
# Electric Rope Shovel Technical Training Catalog

KOMATSU

Product Training and Publications

# Contents

# Global Mining Solutions eLearning

Product Training and Publications has identified eLearning as a delivery option for fundamental knowledge and product specific training. eLearning provides several advantages over traditional training methods:

- eLearning content can be accessed through the Internet by any individual who has the appropriate login and password credentials.
- Immediate availability of training content which provides a quicker, more productive workforce.
- Online training reduces the cost of training by eliminating travel, living, and other expenses associated with Instructor-Led Training.
- eLearning provides students with the ability to learn at their own pace and in their own comfortable environment.
- The training content can be delivered to a large contingent of people in varying locations and be technically consistent across the board.
- When used as a prerequisite to Instructor-Led Training, eLearning can level the playing field between novice and senior personnel. 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 Product Training and Publications.

**Lesson duration:**
Each eLearning Lesson is designed to be less than 60 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 as well as a fundamental understanding of electronics, mechanics, pneumatics, and hydraulics as it applies to the systems of P&H Mining Shovel.

**Lesson location:**
eLearning content can be accessed through the Internet 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:

- Adobe Reader version 8 or better

**Note:**
Our eLearning content is periodically revised and updated.

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# General eLearning Lesson Descriptions

## Introduction and Product Overview

### *Lesson 3.1 Shovel Introduction*

**Lesson description:**
This lesson provides the technician with an overview of the shovel sections, motions, systems, and internal and exterior components.

**Objectives:**
Upon completion of this lesson the student will:

- Understand and identify the major sections, motions, and systems associated with P&H Mining Shovels
- Understand the purpose and function of the exterior and interior components associated with P&H Mining Shovels
- Understand the purpose and function of the major components and controls associated with the Operator Cab on a P&H Mining Shovel

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Shovel Sections
- Topic 3: Shovel Motions
- Topic 4: Shovel Systems
- Topic 5: Exterior Component Overview
- Topic 6: Interior Component Overview
- Topic 7: Loading Control Center

### *Lesson 3.2 Shovel Operation Basics*

**Lesson description:**
This lesson is intended to provide the technician with a general overview of the theory of operation for a P&H Mining Shovel. Due to the wide variety of mining operations and conditions, this lesson cannot detail every application or task. This lesson is intended to suggest general operating procedures and techniques only. Specific procedures will vary from mine to mine.

**Objectives:**
Upon completion of this lesson the student will:

- Understand the steps required to properly operation the shovel Hoist, Swing, Crowd, and Propel motion
- Understand how a shovel operator should setup the shovel for productive digging
- Have a thorough understanding of the Mechanical and Electrical System, the Ground Level, the On-Board, and Operation Station Inspections required prior to start the shovel
- Have a thorough understanding of the 4 Phases required to properly operate the shovel through a complete Dig Cycle

**Lesson outline:**

- Topic 1: Shovel Operation Introduction
- Topic 2: Individual Motion Control Procedures
- Topic 3: Setting Up for Productive Digging
- Topic 4: Pre-Start Inspection – Mechanical Systems
- Topic 5: Pre-Start Inspection – Electrical Systems
- Topic 6: Pre-Start Inspection – Ground Level
- Topic 7: Pre-Start Inspection – On-Board
- Topic 8: Pre-Start Inspection – Operator's Station
- Topic 9: Dig Cycle

## *Lesson 3.3 Shovel Electrical Basics*

**Lesson description:**
This lesson is intended to provide the learner with an introduction to electrostatic discharge, general electrical guidelines, and troubleshooting steps.

**Objectives:**
Upon completion of this lesson the student will:

- State the definition of ESD and explain how to avoid damaging equipment through the transfer of static energy
- Have a thorough understanding of how to navigate through an electrical schematic
- Be introduced to a Six Step Troubleshooting technique
- Understand the steps recommended for shutting the equipment down for maintenance procedures

**Lesson outline:**

- Topic 1: Electrostatic Discharge (ESD)
- Topic 2: Schematic Diagram Guidelines
- Topic 3: Troubleshooting Electrical Equipment
- Topic 4: Maintenance Shutdown Procedures

## *Lesson 3.4 Shovel Mechanical Basics*

**Lesson description:**
This lesson covers basic procedures used in many of the mechanical maintenance tasks associated with P&H Mining Shovels. The procedures covered in this lesson are general in nature and will apply to several tasks on the shovel.

**Objectives:**
Upon completion of this lesson the student will:

- Be aware of items to look for during a routine daily inspection of wire rope
- Have a thorough understanding of how plastic shims are used on P&H shaft and bearing assemblies
- Become familiar with the types of fasteners used on P&H equipment
- Understand the different grade of bolts and how it influences the standard torque value specified for a bolted joint
- Be able to explain the installation and lubrication of P&H gear type motor couplings

**Lesson outline:**

- Topic 1: Wire Rope Inspection
- Topic 2: Shims
- Topic 3: Fasteners and Hardware
- Topic 4: Motor Couplings

# Operator eLearning Lesson Descriptions

## Shovel Operator

### *Lesson 1.1 General Safety Procedures*

**Lesson description:**
This lesson is provided as a guide to personnel involved in the operation of P&H Mining Shovels. We recommend that operators review and become familiar with the general procedures and information contained within the lesson.

**Objectives:**
Upon completion of this lesson the student will:

- Understand the basic qualifications, as recommended for a Mining Shovel Operator
- Have a basic understand of the Functional Checks required of the Operator before starting and operating a P&H Mining Shovel
- Have a basic understanding of the proper conduct for an Operator of a P&H Mining Shovel
- Understand some basic guidelines and suggestions, dos, and don’ts, for operating a P&H Mining Shovel
- Have a basic understanding of the responsibilities of crew members performing a job on or near a Mining Shovel
- Have a basic understanding of the importance of planning a job
- Be able to identify the different warning, prohibition, and mandatory action safety symbols used on the decals of a P&H Mining Shovel
- Be able to identify the different types of fires and ratings of fire extinguishers
- Explain how to use a cartridge operated and stored pressure fire extinguishers provided on P&H mining equipment
- Have a basic understanding of what an Emergency Plan is and what, at minimum, it should include
- Have a basic understanding of how to evacuate a P&H Mining Shovel

**Lesson outline:**

- Topic 1: Safe Operating Practices
- Topic 2: Safety Symbols
- Topic 3: Fire Extinguishers
- Topic 4: Emergency Evacuation

## *Lesson 1.2 Shovel Orientation*

**Lesson description:**
This lesson provides the operator or maintenance technician with a complete overview of the shovel exterior, interior, and cab components of current production model C Series P&H Mining Shovels.

**Objectives:**
Upon completion of this lesson the student will:

- Understand the purpose and function of the exterior and interior components associated with P&H Mining Shovels
- Understand the purpose and function of the major components and controls associated with the Operator Cab on P&H Mining Shovels

**Lesson outline:**

- Topic 1: Exterior Component Overview
- Topic 2: Interior Component Overview
- Topic 3: Loading Control Center

## *Lesson 1.3 Operator Inspections and Procedures*

**Lesson description:**
This lesson provides information for the operator to make Pre-Start, Startup, and Shutdown checks of the P&H Mining Shovel.

**Objectives:**
Upon completion of this lesson the student will:

- Have a thorough understanding of the Ground Level, On-Board, and Operator Station inspections required prior to starting the shovel
- Have a thorough understanding of the steps required to properly startup a shovel
- Have a thorough understanding of the steps required to properly shutdown a shovel under normal conditions and the extra steps required for extended period shutdowns

**Lesson outline:**

- Topic 1: Pre-Start Inspection – Mechanical Systems
- Topic 2: Pre-Start Inspection – Electrical Systems
- Topic 3: Pre-Start Inspection – Ground Level
- Topic 4: Pre-Start Inspection – On-Board
- Topic 5: Pre-Start Inspection – Operator's Station
- Topic 6: Starting Up the Shovel
- Topic 7: Shutdown Procedures

## *Lesson 1.4 Shovel Operation*

**Lesson description:**
This lesson describes the operation of the individual motion controls and includes some recommended operation procedures and practices that will aid the operator in the safe, smooth, and efficient operation of P&H Mining Shovels.

It is important to understand that this lesson is not complete without follow-up hands on skills-based training. This lesson can provide the knowledge of the controls and functions of the P&H Mining Shovel. It is this knowledge portion, combined with the skills training from a Factory Authorized Operator Trainer that will increase the competence of the Shovel Operator Trainee.

