Components
- Topic 2 Theory of Operation
- Topic 3 Supervisor II Control
- Topic 4 Compressor Operation
- Topic 5 Maintenance
- Topic 6 Troubleshooting

## Lesson 19.3 Sullair Type LS-10 Rotary Screw Compressor

### Lesson Description:

This Lesson provides information on component identification, theory of operation, maintenance, and troubleshooting of the Sullair Type LS-10 Rotary Screw Compressor used on P&H Electric Mining Shovels.

### Objectives:

Upon completion of this Lesson the student will:

- Identify the major components associated with the Sullair Type LS-10 Rotary Screw Compressor.
- Discuss the Theory of Operation for the Sullair Type LS-10 Rotary Screw Compressor.
- Identify the operator controls associated with the Supervisor II Controller of the Sullair Type LS-10 Rotary Screw Compressor.
- Understand the function of the buttons used on the Supervisor II Controller of the Sullair Type LS-10 Rotary Screw Compressor.
- Describe the different modes of operation of the Sullair Type LS-10 Rotary Screw Compressor.
- Understand what maintenance is required to keep the Sullair Type LS-10 Rotary Screw Compressor operating at optimal performance.
- Understand possible causes and remedies associated with different failures of the Sullair Type LS-10 Rotary Screw Compressor.

### Lesson Outline:

- Topic 1 Components
- Topic 2 Theory of Operation
- Topic 3 Supervisor II Control
- Topic 4 Compressor Operation
- Topic 5 Maintenance
- Topic 6 Troubleshooting

## Lesson 19.4 Quincy Rotary Screw

### Lesson Description:

This Lesson provides information on component identification, theory of operation, maintenance, and troubleshooting of the Quincy Rotary Screw Compressor used on P&H Electric Mining Shovels.

### Objectives:

Upon completion of this Lesson the student will:

- Identify the major components associated with the Quincy Rotary Screw Compressor.
- Discuss the Theory of Operation for the Quincy Rotary Screw Compressor.
- Identify the operator procedures associated with the controls of the Quincy Rotary Screw Compressor.
- Understand what maintenance is required to keep the Quincy Rotary Screw Compressor operating at optimal performance.
- Understand the basic functions and identify the proper types of fluids used on the Quincy Rotary Screw Compressor.
- Understand possible causes and solutions associated with different failures of the Quincy Rotary Screw Compressor.



## Lesson Outline:

- Topic 1 Components
- Topic 2 Theory of Operation
- Topic 3 Operating Procedures
- Topic 4 Maintenance or Service
- Topic 5 Compressor Fluids
- Topic 6 Troubleshooting

## Lesson 19.5 Quincy Reciprocating (Piston Type) Air Compressor

### Lesson Description:

This Lesson provides information on component identification, theory of operation, maintenance, and troubleshooting of the Quincy Reciprocating Air Compressor used on P&H Electric Mining Shovels.

### Objectives:

Upon completion of this Lesson the student will:

- Identify the major components associated with the Quincy Reciprocating Air Compressor.
- Discuss the Theory of Operation for the Quincy Reciprocating Air Compressor.
- Identify the proper startup and operating procedures associated with the Quincy Reciprocating Air Compressor.
- Understand what maintenance is required to keep the Quincy Reciprocating Air Compressor operating at optimal performance.
- Understand the basic functions and identify the proper types of fluids used on the Quincy Reciprocating Air Compressor.
- Understand possible causes and solutions associated with different failures of the Quincy Reciprocating Air Compressor.

### Lesson Outline:

- Topic 1 Components
- Topic 2 Theory of Operation
- Topic 3 Startup and Operation
- Topic 4 Maintenance and Lubrication
- Topic 5 Troubleshooting

## Lesson 19.6-8 Membrane Air Dryer, Desiccant Air Dryer, and Refrigerated Air Dryer

### Lesson Description:

This Lesson provides information on the different Compressed Air Dryers used on P&H Electric Mining Shovels.

### Objectives:

Upon completion of this Lesson the student will:

- Identify the components associated with the Membrane Air Dryer.
- Understand the Theory of Operation associated with the Membrane Air Dryer.
- Identify the maintenance issues associated with the Membrane Air Dryer.
- Identify the components associated with the Desiccant Air Dryer.
- Understand the theory of Operation associated with the Desiccant Air Dryer.
- Identify the maintenance issues associated with the Desiccant Air Dryer.

