

Penn Foster's Millwright Apprenticeship program

Course Title	Course Number	PF Price	Course Duration
<u>Year 1:</u>			
Basic Industrial Math	Block X21	\$450.00	30 hours
Addition and Subtraction	186008	(\$75.00)	(5 hours)
Multiplication and Division	186009	(\$75.00)	(5 hours)
Fractions, Percents, Proportions, and Angles	186010	(\$75.00)	(5 hours)
Metric System	186011	(\$75.00)	(5 hours)
Formulas	186012	(\$75.00)	(5 hours)
Introduction to Algebra	186013	(\$75.00)	(5 hours)
Practical Measurements	Block X22	\$325.00	25 hours
Linear and Distance Measurement	186021	(\$75.00)	(5 hours)
Bulk Measurement	186022	(\$75.00)	(5 hours)
Temperature Measurement	186023	(\$75.00)	(5 hours)
Energy, Force, and Power	186024	(\$75.00)	(5 hours)
Fluid Measurement	186025	(\$75.00)	(5 hours)
Trades Safety: Getting Started	186001	\$75.00	5 hours
Working Safely with Chemicals	186002	\$75.00	5 hours
Fire Safety	186003	\$75.00	5 hours
Material Handling Safety	186006	\$75.00	5 hours
Electrical Safety for the Trades	186005	\$75.00	5 hours
Jobs, Companies, and the Economy: Basic Concepts for Employees	186034	\$75.00	5 hours
Quality Concepts: Tools and Applications	186036	\$75.00	5 hours
Manufacturing Processes, Part 1	186075	\$75.00	10 hours
Manufacturing Processes, Part 2	186076	\$75.00	10 hours
Manufacturing Processes, Part 3	186077	\$75.00	10 hours
Manufacturing Processes, Part 4	186078	\$75.00	10 hours
Reading Shop Prints, Parts 1 & 2	386043, 386044	\$150.00	20 hours
Common Hand Tools, Part 1	186052	\$75.00	5 hours
Common Hand Tools, Part 2	186053	\$75.00	5 hours
Precision Measuring Instruments, Part 1	186068	\$75.00	10 hours
Electric Drilling and Grinding Tools	186054	\$75.00	5 hours
Power Cutting Tools	186055	\$75.00	5 hours
Pneumatic Hand Tools	186056	\$75.00	5 hours
Electricians' Tools	006026	\$75.00	10 hours
Tool Grinding and Sharpening	186057	\$75.00	5 hours
Woodworking Hand Tools	186058	\$75.00	5 hours
Routers, Power Planers, and Sanders	186059	\$75.00	5 hours
Jacks, Hoists, and Pullers	186060	\$75.00	5 hours
<u>Year 2:</u>			
Preventive Maintenance	286085	\$75.00	5 hours
Preventive Maintenance Techniques	286086	\$75.00	5 hours
Basic Machining Skills	Block X08	\$1,050.00	56 hours
Practical Shop Math, Part 1	X0801	(\$75.00)	(4 hours)
Practical Shop Math, Part 2	X0802	(\$75.00)	(4 hours)
Practical Shop Measurement	X0803	(\$75.00)	(4 hours)
Safe Shop Practices	X0804	(\$75.00)	(4 hours)
Properties and Classifications of Metals	X0805	(\$75.00)	(4 hours)
Progress Examination	X0821	(\$0.00)	(0 hour)
Using Shop Drawings, Process, and Routing			