**Objectives:**
Upon completion of this lesson the student will:

- Have a thorough understanding of the steps required to properly operate the Shovel Hoist, Swing, Crowd, and Propel motions
- Have a basic understanding of Dig Forces and how it affects the shovel
- Have a basic understanding of Dipper Fill Factors
- Have a thorough understanding of the four phases required to properly operate the shovel through a complete dig cycle
- Have a thorough understanding of the steps required to reposition and relocate the shovel for optimal digging
- Understand the purpose of the emergency stop
- Understand how to recognize a thirty-second delayed shutdown alarm and what to do in case it happens on the shovel during operations

**Lesson outline:**

- Topic 1: Shovel Operation Introduction
- Topic 2: Individual Motion Control Procedures
- Topic 3: Dig Cycle
- Topic 4: Propelling Guidelines
- Topic 5: Emergency Stops
- Topic 6: Thirty-Second Delayed Shutdowns

# Electrical eLearning Curriculums

**Below are pre-determined curriculums based on the different electrical systems available for P&H Shovels.**

## Centurion AC Package (ACS880)

- Product Introduction
  - Lesson 3.1 Shovel Introduction
  - Lesson 3.2 Orientation Basics
  - Lesson 3.3 Electrical Basics
- Power Electronics
  - Lesson 4.9 Power Distribution – AC Shovels
  - Lesson 4.10 Protection Circuits – AC Shovels
  - Lesson 4.13 AC Motor Theory and Operation
- Control System
  - Lesson 5.6 Centurion Control System
  - Lesson 5.7 Siemens Remote IO
  - Lesson 5.3 Communication Devices
- Drive Control
  - Lesson 6.8 ACS880
- Miscellaneous Electrical Equipment & HMI Devices
  - Lesson 8.1 UPS System
  - Lesson 8.5 TripRite
  - Lesson 9.5 Touch Screen System

## Centurion AC Package (ACS800)

- Product Introduction
  - Lesson 3.1 Shovel Introduction
  - Lesson 3.2 Orientation Basics
  - Lesson 3.3 Electrical Basics
- Power Electronics
  - Lesson 4.9 Power Distribution – AC Shovels
  - Lesson 4.10 Protection Circuits – AC Shovels
  - Lesson 4.13 AC Motor Theory and Operation
- Control System
  - Lesson 5.6 Centurion Control System
  - Lesson 5.2 Remote IO
  - Lesson 5.3 Communication Devices
- Drive Control
  - Lesson 6.7 ACS800
- Miscellaneous Electrical Equipment & HMI Devices
  - Lesson 8.1 UPS System
  - Lesson 8.5 TripRite
  - Lesson 9.5 Touch Screen System

## Centurion AC Package (2300XPC AC)

- Product Introduction
  - Lesson 3.1 Shovel Introduction
  - Lesson 3.2 Orientation Basics
  - Lesson 3.3 Electrical Basics
- Power Electronics
  - 2300XPC AC – Power Distribution
  - Lesson 4.13 AC Motor Theory and Operation
- Control System
  - 2300XPC AC – Centurion Control System
  - 2300XPC AC – Siemens Remote IO
  - Lesson 5.3 Communication Devices
- Drive Control
  - 2300XPC AC – ACS880
- Miscellaneous Electrical Equipment & HMI Devices
  - Lesson 8.1 UPS System
  - Lesson 8.5 TripRite
  - Lesson 9.5 Touch Screen System

## Centurion DC Package

- Product Introduction
  - Lesson 3.1 Shovel Introduction
  - Lesson 3.2 Orientation Basics
  - Lesson 3.3 Electrical Basics
- Power Electronics
  - Lesson 4.1 Power Distribution – DC Shovels
  - Lesson 4.2 Power Conversion – DC Shovels
  - Lesson 4.3 Protection Circuits – DC Shovels
  - Lesson 4.6 Theory and Operation of the RPC – Centurion
  - Lesson 4.7 Theory of DC Motor Operation
  - Lesson 4.8 DC Motor Maintenance
- Control System
  - Lesson 5.6 Centurion Control System
  - Lesson 5.2 Remote IO
  - Lesson 5.3 Communication Devices
- Drive Control
  - Lesson 6.3 DCS800
- Miscellaneous Electrical Equipment & HMI Devices
  - Lesson 8.1 UPS System
  - Lesson 8.5 TripRite
  - Lesson 9.5 Touch Screen System

# Electrical eLearning Lesson Descriptions

## Power Electronics

### *Lesson 4.1 Power Distribution – DC Shovels*

**Lesson description:**
This lesson provides maintenance personnel with the knowledge of High Voltage Distribution on P&H Mining Shovels.

**Objectives:**
Upon completion of this lesson the student will:

- Identify all safety issues and conduct a risk analysis
- Identify and explain the purpose of all the major components utilized
- Demonstration proficiency in loading, configuring, usage and application of test equipment and remote programming panels as required
- Remove and replace faulty components including a failure analysis
- Explain the relationship to the rest of the shovel systems
- Analyze schematics, control diagrams, and relevant documentation utilized for troubleshooting and repair
- Describe the purpose of the High Voltage Systems in relation to overall Mining Shovel operation
- Identify critical personal safety procedures when working on High Voltage Systems
- Assess risk to humans and machine related to maintaining and servicing the High Voltage Systems
- Describe the purpose of all major assemblies of the High Voltage System

**Lesson outline:**

- Introduction
- Topic 1: Tail Cable
- Topic 2: Air Disconnect Switch with Earthing
- Topic 3: Collector Ring Assemblies
- Topic 4: High Voltage Cabinet
- Topic 5: Key Interlock System
- Topic 6: Main Transformer
- Topic 7: Bus Bars
- Topic 8: Suppression
- Topic 9: Auxiliary/Field Transformer

## *Lesson 4.2 Power Conversion – DC Shovels*

**Lesson description:**
This lesson provides maintenance personnel with the basic knowledge of Power Conversion used on P&H Mining Shovels.

**Objectives:**
Upon completion of this lesson the student will:

- Identify all safety issues and conduct a risk analysis
- Identify and explain the purpose of all the major components utilized
- Demonstration proficiency in loading, configuring, usage and application of test equipment and remote programming panels as required
- Remove and replace faulty components including a failure analysis
- Explain the relationship to the rest of the shovel systems
- Analyze schematics, control diagrams, and relevant documentation utilized for troubleshooting and repair

**Lesson outline:**

- Introduction
- Topic 1: Power Conversion – Theory of Operation
- Topic 2: SCR Testing
- Topic 3: Converter Cabinet Layout

## *Lesson 4.3 Protective Circuits – DC Shovels*

**Lesson description:**
This lesson provides maintenance personnel with the knowledge of Protective Circuits located on P&H Mining Shovels.

**Objectives:**
Upon completion of this lesson the student will:

- Identify all safety issues and conduct a risk analysis
- Identify and explain the purpose of all the major components utilized
- Demonstration proficiency in loading, configuring, usage and application of test equipment and remote programming panels as required
- Remove and replace faulty components including a failure analysis
- Explain the relationship to the rest of the shovel systems
- Analyze schematics, control diagrams, and relevant documentation utilized for troubleshooting and repair

**Lesson outline:**

- Introduction
- Topic 1: Instantaneous Overload Relay
- Topic 2: Main Transformer Thermal Overloads
- Topic 3: Ground Fault Relays
- Topic 4: Suppression Circuits
- Topic 5: Phase Monitor Relay
- Topic 6: Diverter Circuits
- Topic 7: Main Phase Sensing Relay

## *Lesson 4.6 RPC Theory and Operation – Centurion*

**Lesson description:**
In this lesson you will learn about Reactive Power Compensation (RPC) theory and the components used for RPC – Centurion on a P&H Mining Shovel.