- Understand basic causes and solutions for problems associated with the Desiccant Air Dryer.
- Identify the components associated with the Refrigerated Air Dryer.
- Understand the Theory of Operation associated with the Refrigerated Air Dryer.
- Identify the maintenance issues associated with the Refrigerated Air Dryer.

## Lesson Outline:

- Lesson 6 Membrane Air Dryer
- Lesson 7 Desiccant Air Dryer
- Lesson 8 Refrigerated Air Dryer

## Lesson 19.9 Air System Control

### Lesson Description:

This Lesson describes the controls used on the Air Systems for P&H Electric Mining Shovels.

### Objectives:

Upon completion of this Lesson the student will:

- Understand a basic overview of shovel air system control.
- Be able to describe the components and operation of the air manifold assembly.
- Be able to describe the components and operation of the lube pump air control panel.
- Be able to describe the components and operation of the brake air system.
- Be able to describe issues concerning brake air system valve failures.

### Lesson Outline:

- Topic 1 Air Manifold Assembly
- Topic 2 Brake Air System
- Topic 3 Lube Pump Air Control Panel

## Lesson 19.10 Air System Components

### Lesson Description:

This Lesson describes the operation, inspection, and maintenance requirements of the components of the air system.

### Objectives:

Upon completion of this Lesson the student will:

- Be able to identify the components of the Quick Release Valve.
- Understand the operation of the Quick Release Valve.
- Understand the proper inspection criteria for the Quick Release Valve.
- Identify any maintenance requirements associated with the Quick Release Valve.
- Identify the repairable items of the Quick Release Valve.
- Understand the steps required for the removal of the Quick Release Valve.
- Identify the different types of Air Valves used on P&H Mining Equipment Electric Mining Shovels.
- Have a general understanding of the operation of the Air Valves.
- Identify any maintenance requirements associated with the Air Valves.
- Understand the proper inspection criteria for the Air Valves.
- Have a general understanding of how to replace the Air Valves.

- Have a basic understanding of the operation of the Drain Valve System.
- Understand the adjustment procedure associated with the Drain Valve System.
- Understand the removal and replacement procedure associated with the Drain Valve System.
- Have a basic understanding of the operation of the Air System Pressure Transducers.
- Understand the removal and replacement procedure associated with the Air System Pressure Transducers.
- Be able to identify the components of the Air Pressure Regulators used on P&H Mining Equipment Electric Mining Shovels.
- Identify the different types of Air Pressure Regulators used on P&H Mining Equipment Electric Mining Shovels.
- Understand the adjustment procedure associated with the Air Pressure Regulators.
- Understand the proper inspection and replacement criteria for the Air Pressure Regulators.
- Identify causes to basic problems associated with the Air Pressure Regulators.
- Have a basic understanding of the operation of the Sullair ES-8 Air Compressor Regulator.
- Understand the adjustment procedure associated with the Sullair ES-8 Air Compressor Regulator.
- Understand the replacement procedure associated with the Sullair ES-8 Air Compressor Regulator.
- Have a basic understanding of the operation of the Air Lubricators used on P&H Mining Equipment Electric Mining Shovels.
- Identify any maintenance requirements associated with the different Air Lubricators.
- Understand the adjustment procedure associated with the different Air Lubricators.
- Have a basic understanding of the operation of the Air Filters.
- Identify the components associated with the Air Filters.
- Identify any maintenance requirements associated with the Air Filters.
- Understand the steps required to replace the Air Filters.
- Have a basic understanding of what a De-Icer is and what P&H Mining Equipment's recommendations are in regards to De-Icers and Air Dryer Systems.

## **Lesson Outline:**

- Topic 1 Quick Release Valve
- Topic 2 Air Valves
- Topic 3 Drain Valve System
- Topic 4 Air System Pressure Transducer
- Topic 5 Air Pressure Regulators
- Topic 6 Air Lubricators
- Topic 7 Air Filters
- Topic 8 De-Icer

## **Lesson 19.11 Boarding Stairway Air System**

### **Lesson Description:**

This Lesson describes the components, operation, and adjustments of the Boarding Stairway Air System.