Sheets, Part 1	X0806	(\$75.00)	(4 hours)
Using Shop Drawings, Process, and Routing			
Sheets, Part 2	X0807	(\$75.00)	(4 hours)
Layout	X0808	(\$75.00)	(4 hours)
Progress Examination	X0822	(\$0.00)	(0 hour)
Metal Cutting and Machine Tooling, Part 1	X0809	(\$75.00)	(4 hours)
Metal Cutting and Machine Tooling, Part 2	X0810	(\$75.00)	(4 hours)
Metal Cutting Machinery, Part 1	X0811	(\$75.00)	(4 hours)
Metal Cutting Machinery, Part 2	X0812	(\$75.00)	(4 hours)
Fundamentals of Grinding	X0813	(\$75.00)	(4 hours)
CNC Machine Tool Features and Applications	X0814	(\$75.00)	(4 hours)
Progress Examination	X0823	(\$0.00)	(0 hour)
Progress Examination Booklet	X0820	(\$0.00)	(0 hour)
Machine Shop Safety	186007	\$75.00	5 hours
Fasteners	286095	\$75.00	10 hours
Bearings and Seals, Part 1	286093	\$75.00	10 hours
Bearings and Seals, Part 2	286094	\$75.00	10 hours
Lubrication, Part 1	286091	\$75.00	10 hours
Lubrication, Part 2	286092	\$75.00	10 hours
Layout	3501	\$75.00	10 hours
Drilling, Parts 1 & 2	386050, 386051	\$150.00	20 hours
Materials Handling	2512	\$75.00	10 hours
Sheet Metal Technology (replaces 6712 & 6716)	386E05	\$325.00	25 hours
Machine Sketching	5807	\$75.00	10 hours

Year 3:

Principles of Mechanics, Part 1	286007	\$75.00	10 hours
Principles of Mechanics, Part 2	286008	\$75.00	10 hours
Mechanical Power Trans. Pts 1, 2 & 3	286101, -102, -103	\$225.00	30 hours
Belt Power Transmission	2607A-B	\$150.00	20 hours
Hydraulic Power Basics	286060	\$75.00	10 hours
Hydraulic Components: Actuators, Pumps, and Motors	286061	\$75.00	10 hours
Hydraulic Components: Conductors, Conditioners, and Fluids	286062	\$75.00	10 hours
Hydraulic Power System Control	286063	\$75.00	10 hours
Interpreting Hydraulic System Schematics	286064	\$75.00	10 hours
Hydraulic Power System Troubleshooting	286065	\$75.00	10 hours
Pumps, Part 1	286001	\$75.00	10 hours
Pumps, Part 2	286002	\$75.00	10 hours
Pumps, Part 3	286003	\$75.00	10 hours
Pneumatics	6623	\$75.00	10 hours
Pneumatic Instrumentation for the Technician	286M01	\$298.00	35 hours

Year 4:

Fundamental Principles of Rigging Technology	286016	\$75.00	10 hours
Planning the Rigging Operation	286017	\$75.00	10 hours
Working with Rigging Tools, Part 1	286018	\$75.00	10 hours
Working with Rigging Tools, Part 2	286019	\$75.00	10 hours
Rigging: Lifting Equipment & Applications, Part 1	286020	\$75.00	10 hours
Rigging: Lifting Equipment & Applications, Part 2	286021	\$75.00	10 hours
Air Compressors, Part 1	286096	\$75.00	10 hours
Air Compressors, Part 2	286097	\$75.00	10 hours
Fundamentals of Welding, Part 1	286025	\$75.00	10 hours
Fundamentals of Welding, Part 2	286066	\$75.00	10 hours
Safe Handling of Pressurized Gasses and Welding	186004	\$75.00	5 hours
Gas Welding Techniques	6276A-C	\$225.00	30 hours
Shielded Metal Arc Welding Techniques, Part 1	286030	\$75.00	10 hours
Shielded Metal Arc Welding Techniques, Part 2	286031	\$75.00	10 hours
Common Thermal Cutting Processes	286028	\$75.00	10 hours
Industrial Plumbing and Pipefitting	Block D20	\$600.00	40 hours