**Objectives:**
Upon completion of this lesson the student will:

- Identify all safety issues and conduct a risk analysis
- Identify and explain the purpose of all the major components utilized
- Demonstration proficiency in loading, configuring, usage and application of test equipment and remote programming panels as required
- Remove and replace faulty components including a failure analysis
- Explain the relationship to the rest of the shovel systems
- Analyze schematics, control diagrams, and relevant documentation utilized for troubleshooting and repair

**Lesson outline:**

- Topic 1: RPC Component Overview - Centurion
- Topic 2: RPC Power Circuit Operation
- Topic 3: RPC Control Circuit Operation
- Topic 4: RPC Cabinet Layout
- Topic 5: RPC Troubleshooting

## *Lesson 4.7 Theory of DC Motor Operation*

**Lesson description:**
This lesson discusses the theory of DC Motors on P&H Mining Shovels.

**Objectives:**
Upon completion of this lesson the student will:

- Be able to identify and understand the components used in the construction of a DC Motor
- Be able to state the function of torque in a DC Motor and how torque is developed
- Be able to describe how Counter Electromotive Force (CEMF) is developed in a DC Motor
- Be able to describe the relationship between field current and magnetic field size in a DC Motor
- Be able to state the function of the CEMF that is developed in a DC Motor
- Be able to describe how the speed of a DC Motor is adjusted

**Lesson outline:**

- Topic 1: P&H Mining DC Motors
- Topic 2: Types of DC Motors
- Topic 3: DC Motor Construction
- Topic 4: Principles of Operation
- Topic 5: Generator Action in a DC Motor
- Topic 6: Armature Reaction
- Topic 7: DC Motor Speed Control

## *Lesson 4.8 DC Motor Maintenance*

**Lesson description:**
This lesson discusses the inspection and maintenance practices associated with the performance of P&H DC Motors.

**Objectives:**
Upon completion of this lesson the student will:

- Understand the elements associated with Motor Peak Electrical Performance
- Be able to describe and identify Satisfactory and Unsatisfactory Commutator surface conditions
- Understand the steps necessary to maintain the proper Commutator surface conditions
- Understand the importance and steps required for inspection and maintain the Brushes and Brush Holders on P&H DC Electric Motors
- Understand the steps required for replacing the Brushes on P&H DC Electric Motors
- Describe grease lubrication practice for P&H DC Electric Motors
- Identify the locations of lube points associated with P&H Electrical Motors
- Understand the lubrication requirements for replacement of P&H DC Electric Motors
- Understand the lubrication procedures for P&H DC Electric Motors during and after extended storage as well as for remanufactured motors
- Understand and describe the conditions associated with Insulation Failure
- Understand and be able to describe the steps required for performing Insulation Resistance Inspection for P&H DC Electric Motors
- Understand the conditions that cause detrimental conditions for P&H DC Electric Motors
- Be able to describe the inspection process for P&H DC Electric Motors first time use and after Start-Up

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Commutator Maintenance
- Topic 3: Brush Maintenance
- Topic 4: Lubrication Practices
- Topic 5: Insultation System
- Topic 6: Insulation Resistance Inspection
- Topic 7: Detrimental Conditions
- Topic 8: Motor Inspection

## *Lesson 4.9 Power Distribution – AC Shovels*

**Lesson description:**
This lesson provides maintenance personnel with the knowledge of High Voltage Distribution on P&H AC Mining Shovels.

**Objectives:**
Upon completion of this lesson the student will:

- Have a thorough understanding of the high voltage distribution of P&H AC Shovels
- Understand the purpose and function of the Tail Cable as well as identify the basic components
- Understand some basic safety principles associated with the handling of the Tail Cable
- Understand the purpose, function, and operation of the Air Disconnect Switch with Earthing, the Collector Ring Assembly, the Upper High Voltage Cabinet, the Main Transformer Contactor, the Key Interlock System, the Main Transformer, the Auxiliary Transformer, and the Lighting Transformer
- Identify the location and components of the Lower High Voltage Cabinet, the Collector Ring Assembly, the Upper High Voltage Cabinet, the Main Transformer, the Auxiliary Transformer, and the Lighting Transformer

**Lesson outline:**

- Introduction
- Topic 1: Tail Cable
- Topic 2: Air Disconnect Switch with Earthing
- Topic 3: Collector Ring Assembly
- Topic 4: High Voltage Cabinet
- Topic 5: Key Interlock System
- Topic 6: Main Transformer
- Topic 7: Auxiliary Transformer
- Topic 8: Lighting Transformer

## *Lesson 4.10 Protection Circuits – AC Shovels*

**Lesson description:**
This lesson provides maintenance personnel with the knowledge of Protection Circuits on P&H AC Shovels.

**Objectives:**
Upon completion of this lesson the student will:

- Have a thorough understanding of the purpose, location, and operation of the Main Transformer Thermal Overloads, or TTMT
- Have a thorough understanding of the purpose, location, and operation of the Instantaneous Overload Relay, or OTTM
- Have a thorough understanding of the purpose, location, and operation of the Ground Fault Relays, GFRM and GFRA
- Have a thorough understanding of the purpose, location, and operation of the Main Phase Sensing Relay, or PSR
- Have a thorough understanding of the purpose, location, and operation of the Undervoltage Monitor, or UVM
- Have a thorough understanding of the purpose, location, and operation of the E-Stop Safety Relay, or ESSR

**Lesson outline:**

- Introduction
- Topic 1: Main Transformer Thermal Overloads
- Topic 2: Instantaneous Overload Relay
- Topic 3: Ground Fault Relays
- Topic 4: Main Phase Sensing Relay
- Topic 5: Undervoltage Monitor
- Topic 6: E-Stop Safety Relay

## *Lesson 4.13 AC Motor Theory and Operation*

**Lesson description:**
This lesson provides information on the theory of operation and maintenance practices associated with P&H AC Motors.

**Objectives:**
Upon completion of this lesson the student will:

- Have a thorough understand of AC Motor theory as it related to Induction Motors
- Have a working vocabulary of the components associated with the AC Motors on P&H equipment
- Understand the proper maintenance practiced required to keep P&H AC Motors operation at optimal performance.

**Lesson outline:**

- Topic 1: AC Motor Theory
- Topic 2: Types of Motors
- Topic 3: AC Motor Maintenance

# Control System

## *Lesson 5.2 Remote IO*

**Lesson description:**
This lesson provides the electrical maintenance technician or end-user with the necessary knowledge and working skills to maintain the Remote I/O System used on the Centurion Control System.

**Objectives:**
Upon completion of this lesson the student will:

- Describe the purpose of the Remote I/O System
- Locate and identify the main components of the Remote I/O System
- Identify the function of each main component of the Remote I/O system
- Remove and replace the I/O devices
- Perform diagnostics of the Remote I/O System

**Lesson outline:**

- Topic 1: Theory of Operation
- Topic 2: Components
- Topic 3: Module Diagnostics
- Topic 4: Install and Remove

## *Lesson 5.3 Communication Devices*

**Lesson description:**
This lesson provides the electrical maintenance technician or end-user with the necessary knowledge and working skills to maintain the Communication Devices used in the Centurion Control System.

**Objectives:**
Upon completion of this lesson the student will:

- Know the purpose of the Communication Devices
- Locate and identify each Communication Device
- Identify/explain the function of each Communication Device

**Lesson outline:**

- Topic 1: Ethernet Electrical Lean Switch
- Topic 2: Profibus Optical Bus Terminal
- Topic 3: Profibus Resolver Interface Module
- Topic 4: Power Rain Booster
- Topic 5: DDCS Branching Unit

## *Centurion Control System*

**Lesson description:**
This lesson describes the purpose, component location, and operation of the Centurion Control System used on P&H AC Shovels.

**Objectives:**
Upon completion of this lesson the student will:

- Be able to locate the Control Cabinet on a typical Shovel Deck Plan
- Be able to locate the Drive Control Units within the Control Cabinet
- Be able to identify the connectors associated with the Drive Control Unit
- Understand the purpose, function, and operation of the Drive Control Unit
- Understand the Communication Protocols
- Be able to identify the Centurion Electrical Equipment

**Lesson outline:**

- Topic 1: Control System Overview
- Topic 2: Communication Protocols
- Topic 3: AC800
- Topic 4: Centurion Electrical Equipment

## *Siemens Remote IO*

**Lesson description:**
This lesson provides the electrical maintenance technician or end-user with the necessary knowledge and working skills of the Siemens Remote IO System used in the Centurion Control System.

**Objectives:**
Upon completion of this lesson the student will:

- Describe the purpose of the Siemens Remote IO System
- Locate and identify the main components of the Siemens Remote IO System
- Identify the function of each main component of the Siemens Remote IO System

**Lesson outline:**

- Topic 1: Siemens Remote IO Hardware

## Drive System

### *Lesson 6.3 DCS800*

**Lesson description:**
This lesson provides the maintenance technician or end-user with the necessary knowledge of the theory of operation of the DCS800 Digital Drive.