### **Objectives:**

Upon completion of this Lesson the student will:

- Be able to identify the components of the Boarding Stairway Air System.
- Understand the operation of the components associated with the Boarding Stairway Air System.
- Understand the steps required to adjust the raising and lowering speed of the Boarding Stairway Air System.

- Understand the steps required to remove the Boarding Stairway Air Cylinder from the Boarding Stairway.

## **Lesson Outline:**

- Topic 1 Components
- Topic 2 Operation
  - Subtopic 1 Pilot Air Pressure Operated Air Valves
  - Subtopic 2 System Setup and Adjustment
- Topic 3 Boarding Stairway Air Cylinder

## **Lesson 19.12 Champion Compressor**

### **Lesson Description:**

This Lesson provides information on component identification, theory of operation, and maintenance of the Champion Rotary Screw Compressor used on P&H Electric Mining Shovels.

### **Objectives:**

Upon completion of this Lesson the student will:

- Identify the major components associated with the Champion Rotary Screw Compressor.
- Discuss the Theory of Operation for the Champion Rotary Screw Compressor.
- Identify the operator controls associated with the electronic controller of the Champion Rotary Screw Compressor.
- Understand the function of the buttons used on the electronic controller of the Champion Rotary Screw Compressor.
- Understand what maintenance is required to keep the Champion Rotary Screw Compressor operating at optimal performance.

### **Lesson Outline:**

- Topic 1 Components
- Topic 2 Theory of Operation
- Topic 3 Electronic Controller
- Topic 4 Pre-Start and Operation
- Topic 5 Maintenance

## Module 20 Lubrication

### Lesson 20.1 Lubrication System Description

#### Lesson Description:

In this Lesson you will learn the different types of lubrication techniques and systems that are used on P&H Mining Shovels.

#### Objectives:

Upon completion of this Lesson the student will:

- Understand the basic lubrication techniques and systems.
- Periodically inspect the Upper, Lower, and Attachment.
- Maintain proper lubrication.

#### Lesson Outline:

- Topic 1 Lubrication System Overview
- Topic 2 Lubrication Charts
- Topic 3 Upper Lubrication Chart
- Topic 4 Lower Lubrication Chart
- Topic 5 Attachment Lubrication Chart

### Lesson 20.2 Types of Lubricants

#### Lesson Description:

In this Lesson you will learn how to select the right type of lubricant and gearcase oils, as well as identify the P&H lubricant material specifications.

#### Objectives:

Upon completion of this Lesson the student will:

- Understand the proper selection of lubricants.
- Understand the proper selection of gearcase oils.
- Identify P&H lubricant material specifications.

#### Lesson Outline:

- Topic 1 Selection of Lubricants
- Topic 2 Selection of Gearcase Oils
- Topic 3 P&H Lubricant Material Specifications

### Lesson 20.3 Electric Motor Lubrication and Maintenance

#### Lesson Description:

This Lesson describes the procedure for lubricating the DC Electric Motors on P&H Mining Shovels. It also provides information on lubrication practices for replacement motors, motors in extended storage, and remanufactured motors.

#### Objectives:

Upon completion of this Lesson the student will:

- Describe grease lubrication practices for P&H DC Electric Motors.
- Identify the locations of lube points associated with P&H DC Electric Motors.
- Understand the lubrication requirements for replacement P&H DC Electric Motors.
- Understand the lubrication procedures for P&H DC Electric Motors during and after extended storage.
- Understand the lubrication procedures for remanufactured P&H DC Electric Motors.

## Lesson Outline:

- Topic 1 Electric Motor Bearings
- Topic 2 Replacement Motors
- Topic 3 Lubrication After Extended Storage
- Topic 4 Lubrication of Remanufactured Motors

## Lesson 20.4 Hoist Gearcase Lubrication System

### Lesson Description:

This Lesson provides information on the Hoist Gearcase Lubrication System (w/Gravity Flow) and the Hoist Gearcase Lubrication System (w/Cooler).

### Objectives:

Upon completion of this Lesson the student will:

- Understand the basics of the Hoist Gearcase Lubrication System (w/Gravity Flow).
- Understand the basics of the Hoist Gearcase Lubrication System (w/Gravity Flow) Inspection.
- Understand the maintenance of the Hoist Gearcase Lubrication System (w/Gravity Flow).
- Understand the basics of the Hoist Gearcase Lubrication System (w/Cooler).
- Understand the basics of the Hoist Gearcase Lubrication System (w/Cooler) Inspection.
- Understand the maintenance of the Hoist Gearcase Lubrication System (w/Cooler).