The Trades of Plumbing and Pipefitting	286040	(\$75.00)	(5 hours)
Pipes, Fittings, and Valves	286041	(\$75.00)	(5 hours)
Plumbing and Pipefitting Tools	286042	(\$75.00)	(5 hours)
Joining and Assembling Pipes	286043	(\$75.00)	(5 hours)
Supporting, Installing, and Testing Pipes	286044	(\$75.00)	(5 hours)
Plumbing Fixtures and Appliances	286045	(\$75.00)	(5 hours)
Tanks, Pumps, and Boilers	286046	(\$75.00)	(5 hours)
Insulation for Piping and Ducting	286047	(\$75.00)	(5 hours)
Predictive Maintenance	286087	\$75.00	5 hours
Predictive Maintenance: Vibration Analysis	286088	\$75.00	5 hours
Predictive Maintenance: Advanced Topics	286089	\$75.00	5 hours

Estimated Total Curriculum Duration: 841 hours

Number of Exams: 104

Cost: Year 1: \$ 2,625.00 (+ s/h); Year 2: \$2,350.00 (+ s/h); Year 3: \$1,573.00 (+ s/h); Year 4: \$2,100.00 (+ s/h)

*****SEE FULL COURSE DESCRIPTIONS BELOW**

Block X21

Basic Industrial Math

Duration:

30 hours (includes 6 tests)

What Students Learn:

This module of six study units offers the trainee arithmetic and basic mathematics, metric measurement, and calculator fundamentals. The Metric System is an introductory unit which includes metric conversions. Problem exercises and examples in this module are presented in on-the-job scenarios with applications drawn from the industrial context.

Special Notes:

This updated course replaces lessons contained within Practical Math and Measurements, Block X01. Each study unit contains a progress examination.

Components:

Addition and Subtraction (186008)

Multiplication and Division (186009)

Fractions, Percents, Proportions, and Angles (186010)

Metric System (186011)

Formulas (186012)

Introduction to Algebra (186013)

186008

Addition and Subtraction

Objectives:

- Define the terms: whole number, numeral, digit, decimal, place value, addend, sum, minuend, subtrahend, and difference.
- Explain the significance of the digit zero in a number.
- Differentiate between concrete and abstract numbers.
- Properly prepare numbers for addition and subtraction.
- Perform addition and subtraction on numbers.
- How to check your answers to both addition and subtraction problems.
- How to use a calculator to add and subtract numbers.

186009

Multiplication and Division

Objectives:

- Define the terms: factor, multiplicand, multiplier, partial product, dividend, divisor, quotient, and remainder.
- Recognize the various signs used for multiplication and division.
- Properly prepare numbers for multiplication and division.

- Perform multiplication and division on whole numbers and decimals.
- How to check your answers to both multiplication and division problems.
- How to find the average of a group of numbers.
- How to use a calculator to multiply and divide numbers.

186010

Fractions, Percents, Proportions, and Angles

Objectives:

- Define the terms: fraction, proper fraction, improper fraction, lowest common denominator, percent, ratio, and proportion.
- How to add, subtract, multiply, and divide fractions and decimals.
- How to change fractions to decimals and decimals to fractions.
- Solve problems involving percent.
- How to use a protractor to measure angles.
- Lay out templates for checking angles.
- How to use a calculator to solve percent problems and to convert fractions to decimals.

186011

Metric System

Objectives:

- Name the base units most commonly used in the metric system.
- Identify metric prefixes and their values.
- Apply conversion factors to increase or decrease metric base units.
- Estimate lengths in metric units.
- Express temperature in degrees Celsius.
- Define the terms: mass, density, force, torque, and pressure. Identify the metric units used to measure each one.
- How to use a calculator to convert one metric unit to another.

186012

Formulas

Objectives:

- Explain the use of letters in formulas.
- Prepare and use formulas to solve problems.
- The use of formulas to calculate the perimeter of a triangle and rectangle, distance, area of a triangle, rectangle, and circle, volume of a pyramid, current in a circuit, and volume of a sphere.

- How to use a calculator to find square root and solve formulas.
- Transform and solve an equation.
- Perform basic arithmetic operations with signed terms.
- Substitute given numerical values for letters in a formula and find the unknown quantity.