**Objectives:**
Upon completion of this lesson the student will:

- Explain the purpose of the DCS800
- Locate and identify the hardware components associated with the DCS800
- Identify and explain the function of each hardware component associated with the DCS800
- Identify and explain the DCS800 troubleshooting procedures and corrective actions

**Lesson outline:**

- Topic 1: Theory of Operation
- Topic 2: Hardware Overview
- Topic 3: Troubleshooting

### *ACS800*

**Lesson description:**
This lesson provides the electrical maintenance technician or end-user with the necessary knowledge and working skills to maintain the ACS800 used on Mining Shovels.

**Objectives:**
Upon completion of this lesson the student will:

- Understand and identify the major sections of the ACS800 BCU
- Understand and identify the major sections of the IGBT Supply Unit (ISU)
- Understand and identify the major sections of the Inverter (INV)

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: ACS800 RDCU
- Topic 3: IGBT Supply Unit (ISU)
- Topic 4: Inverter (INV)

### *ACS880*

**Lesson description:**
This lesson provides the electrical maintenance technician or end-user with the necessary knowledge and working skills to maintain the ACS880 used on Mining Shovels.

**Objectives:**
Upon completion of this lesson the student will:

- Understand and identify the major section of the ACS880 BCU
- Understand and identity the major sections of the IGBT Supply Unit (ISU)
- Understand and identify the major sections of the Inverter (INV)

**Lesson outline:**

- Topic 1: System Introduction
- Topic 2: ACS880 BCU
- Topic 3: IGBT Supply Unit (ISU)
- Topic 4: Inverter (INV)

# Miscellaneous Electrical Equipment

## *Lesson 8.1 UPS System*

**Lesson description:**
This tutorial provides the electrical maintenance technician or end-user with the necessary knowledge and working skills to understand the UPS System.

**Objectives:**
Upon completion of this lesson the student will:

- Describe the purpose of the UPS system
- Locate and identify the hardware components of the UPS system
- Identify and explain the function of each hardware component of the UPS system
- Identify and explain the procedures of the UPS system
- Distinguish/recognize the alarm signals and troubleshooting procedures of the UPS system

**Lesson outline:**

- Topic 1: General Information
- Topic 2: Settings and Procedures
- Topic 3: Troubleshooting

## *TripRite*

**Lesson description:**
This lesson provides the electrical maintenance technician or end-user with the necessary knowledge and working skills to understand the TripRite System.

**Objectives:**
Upon completion of this lesson the student will:

- Describe the basic Theory of Operation of the TripRite
- Locate and identify the hardware components of the TripRite
- Identify and explain the function of each hardware component of the TripRite
- Identify and explain the function of each software used on the TripRite

**Lesson outline:**

- Topic 1: Location
- Topic 2: System Overview

## HMI Devices

### *Lesson 9.5 Touch Screen System*

**Lesson description:**
This lesson provides the electrical maintenance technician or end-user with the necessary knowledge and working skills to understand the Touch Screen System.

**Objectives:**
Upon completion of this lesson the student will:

- Identify and explain the purpose of the Touch Screen System
- Locate and identify the hardware components of the Touch Screen System
- Identify and explain the function of each hardware component of the Touch Screen System
- Identify and explain the Touch Screen troubleshooting procedures and corrective actions.

**Lesson outline:**

- Topic 1: Theory of Operation
- Topic 2: Hardware Overview
- Topic 3: Procedures Overview
- Topic 4: Operation Screen Procedures
- Topic 5: Diagnostic Screen Procedures
- Topic 6: Setup Screen Procedures
- Topic 7: Activity Screen Procedures
- Topic 8: Help Screen Procedures
- Topic 9: Troubleshooting

# Mechanical eLearning Curriculums

**Below are pre-determined curriculums based on the different C-Series P&H Shovel models.**

***denotes machine class specific lessons***

## 4800XPC AC Mechanical

Product Introduction
- Lesson 3.1 Shovel Introduction

Disc Brakes
- Lesson 6.1 Introduction to Disc Brakes
- Lesson 6.2 Brake System Operation

Propel System
- Lesson 7.1 Propel System Description
- Lesson 7.2 Propel System Inspections
- Lesson 7.3 Crawler Adjustments**

Air Filtration
- Lesson 9.1 AirScrubPro**

Mine Air
- Lesson 10.1 Mine Air

Swing System
- Lesson 11.1 Swing System Description
- Lesson 11.2 Swing Roller Circle**
- Lesson 11.3 Center of Rotation**

Hoist System
- Lesson 12.1 Hoist System Description**
- Lesson 12.2 Hoist Gearcase**
- Lesson 12.3 Hoist Drum**
- Lesson 12.4 Hoist Ancillary Systems

Attachments
- Lesson 14.1 Attachments**

Crowd System
- Lesson 16.1 Crowd System Description**
- Lesson 16.3 Shipper Shaft and Saddle Blocks**

Air Compressors
- Lesson 17.1 Sullair with Supervisor II Control
- Lesson 17.2 Sullair with Q1 Controller

## 4100XPC AC or DC Mechanical

Product Introduction
- Lesson 3.1 Shovel Introduction

Disc Brakes
- Lesson 6.1 Introduction to Disc Brakes
- Lesson 6.2 Brake System Operation

Propel System
- Lesson 7.1 Propel System Description
- Lesson 7.2 Propel System Inspections
- Lesson 7.3 Crawler Adjustments**

Air Filtration
- Lesson 9.1 AirScrubPro**

Mine Air
- Lesson 10.1 Mine Air

Swing System
- Lesson 11.1 Swing System Description
- Lesson 11.2 Swing Roller Circle**
- Lesson 11.3 Center of Rotation**

Hoist System
- Lesson 12.1 Hoist System Description**
- Lesson 12.2 Hoist Gearcase**
- Lesson 12.3 Hoist Drum**
- Lesson 12.4 Hoist Ancillary Systems

Attachments
- Lesson 14.1 Attachments**

Crowd System
- Lesson 16.1 Crowd System Description**
- Lesson 16.2 Crowd Belt Assembly**
- Lesson 16.3 Shipper Shaft and Saddle Blocks**

Air Compressors
- Lesson 17.1 Sullair with Supervisor II Control
- Lesson 17.2 Sullair with Q1 Controller

## 4100C BOSS AC or DC Mechanical

- Product Introduction
  - Lesson 3.1 Shovel Introduction
- Disc Brakes
  - Lesson 6.1 Introduction to Disc Brakes
  - Lesson 6.2 Brake System Operation
- Propel System
  - Lesson 7.1 Propel System Description
  - Lesson 7.2 Propel System Inspections
  - Lesson 7.3 Crawler Adjustments**
- Air Filtration
  - Lesson 9.1 AirScrubPro**
- Mine Air
  - Lesson 10.1 Mine Air
- Swing System
  - Lesson 11.1 Swing System Description
  - Lesson 11.2 Swing Roller Circle**
  - Lesson 11.3 Center of Rotation**
- Hoist System
  - Lesson 12.1 Hoist System Description**
  - Lesson 12.2 Hoist Gearcase**
  - Lesson 12.3 Hoist Drum**
  - Lesson 12.4 Hoist Ancillary Systems
- Attachments
  - Lesson 14.1 Attachments**
- Crowd System
  - Lesson 16.1 Crowd System Description**
  - Lesson 16.2 Crowd Belt Assembly**
  - Lesson 16.3 Shipper Shaft and Saddle Blocks**
- Air Compressors
  - Lesson 17.1 Sullair with Supervisor II Control
  - Lesson 17.2 Sullair with Q1 Controller

## 4100C Mechanical

- Product Introduction
  - Lesson 3.1 Shovel Introduction
- Disc Brakes
  - Lesson 6.1 Introduction to Disc Brakes
  - Lesson 6.2 Brake System Operation
- Propel System
  - Lesson 7.1 Propel System Description
  - Lesson 7.2 Propel System Inspections
  - Lesson 7.3 Crawler Adjustments**
- Air Filtration
  - Lesson 9.1 AirScrubPro**
- Mine Air
  - Lesson 10.1 Mine Air
- Swing System
  - Lesson 11.1 Swing System Description
  - Lesson 11.2 Swing Roller Circle**
  - Lesson 11.3 Center of Rotation**
- Hoist System
  - Lesson 12.1 Hoist System Description**
  - Lesson 12.2 Hoist Gearcase**
  - Lesson 12.3 Hoist Drum**
  - Lesson 12.4 Hoist Ancillary Systems
- Attachments
  - Lesson 14.1 Attachments**
- Crowd System
  - Lesson 16.1 Crowd System Description**
  - Lesson 16.2 Crowd Belt Assembly**
  - Lesson 16.3 Shipper Shaft and Saddle Blocks**
- Air Compressors
  - Lesson 17.1 Sullair with Supervisor II Control
  - Lesson 17.2 Sullair with Q1 Controller