### Lesson Outline:

- Topic 1 Hoist Gearcase Lubrication System (w/Gravity Flow)
  - Subtopic 1 Description
  - Subtopic 2 Inspection
  - Subtopic 3 Maintenance
- Topic 2 Hoist Gearcase Lubrication System (w/Cooler)
  - Subtopic 1 Description
  - Subtopic 2 Inspection
  - Subtopic 3 Maintenance

## Lesson 20.5 Swing Gearcase Lubrication System

### Lesson Description:

This Lesson discusses the Swing Gearcase Lubrication System to include the recommended inspection and maintenance procedures that are utilized with this system.

### Objectives:

Upon completion of this Lesson the student will:

- Understand the basic operation of the Swing Gearcase Lubrication System.

- Understand the recommended inspection practices associated with the Swing Gearcase Lubrication System.
- Understand the maintenance issues associated with the Swing Gearcase Lubrication System.

## Lesson Outline:

- Topic 1 Swing Gearcase Lubrication System
  - Subtopic 1 Description
  - Subtopic 2 Inspection
  - Subtopic 3 Maintenance

## Lesson 20.6 Crowd Gearcase Lubrication System

### Lesson Description:

This Lesson provides information about the Crowd Gearcase Lubrication System including both recommended inspection and maintenance procedures that are utilized with this system.

### Objectives:

Upon completion of this Lesson the student will:

- Understand the basic operation of the Crowd Gearcase Lubrication System.
- Understand the recommended inspection practices associated with the Crowd Gearcase Lubrication System.
- Understand the maintenance issues associated with the Crowd Gearcase Lubrication System.

## Lesson Outline:

- Topic 1 Crowd Gearcase Lubrication System
  - Subtopic 1 Description
  - Subtopic 2 Inspection
  - Subtopic 3 Maintenance

## Lesson 20.7 Lubrication System Components

### Lesson Description:

This Lesson describes the components associated with the Lubrication Systems for the Gearcases on the P&H Electric Mining Shovel.

### Objectives:

Upon completion of this Lesson the student will:

- Be able to locate and describe the function of the Oil Filters of the Gearcase Lubrication System.
- Understand the disassembly procedure associated with the Oil Filters.
- Understand the maintenance required to maintain the Oil Filters.
- Understand the assembly procedure associated with the Oil Filters.
- Be able to locate and describe the function of the Oil Strainers of the Gearcase Lubrication System.
- Understand the procedure required to clean the Oil Strainers.
- Be able to locate and describe the function of the Lubrication Pumps of the Gearcase Lubrication System.
- Understand the procedure required to remove the Lubrication Pump.
- Understand the procedure required to install the Lubrication Pump.

- Be able to locate and describe the function of the Hoist and Crowd Lube Pump Flexible Coupling of the Gearcase Lubrication System.
- Understand the procedure required to align the Hoist and Crowd Lube Pump Flexible Coupling.
- Be able to locate and describe the function of the Swing Lube Pump Flexible Coupling of the Gearcase Lubrication System.
- Understand the procedure required to align the Swing Lube Pump Flexible Coupling.
- Be able to locate and describe the function of the Lube Pump Gear Reducer of the Gearcase Lubrication System.
- Understand the maintenance required to maintain the Lube Pump Gear Reducer.
- Understand the procedure required to remove the Lube Pump Gear Reducer.
- Understand the assembly procedure associated with the Lube Pump Gear Reducer.
- Be able to identify the different Gearcase Lube Oil Capacities for P&H Electric Mining Shovels.

## **Lesson Outline:**

- Topic 1 Oil Filters
- Topic 2 Oil Strainer
- Topic 3 Lubrication Pump
- Topic 4 Hoist and Crowd Lube Pump Flexible Coupling
- Topic 5 Swing Lube Pump Flexible Coupling
- Topic 6 Lube Pump Gear Reducer
- Topic 7 Gearcase Capacities



## Module 21 Automatic Lubrication System

### Lesson 21.1 Lubrication System Description and Controls

#### Lesson Description:

This Lesson provides detailed information on the different Automatic Lubrication Systems provided by P&H Mining Equipment. Components and controls of the Lincoln 3 Zone, Lincoln 4 Zone, and Farval Systems are discussed in regards to locations, functions, operation, and start-up after maintenance or repair.