186013

Introduction to Algebra

Objectives:

- Define the terms: term, constant, coefficient, exponent, monomial, trinomial, and polynomial.
- Identify and combine like terms in an expression.
- Multiply and divide terms containing exponents.
- Remove parentheses from an expression and simplify the expression.
- Perform basic arithmetic operations with signed terms.

Block X22

Practical Measurements

Duration:

25 hours (includes 5 tests)

What Students Learn:

The five lessons in this block present the trainee with a broad overview of measurements found in an industrial setting. In addition to the basic measurements of length, temperature, energy, force, and power, the trainee will learn how materials are measured and handled in bulk quantities. Fluid measurements include the measuring of fluid flow, fluid pressure, and fluid level. All lessons include the metric conversions in addition to the English units.

Special Notes:

This updated course replaces the X0105 to X0109 lessons found in Practical Math and Measurements, Block X01. Each study unit contains a progress examination.

Components:

Linear and Distance Measurement (186021)
 Bulk Measurement (186022)
 Temperature Measurement (186023)
 Energy, Force, and Power (186024)
 Fluid Measurement (186025)

186021

Linear and Distance Measurement

Objectives:

- Recognize the difference between English and metric units of length.

- Find the perimeter of rectangular, square, or triangular areas or objects, such as rooms or machine bases, after measuring the sides.
- Calculate the circumference of circular objects like pipes of tanks after measuring the diameter.
- Measure lengths with the aid of rigid and flexible rules, thickness gauges and screw pitch gauges.
- Read a typical vernier scale and micrometer to take precise measurements.

186022

Bulk Measurement

Objectives:

- Measure an angle by degrees.
- Find the areas of rectangles, triangles, and circles.
- Find the volumes of prisms, cylinders, and cones.
- Find the weight of material stored in a container.
- Determine the amount of material that can be stored or handled.
- Discuss the types and uses of conveyors and weighing systems.

186023

Temperature Measurement

Objectives:

- Change temperature units from one system to another.
- Discuss the use of the various types of thermometers.
- Select the type of thermometer to be used at certain temperatures.

186024

Energy, Force, and Power

Objectives:

- Distinguish between the concepts of energy, force, and power.
- Explain what the term "work" means, and how it is measured.
- Know by sight the basic machines, lever, inclined plane, wedge, wheel and axle, and screw.
- Solve simple problems that involve levers, mechanical advantage, and machine efficiency.
- List the forms of energy that have important industrial applications, and the instruments used for measuring energy.

186025

Fluid Measurement

Objectives:

- Understand the properties of fluids.
- Determine the density, specific gravity, and viscosity of fluids.
- Express pressure in three different units.
- Measure the pressure of fluids using manometers and Bourdon tube pressure gauges.
- Measure the flow rate of fluids using different types of flowmeters.

186001

Trades Safety: Getting Started

Duration:

5 hours (includes 1 test)

What Students Learn:

Preview

A thorough knowledge of safe practices is an important part of working in any industrial setting. Every industrial worker should be familiar with accident prevention techniques, fire safety methods, and the use of personal protective equipment. Injuries in the workplace cost many millions of dollars in medical costs, lost wages, and production losses each year. Many injuries can be prevented by understanding how accidents and injuries can occur. This study unit is designed to help trainees understand why safety is so important, and to present students with information about safety that goes beyond common sense.

Objectives

When a student completes this study unit, he and she will be able to:

- Name the agencies that make and enforce safety regulations and explain an employee's responsibilities under those regulations.
- List the physical hazards associated with chemicals and describe how to avoid those hazards.
- Name several electrical shock hazards and the techniques used to prevent shocks.
- List the steps in a lock-out / tag-out procedure.
- Explain the importance of machine guarding and name several types of machine guards.
- Name the four classes of fire and how to extinguish each of them.
- Describe the proper technique used to lift a heavy load.
- Explain how to avoid hand injuries when using hand and power tools.
- List some of the hazards involved in welding and hot cutting operations and how to prevent them.
- Explain how job analysis and the science of ergonomics are used to improve the workplace.
- Explain the importance of personal protective equipment and name several types of PPE.