## 2800XPC AC or DC Mechanical

- Product Introduction
  - Lesson 3.1 Shovel Introduction
- Disc Brakes
  - Lesson 6.1 Introduction to Disc Brakes
  - Lesson 6.2 Brake System Operation
- Propel System
  - Lesson 7.1 Propel System Description
  - Lesson 7.2 Propel System Inspections
  - Lesson 7.3 Crawler Adjustments**
- Air Filtration
  - Lesson 9.1 AirScrubPro**
- Mine Air
  - Lesson 10.1 Mine Air
- Swing System
  - Lesson 11.1 Swing System Description
  - Lesson 11.2 Swing Roller Circle**
  - Lesson 11.3 Center of Rotation**
- Hoist System
  - Lesson 12.1 Hoist System Description**
  - Lesson 12.2 Hoist Gearcase**
  - Lesson 12.3 Hoist Drum**
  - Lesson 12.4 Hoist Ancillary Systems
- Attachments
  - Lesson 14.1 Attachments**
- Crowd System
  - Lesson 16.1 Crowd System Description**
  - Lesson 16.2 Crowd Belt Assembly**
  - Lesson 16.3 Shipper Shaft and Saddle Blocks**
- Air Compressors
  - Lesson 17.1 Sullair with Supervisor II Control
  - Lesson 17.2 Sullair with Q1 Controller

## 2300XPC Mechanical

- Product Introduction
  - Lesson 3.1 Shovel Introduction
- Disc Brakes
  - Lesson 6.1 Introduction to Disc Brakes
  - Lesson 6.2 Brake System Operation
- Propel System
  - Lesson 7.1 Propel System Description
  - Lesson 7.2 Propel System Inspections
  - Lesson 7.3 Crawler Adjustments**
- Air Filtration
  - Lesson 9.1 AirScrubPro**
- Mine Air
  - Lesson 10.1 Mine Air
- Swing System
  - Lesson 11.1 Swing System Description
- Hoist System
  - Lesson 12.4 Hoist Ancillary Systems
- Attachments
  - Lesson 14.1 Attachments
- Crowd System
  - Lesson 16.3 Shipper Shaft and Saddle Blocks**
- Air Compressors
  - Lesson 17.1 Sullair with Supervisor II Control
  - Lesson 17.2 Sullair with Q1 Controller

# Mechanical eLearning Lesson Descriptions

## Disc Brakes

### *Lesson 6.1 Introduction to Disc Brakes*

**Lesson description:**
This lesson describes the component functions and system operation of the disc brakes on P&H Mining Shovels.

**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 disc 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 assemble
- 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 6.2 Brake System Operation*

**Lesson description:**
This lesson provides information on the brake systems associated with the P&H 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 logical control system
- Identify and understand the function of the limit switches
- Describe the sequence of events that occurs as the brake releases and sets
- 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

# Propel System

## *Lesson 7.1 Propel System Description*

**Lesson description:**
This lesson provides a brief overview of the propel system components associated with P&H 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 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 Details

## *Lesson 7.2 Propel System Inspections*

**Lesson description:**
This lesson provides the information required to inspect the Propel and Crawler Systems of a Mining Shovel.

**Objectives:**
Upon completion of this lesson the student will:

- Be able to identify the major assemblies and components of the Propel and Crawler Systems
- Be able to describe the function of the major assemblies and components for the Propel and Crawler Systems
- Have a thorough understand of the inspection requires for the components of the Propel and Crawler Systems

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Propel System Components
- Topic 3: Crawler System Components

## *Lesson 7.3 Crawler Adjustments*

**Lesson description:**
This lesson provides the technician information on adjusting and maintaining the components of the crawler tracks.

**Objectives:**
Upon completion of this lesson the student will:

- Understand the importance of crawler track tension and how to determine if track tension is ideal, too tight, or too loose
- Have a thorough understanding of how to adjust the crawler track tension
- Have a thorough understanding of how to adjust the front idler shaft retainer collars

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Adjusting Crawler Track Tension
- Topic 3: Adjusting Front Idler Shaft Retainer Collars

## House Filtration

### *Lesson 9.1 AirScrubPro*

**Lesson description:**
This lesson provides the technician with information they need to understand the components of the AirScrubPro System, how they operate, and how they should be maintained.

**Objectives:**
Upon completion of this lesson the student will:

- Be able to identify the components of the AirScrubPro system and describe their function/purpose
- Have a thorough understanding of the theory of operation as it relates to the AirScrubPro System
- Have a thorough understanding of how to inspect the components of the AirScrubPro System
- Understand the steps required to adjust the air pressure regulator, replace the cartridge filters, and clearing objects within the screw conveyor

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Theory of Operation
- Topic 3: System Inspections
- Topic 4: System Adjustments

## Mine Air

### *Lesson 10.1 Mine Air*

**Lesson description:**
This lesson provides a general overview of the Mine Air System, its controllers, and maintenance required to keep the system operating efficiently.

**Objectives:**
Upon completion of this lesson the student will:

- Be able to identify the major components of the Mine Air System
- Have a basic understanding of the operation of the Mine Air System
- Be able to identify the SEC and MLC controllers, and their functions, associated with the Mine Air System
- Have a general understanding of the maintenance required to keep the Mine Air System operating efficiently

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Mine Air Controllers
- Topic 3: Maintenance

# Swing System

## *Lesson 11.1 Swing System Description*

**Lesson description:**
This lesson provides technicians with an introduction to the Swing System components.

**Objectives:**
Upon completion of this lesson the student will:

- Be able to identify and locate all major components of the Swing System
- Have a thorough understanding of the purpose of the components used in the Swing System

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Component Identification

## *Lesson 11.2 Swing Roller Circle*

**Lesson description:**
This lesson provides the technician information on inspecting and maintaining the components of the Swing Roller Circle.

**Objectives:**
Upon completion of this lesson the student will:

- Have a thorough understanding of how to inspect the components and assemblies of the Swing Roller Circle
- Have a thorough understanding of the procedures required to repair the upper and lower roller paths
- Have a thorough understanding of the procedures required to repair gaps between the swing ring gear and carbody

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Inspecting the Roller Paths
- Topic 3: Inspecting the Ring Gear
- Topic 4: Inspecting all other Roller Circle Components
- Topic 5: Repairing the Upper Roller Path
- Topic 6: Repairing the Lower Roller Path
- Topic 7: Repair Caps between the Ring Gear and Carbody

### *Lesson 11.3 Center of Rotation*

**Lesson description:**
This lesson provides the technician information on inspecting and maintaining the components of the center gudgeon.

**Objectives:**
Upon completion of this lesson the student will:

- Have a thorough understanding of how to inspect the components associated with the center gudgeon and be instructed on when the center gudgeon adjusting nut needs to be adjusted
- Have a thorough understanding of the procedures required to adjust the center gudgeon adjusting nut
- Understand when the spherical washer and thrust washer on the center gudgeon needs to be replaced
- Have a thorough understanding of the steps required to replace the spherical washer and thrust washer on the center gudgeon

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Inspecting the Center Gudgeon
- Topic 3: Adjusting the Center Gudgeon Adjusting Nut
- Topic 4: Spherical and the Thrust Washer Replacement

## Hoist System

### *Lesson 12.1 Swing System Description*

**Lesson description:**
This lesson provides technicians with an introduction to the Hoist System components.

**Objectives:**
Upon completion of this lesson the student will:

- Be able to identify and locate all major components of the Hoist System
- Have a thorough understanding of the purpose of the components used in the Hoist System

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Component Identification

## *Lesson 12.2 Hoist Gear Case*

**Lesson description:**
This lesson provides the technician information on inspecting and maintaining the components of the Hoist Gear Case.

**Objectives:**
Upon completion of this lesson the student will:

- Be able to identify all the components of the Hoist Hear Case and describe their function/purpose in the system
- Have a thorough understanding of how to inspect the components and assemblies of the Hoist Gear Case
- Have a thorough understanding of the procedure required to adjust the Hoist Gear Case supports

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Hoist Gear Case Inspection
- Topic 3: Adjusting the Hoist Gear Case Support

## *Lesson 12.3 Hoist Drum*

**Lesson description:**
This lesson provides the technician information on inspecting and maintaining the components of the Hoist Drum.