#### Objectives:

Upon completion of this Lesson the student will:

- Describe and understand the major components of the Lincoln 3 Zone Automatic Lube System.
- Describe and understand the major components of the Lincoln 4 Zone Automatic Lube System.
- Describe and understand the major components of the Farval Automatic Lube System.
- Discuss the System Set Points associated with the different Automatic Lubrication Systems provided by P&H Mining Equipment.
- Describe and program the Lube Level Sensor associated with the Automatic Lubrication System.
- Understand the PLC and Touch Panels associated with the Automatic Lubrication System.
- Describe the location and operation of the Lubrication Control Panel.
- Perform a Manual Lubrication Cycle.
- Describe the checks needed to be performed to the Automatic Lubrication System after performing maintenance or repair procedures on the shovel.

#### Lesson Outline:

- Topic 1 Automatic Lubrication System
- Topic 2 Lubrication Tanks
- Topic 3 PLC and Touch Panels
- Topic 4 Lube Room Control Panels
- Topic 5 System Start-up

### Lesson 21.2 Automatic Lubrication Hydraulic and Pneumatic System

#### Lesson Description:

This Lesson describes the component functions and system operation of the Automatic Lubrication Hydraulic and Pneumatic System.

#### Objectives:

Upon completion of this Lesson the student will:

- Understand the components and operation of the Lube Pump and Spray Air Supply.
- Understand the operation of the Lube Pump and Spray Air Supply Flow Control Valves.
- Be able to identify the components of the Lube Pumps.
- Understand the criteria for inspection, maintenance, removal, repair, and installation of the Lube Pumps.
- Be able to describe the Pumping and Venting operation of the Lincoln 3 Zone System.
- Understand the operation, maintenance, removal, disassembly, assembly, and installation of the Vent Valve associated with the Lincoln 3 Zone System.
- Understand the operation, maintenance, repair, removal, and installation of the Elbow Union Check Valve associated with the Lincoln 3 Zone System.

- Describe the operation of the Lincoln 3 Zone System Downstream Hydraulic:
  - Upper Zone
  - Lower Zone
  - Open Gear Zone
- Be able to identify the components of, and describe the operation of the SL1 and SL11 Injectors.
- Understand the steps required for adding SL1 and SL11 Injectors to the Lincoln 3 Zone System.
- Understand the adjustment, removal, and installation requirements for the SL1 and SL11 Injectors to the Lincoln 3 Zone System.
- Understand basic troubleshooting techniques as they apply to the Lincoln 3 Zone System.
- Be able to describe the pumping and venting operation of the Lincoln 4 Zone System.
- Understand the operation of the Vent Valve Operation.
- Understand the criteria for maintenance, removal, repair and installation of the Vent Valve.
- Understand the criteria for maintenance, removal, repair and installation of the Pressure Relief Valve.
- Understand the criteria for maintenance, removal, repair and installation of the Accumulator.
- Understand the criteria for maintenance, removal, repair and installation of the Zone Control Valve.
- Be able to describe the operation of the Lincoln 4 Zone System Downstream Hydraulic:
  - Upper Zone
  - Lower Zone
  - Crowd Open Gear Zone
  - Swing Open Gear Zone
- Understand basic troubleshooting techniques as to the Lincoln Four Zone System.
- Understand the criteria for maintenance, removal, repair and installation of the Spray Valve.
- Understand how to bleed air from supply lines.
- Understand supply lines component replacement.

## **Lesson Outline:**

- Topic 1 Lubricant Pump and Spray Air Supply
- Topic 2 Lubrication Pumps
- Topic 3 Lincoln 3 Zone System Pumping and Venting
- Topic 4 Lincoln 3 Zone System Downstream Hydraulic Description
- Topic 5 Lincoln 3 Zone System Troubleshooting
- Topic 6 Lincoln Four Zone System Pumping and Venting
- Topic 7 Lincoln Four Zone System Downstream Hydraulic Description
- Topic 8 Lincoln Four Zone System Troubleshooting
- Topic 9 Spray Valves
- Topic 10 Bleeding Air from Supply Lines



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