Contents

Introduction; Safety Regulations; Key safety Issues; Protecting Yourself and Your Co-workers.

186002

Working Safely with Chemicals

Duration:

5 hours (includes 1 test)

What Students Learn:

Preview

This study unit deals with the safe use of chemicals in the workplace. The two primary causes of chemical accidents are the misuse of chemicals and the improper disposal of chemical wastes. Understanding the hazards that chemicals can create is the first step in protecting people from harm.

The main goal of this study unit is to provide students with sound, practical knowledge about chemical use and disposal, both in the workplace and at home. You will learn how to recognize common chemical hazards and how to deal with them. Trainees will learn how to perform a job analysis to look for potential chemical dangers in your daily tasks. Finally, people will learn how to take precautions to avoid chemical accidents and make all jobs as safe as possible.

Objectives

When a student completes this study unit, he and she will be able to:

- Recognize the six different ways in which a chemical can cause physical injury.
- Name the routes or paths of entry by which chemicals can enter the body.
- Describe the types of injuries caused by chemicals.
- Identify potential chemical dangers in your workplace.
- Describe how to identify, store and label hazardous chemicals.
- List several methods used to prevent chemical accidents.
- Explain why proper training is important to chemical handling.
- Describe the types of personal protective equipment used and worn when handling chemicals.
- Explain the role of governmental agencies in enforcing chemical regulations.

Contents

Introduction; Living with Chemicals; Chemical Injuries; Accident Prevention; Handling Hazardous Wastes.

186003

Fire Safety

Duration:

5 hours (includes 1 test)

What Students Learn:

Preview

Fires are the most destructive and expensive of all accidents. However, fires can be effectively prevented through the combined use of technology and common sense. By understanding how fires get started and how to extinguish them, students will have much of the knowledge needed to protect people from fire. This study unit will introduce trainees to the information you need to practice fire safety and prevention in the workplace.

Objectives

When a student completes this study unit, he and she will be able to:

- Describe the types of property losses and injuries associated with fires.
- Explain how fires are ignited.
- Identify the four classes of fire.
- Describe the primary fire hazards found in the workplace.
- Explain the various ways in which fires can be prevented.
- Describe the operation of several different fixed fire protection systems.
- Identify the proper type of portable fire extinguisher to use on a fire.
- Describe the operation of several different types of fire extinguishers.
- Explain how to defend yourself and others in a fire situation.
- Describe how to safely evacuate a burning building.

Contents

Introduction to Fire; Fire Hazards in the Workplace; Preventing Fires; Fixed Fire Protection Equipment; Portable Fire Extinguishers; Fire Protection Techniques.

186006

Material Handling Safety

Duration:

5 hours (includes 1 test)

What Students Learn:

Preview

This study unit introduces the safe techniques and work practices commonly used when handling manufacturing and industrial materials. Trainees will learn the procedures necessary to avoid physical injury to yourself and those working with you, for both manual handling methods and mechanical handling methods. You will also learn procedures that minimize damage to the materials being moved and to facility property. Knowing the proper procedures will also give you the insight to decide when mechanical handling is necessary, or preferred, over traditional physical handling.

Objectives

When a student completes this study unit, he and she will be able to:

- Recognize the hazards associated with handling materials.

- Know the types of injuries that can be caused by these hazards.
- Understand how to effectively use safe material handling practices.
- Know how to avoid physical injury when handling loads.
- Know and follow the rules for safe operation of powered industrial material handling equipment.
- Understand and respect the limits and restrictions placed on powered material handling mechanisms.

Contents

Introduction to Material Handling; Housekeeping and Storage; Material Handling Equipment; Hoists and Cranes.