**Objectives:**
Upon completion of this lesson the student will:

- Be able to identify all the components of the hoist drum and describe their function/purpose in the system
- Have a thorough understanding of how to inspect the components and assemblies of the Hoist Drum
- Have a thorough understanding of the procedure required to engage/disengage the hoist drum locking bar
- Have a basic understanding of the components of the hoist slack rope detector and their purpose in the hoist system

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Inspecting the Hoist Drum
- Topic 3: Hoist Drum Locking System
- Topic 4: Hoist Slack Rope Detector

## *Lesson 12.4 Hoist Ancillary System*

**Lesson description:**
This lesson provides the information a technician requires to utilize and maintain the remote hoist controller and cable tuggers.

**Objectives:**
Upon completion of this lesson the student will:

- Have a thorough understanding of how to utilize and maintain the remote hoist controller and the cable tuggers

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Remote Hoist Controller
- Topic 3: Cable Tugger Operation

# Attachments

## *Lesson 14.1 Attachments*

**Lesson description:**
This lesson provides maintenance personnel the information their require inspecting and maintain the attachments associated with the boom assembly.

**Objectives:**
Upon completion of this lesson the student will:

- Be able to identify and describe the attachment components associated with the boom assembly
- Have a thorough understanding of the inspection process required for the boom and gantry
- Have a thorough understanding of the inspection process required for the boom point assembly and boom limit resolver
- Have a thorough understanding of the inspection process required for the hoist rope guides

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Boom Assembly
- Topic 3: Gantry
- Topic 4: Boom Point Assembly
- Topic 5: Boom Limit Resolver
- Topic 6: Hoist Rope Guides

# Crowd System

## *Lesson 16.1 Crowd System Description*

**Lesson description:**
This lesson provides technicians with an introduction to the Crowd System components.

**Objectives:**
Upon completion of this lesson the student will:

- Be able to identify and locate all major components of the Crowd System
- Have a thorough understanding of the purpose of the components used in the Crowd System

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Component Identification

## *Lesson 16.2 Crowd Belt Assembly*

**Lesson description:**
This lesson provides the technician information on inspecting and maintaining the components of the crowd belt assembly.

**Objectives:**
Upon completion of this lesson the student will:

- Be able to identify all the components of the crowd belt assembly and describe their function/purpose in the system
- Have a thorough understanding of how to inspect the components of the crowd belt assembly
- Have a thorough understanding of the procedure required to adjust the crowd belt assembly

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Inspecting the Crowd Belt Assembly
- Topic 3: Hydraulic Hand Pump
- Topic 4: Re-tensioning the Crowd Belt

## *Lesson 16.3 Shipper Shaft and Saddle Block*

**Lesson description:**
This lesson will teach you how to perform the shipper shaft axial clearance and saddle block upper and lower wear plate adjustments.

**Objectives:**
Upon completion of this lesson the student will:

- Be able to identify all the components of the shipper shaft assembly and saddle block assembly
- Understand what inspection criteria is required when performing the prescribe inspections
- 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 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

# Air Compressors

## *Lesson 17.1 Sullair with Supervisor II Control*

**Lesson description:**
This lesson provides the technician information on using and maintaining the Sullair Air Compressor with Supervisor II Controller.

**Objectives:**
Upon completion of this lesson the student will:

- Be able to identify the components of the Sullair Air Compressor
- Have a thorough understanding of the operation of the Sullair Air Compressor
- Understand the buttons, lamps, and display features of the Supervisor II Controller associated with the Sullair Air Compressor
- Understand the procedures required for the fluid filter replacement, the air/fluid separator replacement, and inlet control valve maintenance.

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Theory of Operation
- Topic 3: Supervisor II Controller
- Topic 4: Maintenance

## *Lesson 17.2 Sullair with Q1 Control*

**Lesson description:**
This lesson provides the technician information on using and maintaining the Sullair Air Compressor with Q1 Controller

**Objectives:**
Upon completion of this lesson the student will:

- Be able to identify all the components of the Sullair Air Compressor
- Have a thorough understanding of the operator of the Sullair Air Compressor
- Understand the buttons, lamps, and display features of Q1 Controller associated with the Sullair Air Compressor
- Understand the procedures required for the fluid filter replacement, the air/fluid separator replacement, and inlet control valve maintenance.

**Lesson outline:**

- Topic 1: Introduction
- Topic 2: Theory of Operation
- Topic 3: Q1 Controller
- Topic 4: Maintenance

# Rope Shovel Instructor-Led Training Outlines

## Shovel Operator

### *Shovel Operator Training*

**Course Description:**
Operators will gain insight into the overall machine operation and learn required user maintenance areas. Initially a classroom presentation is conducted which is followed by hands-on training with the shovel in a production environment. Students will be given the opportunity to operate the shovel and practice the techniques covered in the classroom.

**Course Duration:**
40 Hours

**Target Audience:**
This training is targeted for personnel who operate P&H Mining Shovels for production.

**Prerequisites:**
Operators should have a basic knowledge of Mining Shovels.

**Course Location:**
Field

**Objectives:**
Upon completion of this lesson the student will:

- Make walk around safety inspections
- Identify the location of the controls and warning systems
- Understand the function of the controls and warning systems
- Perform minor mechanical repairs and adjustments
- Operate the shovel in a productive and safe manner to avoid damage to equipment and reduce overall operating cost

**Main Concepts:**

- Shovel Mechanical Overview
- Production Techniques
- Various Digging Techniques
- User Maintenance Areas
- Identifying Machine Problems
- Drives Windows Overview

**Course Outline:**

*Safety*

- Safety equipment
- Communications
- Pre-operational checks
- Inspection of operational area
- Job conditions
- Weather conditions
- Operation at night

*Operation*

- Communications
- Shovel swing radius
- Traffic patterns
- Clean up at the shovel
- Positioning of power cables
- Maintaining bench grades

*Feeding a Crusher*

- Communications
- Traffic patterns
- Inspection of working area
- Material selection

*Truck Operation*

- Communications
- Inspection of working area
- Condition of the digging area
- Blasting residue in the digging area
- Type of material being loaded
- Traffic patterns
- Truck positioning
- Uniform load
- Loading set-up

*Course Evaluation and Wrap Up*

- Q&A
- Course evaluation

# Electrical Systems

## *Electrical Systems (AC) - Field*

**Course Description:**
The student is introduced to the operation and maintenance of the P&H Mining Shovel. Furthermore, the course focuses on critical knowledge and skills required in supporting present day P&H Mining Shovels. Topics included are the Centurion AC Shovel Control System.

**Course Duration:**
Two Days

**Target Audience:**
Electricians, Technicians, and Engineers who service and maintain P&H Mining Shovels.

**Prerequisites:**
Students should have knowledge of power electronics and computers. It is suggested that students complete Power, Drive, and Control System eLearning training modules.

**Course Location:**
Field

**Objectives:**
Upon completion of this lesson the student will:

- Identify and explain the purpose of all the major components utilized
- Use application software and programs as required
- Remove and replace faulty components including a failure analysis
- Explain the inter-relationship of the shovel systems
- Analyze schematics and control diagrams utilized for troubleshooting and repair

**Main Concepts:**

- AC Drive Overview
- Drive PC Tool Overview
- AC800M (Advant Controller 800) Hardware Overview
- Control Builder Overview
- Auxiliary Systems Operation
- System Maintenance and Troubleshooting

**Course Outline:**

***Day 1***

*Course Introduction*
- Pre-assessment
- General safety
- ESD

*Electrical System Diagrams*
- Systems diagram overview
- Shovel schematics
- Use of the index
- Use of location codes
- Reading P&H Schematics
- *Schematic Exercises*

*Touch Panel & GUI Systems*
- Touch panel navigation
- Touch panel software tools and calibration
- *Touch Panel Navigation Lab*

*AC Power Systems*
*IGBT Devices (101)*
- Basic theory of operation
- Basic troubleshooting techniques

*IGBT Supply Unit (ISU)*
- Theory of operation
- Hardware overview
- Reduced run feature
- Fault tracing

*Inverter Unit (INV)*
- Theory of operation

*Auxiliary Control Unit (ACU)*
- Theory of operation
- Hardware overview

*Drive Control Unit (RDCU)*
- Theory of operation
- Hardware overview
- Software chains
- Group 19 data transfer
- *Student worksheets*

***Day 2***

*Advant Controller 800 and Remote I/O*
- Advant Controller Components
- Remote I/O Components
- Control builder overview
- Monitoring I/O Status
- *Student worksheets*

*Air System*
- Theory of operation
- Hardware overview
- Troubleshooting

*Brake System*
- Theory of operation
- Hardware overview
- Troubleshooting

*Automatic Lubrication System*
- Theory of operation
- Hardware overview
- Troubleshooting
- *Student worksheets*

*Hoist Lube Pump System*
- Theory of operation
- Hardware overview

*Rear House Blower System*
- Theory of operation
- Hardware overview

*Auto Crowd Belt Tensioning System (4100XPC)*
- Theory of operation

*Course Evaluation and Wrap Up*
- Post-assessment
- Course evaluation

## *Electrical Systems (AC) - Milwaukee*

**Course Description:**
The student is introduced to the operation and maintenance of the P&H Mining Shovel. Furthermore, the course focuses on critical knowledge and skills required in supporting present day P&H Mining Shovels. Topics included are the Centurion AC Shovel Control System. The concepts that are covered in the classroom are reinforced in a laboratory environment that allows the students to load, install, and configure application software.

**Course Duration:**
Three Days

**Target Audience:**
Electricians, Technicians, and Engineers who service and maintain P&H Mining Shovels.

**Prerequisites:**
Students should have knowledge of power electronics and computers. Students will be assigned Power and Control System eLearning training modules as part of course registration.

**Course Location:**
Milwaukee Training Facility

**Objectives:**
Upon completion of this lesson the student will:

- Identify and explain the purpose of all the major components utilized
- Use application software and programs as required
- Remove and replace faulty components including a failure analysis
- Explain the inter-relationship of the shovel systems
- Analyze schematics and control diagrams utilized for troubleshooting and repair

**Main Concepts:**

- AC Drive Overview
- Drive PC Tool Overview
- AC800M (Advant Controller 800) Hardware overview
- Control Builder Overview
- Auxiliary Systems Operation
- System Maintenance and Troubleshooting

**Course Outline:**

***Day 1***

*Course Introduction*
- Pre-assessment
- General safety
- ESD

*Electrical System Diagrams*
- Systems diagram overview
- Shovel schematics
- Use of the index
- Use of location codes
- Reading P&H Schematics
- *Schematic Exercises*

*Touch Panel & GUI Systems*
- Touch panel navigation
- Touch panel software tools and calibration
- *Touch Panel Navigation Lab*

*AC Power Systems*
*IGBT Devices (101)*
- Basic theory of operation
- Basic troubleshooting techniques

*IGBT Supply Unit (ISU)*
- Theory of operation
- Hardware overview
- Reduced run feature
- Fault tracing

*Inverter Unit (INV)*
- Theory of operation

*Auxiliary Control Unit (ACU)*
- Theory of operation
- Hardware overview

***Day 2***

*Drive Control Unit (RDCU)*
- Theory of operation
- Hardware overview

*Drive PC Tool Software*
- Drives Windows overview
- ID RUN overview
- *Student lab activities*

*Advant Controller 800 and Remote I/O*
- Advant Controller Components
- Remote I/O Components
- Control builder overview
- Monitoring I/O Status
- *Student lab activities*

*Air System*
- Theory of operation
- Hardware overview
- Troubleshooting
- *Student lab activities*

*Brake System*
- Theory of operation
- Hardware overview
- Troubleshooting

*Automatic Lubrication System*
- Theory of operation
- Hardware overview
- Troubleshooting
- *Student lab activities*

*Hoist Lube Pump System*
- Theory of operation
- Hardware overview

***Day 3***

*Rear House Blower System*
- Theory of operation
- Hardware overview

*Auto Crowd Belt Tensioning System (4100XPC)*
- Theory of operation
- Hardware overview
- Troubleshooting

*Student Lab Activities*
- *AC800 Procedures*
- Drive Procedures
- Install I/O stations
- Verify connectivity
- Test Inputs
- Test Outputs
- I/O system troubleshooting

*Shop Tour*

*Course Evaluation and Wrap Up*
- Post-assessment
- Course evaluation

## *Electrical Systems (DC) - Field*

**Course Description:**
The student is introduced to the operation and maintenance of the P&H Mining Shovel. Furthermore, the course focuses on critical knowledge and skills required in supporting present day P&H Mining Shovels. Topics included are the Centurion DC Shovel Control System.

**Course Duration:**
Two days

**Target Audience:**
Electricians, Technicians, and Engineers who service and maintain P&H Mining Shovels.

**Prerequisites:**
Students should have knowledge of power electronics and computers. It is suggested that students complete Power, Drive, and Control System eLearning training modules.

**Course Location:**
Field

**Objectives:**
Upon completion of this lesson the student will:

- Identify and explain the purpose of all the major components utilized
- Use application software and programs as required
- Remove and replace faulty components including a failure analysis
- Explain the inter-relationship of the shovel systems
- Analyze schematics and control diagrams utilized for troubleshooting and repair

**Main Concepts:**

- DC Drive Overview
- Drive PC Tool Overview
- AC800M (Advant Controller 800) Hardware overview
- Control Builder Overview
- Auxiliary Systems Operation
- System Maintenance and Troubleshooting

**Course Outline:**

***Day 1***

*Course Introduction*

- Pre-assessment
- General safety
- ESD

*Electrical System Diagrams*

- Systems diagram overview
- Shovel schematics
- Use of the index
- Use of location codes
- Reading P&H Schematics
- *Schematic Exercises*

*DC Motors*

- Theory of operation
- P&H Motor Types
- Maintenance inspections/procedures

*DC Power Systems*

*SCR (101)*

- Basic theory of operation
- Basic troubleshooting techniques

*P&H Converter Configuration*

- Theory of operation
- Hardware overview
- SCR Troubleshooting 101

*Diverter Circuit*

- Theory of operation
- Hardware Overview
- Basic troubleshooting
- *Student worksheets*

*RPC*

- Theory of operation
- Hardware overview
- *Student worksheets*

***Day 2***

*Drive System (DCS800 or DCS600)*

- Theory of operation
- Hardware overview
- Student worksheets
- Drive Windows procedure

*Advant Controller 800 and Remote I/O*

- Advant Controller Components
- Remote I/O Components
- Control builder overview
- Monitoring I/O Status
- *Student Lab Activities*
- Controller loading procedures
- I/O System troubleshooting

*Air System*

- Theory of operation
- Hardware overview
- Troubleshooting
- *Student worksheets*

*Brake System*

- Theory of operation
- Hardware overview
- Troubleshooting

*Automatic Lubrication System*

- Theory of operation
- Hardware overview
- Troubleshooting
- *Student worksheets*

*Touch Panel & GUI Systems*

- Touch panel navigation
- Touch panel software tools and calibration
- *Touch Panel Navigation Lab*

*Course Evaluation and Wrap Up*

- Post-assessment
- Course evaluation

## *Electrical Systems (DC) - Milwaukee*

**Course Description:**
The student is introduced to the operation and maintenance of the P&H Mining Shovel. Furthermore, the course focuses on critical knowledge and skills required in supporting present day P&H Mining Shovels. Topics included are the Centurion DC Shovel Control System. The concepts that are covered in the classroom are reinforced in a laboratory environment that allows the students to load, install, and configure application software.

**Course Duration:**
Three days

**Target Audience:**
Electricians, Technicians, and Engineers who service and maintain P&H Mining Shovels.

**Prerequisites:**
Students should have knowledge of power electronics and computers. Students will be assigned Power and Control System eLearning training modules as part of course registration.