186005

Electrical Safety for the Trades

Duration:

5 hours (includes 1 test)

What Students Learn:

Preview

This study unit will introduce students to many workplace situations that require you to work safely with electricity. You will learn how and why electricity can be dangerous. Trainees will also learn about various methods used for protection. Safety begins with the careful installation of electrical components by means of approved wiring methods. You should use safety procedures and practices that insulate you from electricity's power anytime you work with, or near, electrical equipment and components.

Objectives

When a student completes this study unit, he and she will be able to:

- Explain how electricity can harm you and your property.
- Discuss the importance of properly using quality electrical components.
- Follow the basic methods of protection when wiring electrical installations.
- Tell why it is important to ground electrical equipment and systems.
- Select the type of electrical equipment to use in a hazardous location.
- List the safety practices required in an electrical work area.
- Talk about the importance of a clear working space around electrical equipment.
- Educate your own level of safety training to be sure it matches the electrical work you are performing.

Contents

Introduction to Electrical Safety; Using Proper Materials and Components; Equipment Grounding; Hazardous Locations; Safe Working Clearances; Safety Practices.

186034

Jobs, Companies, and the Economy: Basic Concepts for Employees

Duration:

5 hours (includes 1 test)

What Students Learn:

- Recognition of how the economy affects the actions of companies, employees, consumers, and investors.
- The concept of capitalism and the principles of supply and demand.
- How government policies affect the amounts of saving, spending, and investing by companies and individuals.
- Understand economic measuring tools such as the inflation rate, the unemployment rate and Gross Domestic Product (GDP).
- How labor is divided into three employment sectors and how wages are set, including the influence of labor unions and the benefits of a multi-functional workforce.
- Recognition of how both the employee and the company must compete in an increasingly international marketplace.

Special Notes:

This updated course replaces How Our Economic System Works, study unit 6606, and Economics Today, study unit 186034.

186036

Quality Concepts: Tools and Applications

Duration:

5 hours (includes 1 test)

What Students Learn:

- Describe how job roles change as a company evolves in its quality consciousness.
- Explain several ways in which you can support TQM.
- Identify approaches, practices and skills associated with positive organizational change.
- Differentiate between the "change process" at the company level and the manufacturing processes that require improvement.
- Describe major causes of process variation and give examples of how they may affect you in your job.
- Explain why and how the reduction of variability is a key factor in process improvement.
- Describe why and how quality and process improvement depend on data-driven decision making.
- Identify seven quality tools and explain their uses.

186075

Manufacturing Processes, Part 1

Duration: 10 hours (includes 1 test)

What Students Learn:

- Relate historical trends in manufacturing to modern ones
- Describe the development and importance of modern quality systems
- Explain how available material types shape manufacturing processes
- Describe early factory systems and their impact on modern systems
- Classify modern manufacturing systems by type and abilities This course replaces 2520A

186076

Manufacturing Processes, Part 2

Duration: 10 hours (includes 1 test) \

What Students Learn:

- Explain the relationship between atomic structure and material properties
- Classify materials used in manufacturing based on physical and mechanical properties
- Identify benefits and drawbacks of specific materials for a given application
- Interpret the classifications of various metallic materials
- Compare properties of various metallic materials
- Identify properties of and applications for various nonmetallic materials

NOTE: This course replaces 2520B

186077

Manufacturing Processes, Part 3

Duration: 10 hours (includes 1 test)

What Students Learn:

- Describe common methods and applications for casting metals and plastics
- Describe and contrast various forming processes including forging, drawing, and others
- Differentiate between the benefits and costs of casting and forming processes
- Explain how the various conventional metal-removal technologies are used in manufacturing
- Identify the benefits of and range of applications for robotics and CNC systems in manufacturing
- Describe the benefits and costs of non-contact metal removal and shaping processes

NOTE: This course replaces 2520C

186078

Manufacturing Processes, Part 4

Duration: 10 hours (includes 1 test)

What Students Learn:

- Relate the factors of production to how a given manufacturing organization is structured
- List the types of manufacturing production systems
- Suggest modifications of equipment layout to improve productivity
- Evaluating automation strategies and problems