**Course Location:**
Milwaukee Training Facility

**Objectives:**
Upon completion of this lesson the student will:

- Identify and explain the purpose of all the major components utilized
- Use application software and programs as required
- Remove and replace faulty components including a failure analysis
- Explain the inter-relationship of the shovel systems
- Analyze schematics and control diagrams utilized for troubleshooting and repair

**Main Concepts:**

- DC Drive Overview
- Drive PC Tool Overview
- AC800M (Advant Controller 800) Hardware overview
- Control Builder Overview
- Auxiliary Systems Operation
- System Maintenance and Troubleshooting

**Course Outline:**

***Day 1***

*Course Introduction*
- Pre-assessment
- General safety
- ESD

*Electrical System Diagrams*
- Systems diagram overview
- Shovel schematics
- Use of the index
- Use of location codes
- Reading P&H Schematics
- *Schematic Exercises*

*Touch Panel & GUI Systems*
- Touch panel navigation
- Touch panel software tools and calibration
- *Touch Panel Navigation Lab*

*DC Power Systems*
*SCR (101)*
- Basic theory of operation
- Basic troubleshooting techniques

*Converter Operation*
- Theory of operation
- Shovel Configuration
- Troubleshooting
- *Student lab activities*

*Diverter Operation*
- Theory of operation
- Shovel Configuration
- Troubleshooting
- *Student lab activities*

*RPC Operation*
- Theory of operation
- Program Configuration
- Troubleshooting
- *Student lab activities*

***Day 2***

*Drive System Hardware Overview*
- DCS600 Circuit board operation

  **OR**
- DCS800 Circuit board Operation

*Drive PC Tool Software*
- Drives Windows Overview
- *Student lab activities*

*Advant Controller 800 and Remote I/O*
- Advant Controller Components
- Remote I/O Components
- Control builder overview
- Monitoring I/O Status
- *Student lab activities*

*Air System*
- Theory of operation
- Hardware overview
- Troubleshooting
- *Student lab activities*

*Brake System*
- Theory of operation
- Hardware overview
- Troubleshooting

*Automatic Lubrication System*
- Theory of operation
- Hardware overview
- Troubleshooting
- *Student lab activities*

***Day 3***

*Auto Crowd Belt Tensioning System (4100XPC)*
- Theory of operation
- Hardware overview
- Troubleshooting

*Student Lab Activities*
- *AC800 Procedures*
- Drive Procedures
- Install I/O stations
- Verify connectivity
- Test Inputs
- Test Outputs
- I/O system troubleshooting

*Shop Tour*

*Course Evaluation and Wrap Up*
- Post-assessment
- Course evaluation

# Mechanical Systems

## *Mechanical Systems - Field*

**Course Description:**
The course introduces the student to the operation and maintenance of P&H Mining Shovels. The course focuses on critical knowledge and skills required in supporting P&H Mining Shovels. All mechanical systems and adjustments are discussed. Recommended preventive and corrective maintenance procedures and practices are also discussed.

**Course Duration:**
Two days

**Target Audience:**
This training is targeted for Mechanical Maintenance and Supervisory personnel responsible for preventive and corrective maintenance and servicing of P&H Mining Shovels.

**Prerequisites:**
Students should have a basic knowledge of mechanical terminology and practical experience with maintenance equipment.

It is also suggested that students complete the following eLearning training modules: Product Overview, Disc Brakes, Theory of Operation of the Propel, Swing, Hoist, and Crowd Systems, and Compressed Air.

**Course Location:**
Field

**Objectives:**
Upon completion of this lesson the student will:

- Locate and identify major mechanical systems, subsystems, and components
- Identify and use available reference material to operate or maintain the shovel
- Understand the design and function of various Shovel Mechanical Systems
- Conduct preventive maintenance inspections
- Perform maintenance adjustments and repairs
- Recognize safety hazards associated with inspection, repair, and maintenance of shovel mechanical systems

**Main Concepts:**

- Review of relevant reference material
- Shovel motions and major components
- Lower machine structure and Propel System
- Revolving Frame and Swing System
- Hoist System
- Boom Assembly and Crowd System
- Machinery House and Ventilation System
- Compressed Air System
- Brake System
- Automatic Lubrication System
- Inspections, tests, and adjustments of major Mechanical Systems
- Preventive and corrective maintenance procedures

**Course Outline:**

***Day 1***

*Source Information*
- Mechanical Maintenance Manual
- LinkOne Parts Book
- Service Bulletins and Service Notices

*Shovel Orientation and Introduction*
- Shovel Orientation
- Mechanical and Structural Overview

*Safety Overview*
- Electrical and Mechanical Hazards
- Stored Mechanical Energy

*General Assembly Procedures*
- Bolt Torqueing Principles and Practices
- Bolt Tensioning
- “SuperNuts”
- Bearing Types and Adjustment

*Shovel System: Propel*
- Lower Structure and Lower Works
- Propel System Overview
- DELTA Drive System
- Crawler Track Tension Adjustment

*Shovel System: Machinery House*
- House Ventilation and Pressurization
- AirScrubPro

*Shovel System: Swing*
- Swing System Overview
- Center Gudgeon Nut Adjustment

***Day 2***

*Shovel System: Hoist*
- Hoist System Overview

*Shovel Structures: Attachment*
- Booms, Handles and ABSS

*Shovel System: Dippers*
- Dipper Wear Components
- Dipper Trip Mechanism
- “SnubRite” Snubbers
- Pitch Braces

*Shovel System: Crowd*
- Crowd System Overview
- Crowd Belt Replacement and Tensioning
- Shipper Shaft and Saddle Block Adjustments

*Shovel System: Compressed Air System*
- Air System Overview
- Air Compressor
- Air System Control
- Brake Air System
- Lube Air System

*Shovel System: Disc Brakes*
- Operation and Components Overview
- Disc Brake Safety
- Disc Brake Maintenance

*Shovel System: Lubrication System*
- Types of Lubricants
- Motor and Gearcase Lubrication
- Automatic Lubrication System Overview

*Course Evaluation and Wrap Up*
- Q&A
- Course evaluation

## *Mechanical Systems - Milwaukee*

**Course Description:**
The course introduces the student to the operation and maintenance of P&H Mining Shovels. The course focuses on critical knowledge and skills required in supporting P&H Mining Shovels. All mechanical systems and adjustments are discussed. Recommended preventive and corrective maintenance procedures and practices are also discussed.

**Course Duration:**
Three Days

**Target Audience:**
This training is targeted for Mechanical Maintenance and Supervisory personnel responsible for preventive and corrective maintenance and servicing of P&H Mining Shovels.

**Prerequisites:**
Students should have a basic knowledge of mechanical terminology and practical experience with maintenance equipment.

It is also suggested that students complete the following eLearning training modules: Product Overview, Disc Brakes, Theory of Operation of the Propel, Swing, Hoist, and Crowd Systems, and Compressed Air.

**Course Location:**
Milwaukee Training Facility

**Objectives:**
Upon completion of this lesson the student will:

- Locate and identify major mechanical systems, subsystems, and components
- Identify and use available reference material to operate or maintain the shovel
- Understand the design and function of various Shovel Mechanical Systems
- Conduct preventive maintenance inspections
- Perform maintenance adjustments and repairs
- Recognize safety hazards associated with inspection, repair, and maintenance of shovel mechanical systems

**Main Concepts:**

- Review of relevant reference material
- Shovel motions and major components
- Lower machine structure and Propel System
- Revolving Frame and Swing System
- Hoist System
- Boom Assembly and Crowd System
- Machinery House and Ventilation System
- Compressed Air System
- Brake System
- Automatic Lubrication System
- Inspections, tests, and adjustments of major Mechanical Systems
- Preventive and corrective maintenance procedures

**Course Outline:**

*Source Information*
- Mechanical Maintenance Manual
- LinkOne Parts Book
- Service Bulletins and Service Notices

*Shovel Orientation and Introduction*
- Shovel Orientation
- Mechanical and Structural Overview

*Safety Overview*
- Electrical and Mechanical Hazards
- Stored Mechanical Energy

*General Assembly Procedures*
- Bolt Torqueing Principles and Practices
- Bolt Tensioning
- “SuperNuts”
- Bearing Types and Adjustment

*Shovel System: Propel*
- Lower Structure and Lower Works
- Propel System Overview
- DELTA Drive System
- Crawler Track Tension Adjustment

*Shovel System: Machinery House*
- House Ventilation and Pressurization
- AirScrubPro

*Shovel System: Swing*
- Swing System Overview
- Center Gudgeon Nut Adjustment

*Shovel System: Hoist*
- Hoist System Overview

*Shovel Structures: Attachment*
- Booms, Handles and ABSS

*Shovel System: Dippers*
- Dipper Wear Components
- Dipper Trip Mechanism
- “SnubRite” Snubbers
- Pitch Braces

*Shovel System: Crowd*
- Crowd System Overview
- Crowd Belt Replacement and Tensioning
- Shipper Shaft and Saddle Block Adjustments

*Shovel System: Compressed Air System*
- Air System Overview
- Air Compressor
- Air System Control
- Brake Air System
- Lube Air System

*Shovel System: Disc Brakes*
- Operation and Components Overview
- Disc Brake Safety
- Disc Brake Maintenance

*Shovel System: Lubrication System*
- Types of Lubricants
- Motor and Gearcase Lubrication
- Automatic Lubrication System Overview

*Course Evaluation and Wrap Up*
- Q&A
- Course evaluation