- Benefits of quality management methods

- Describe their role in JIT, Lean, and e Manufacturing systems

NOTE: This course replaces 2520D

386043

Reading Shop Prints, Part 1

Duration: 10 hours (includes 1 test)

What Students Learn:

- Interpret working drawings
- Evaluate various systems of dimensions and tolerances
- Recognize symbols, notes, and specifications called out on detail and assembly prints
- Identify material requirements as specified on a print
- Evaluate a print to determine the proper procedure to make a simple part

Special Note:

- **This study unit takes the place of study unit 6720A.**

386044

Reading Shop Prints, Part 2

Duration: 10 hours (includes 1 test)

Course Prerequisite:

Reading Shop Prints, Part 1 (386043)

What Students Learn:

- Interpret more complex working drawings
- Define and use cam, gear, and thread terminology
- Interpret cam, gear, and thread specifications on shop prints
- Work with various sectioning techniques
- Read and interpret a bill of materials
- Evaluate more complex prints to determine the best order of machining

Special Note:

- **This study unit takes the place of study unit 6720B.**

186052

Common Hand Tools, Part 1

Duration:

5 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)

Practical Measurements (Block X22)

Trades Safety: Getting Started (186001)

What Students Learn:

Preview

In the first part of a student's introduction to hand tools, you'll learn about various types of tools as well as how to use them safely. You'll also learn how workpieces are held in place, the manner in which workpieces are marked prior to actually starting a given job, and how to make the most of a workbench's many useful features.

Next, students will be introduced to a group of hand tools which most technicians use on a daily basis -- wrenches, pliers, screwdrivers, and hammers. Again, you'll learn the correct ways to safely use and take care of these tools. Equally important, students will learn how not to use these tools and the results of their improper use.

Objectives

When a student completes this study unit, he and she will be able to:

- Identify common hand tools and their function.
- Explain how to safely use common hand tools.
- Maintain most types of hand tools.
- Describe the benefits of several special features available for some hand tools.

Contents

Working with Hand Tools; Wrenches; Pliers; Screwdrivers; Striking Tools; Tool Storage and Benchwork.

186053

Common Hand Tools, Part 2

Duration:

5 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)
Practical Measurements (Block X22)
Trades Safety: Getting Started (186001)

What Students Learn:

Preview

In this study unit, we'll continue the discussion of hand tools commonly used by technicians. While a broad range of technicians use many of the tools discussed here, such as chisels and punches, many others are more specialized and are commonly used by maintenance and machine trades technicians.

Students will learn how to choose the correct chisel or punch for the job, how to care for it, and use it safely.

Next, you'll learn about the variety of different cutting tools such as snips, knives, and hacksaws. Another important group of tools is shaping tools, such as files. Students will learn the different types of files, and again, how to care for them, and use them safely.

Also discussed in this unit are various specialized maintenance tools. These are tools used for specific types of maintenance jobs such as pulling or prying objects from machines, safely inspecting machines, and retrieving objects in areas that aren't easily accessible to the technician.

Objectives

When a student completes this study unit, he and she will be able to:

- Identify and use various chisels and punches safely.
- Use and care for cutting tools.
- Understand the need for specialized maintenance tools.
- Correctly use threading and other precision tools.

Contents

Struck Tools; Cutting Tools; Sheet Metal Tools; Shaping Hand Tools; Hand Tools for Threading and other Precision Work; Specialized Maintenance Hand Tools.

186068

Precision Measuring Instruments, Part 1

Duration:

10 hours (includes 1 test)

What Students Learn:

Purpose and Language of Measurement; Scale Instruments and Accessories; Vernier Caliper; Micrometers, Gages, and Protractors.

Special Notes:

- This updated course replaces course 3500A.
- The entire course consists of study units 186068, 186069, and 3500C.

186054

Electric Drilling and Grinding Tools

Duration:

5 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)
Practical Measurements (Block X22)
Trades Safety: Getting Started (186001)

What Students Learn:

Preview

The electric drill is one of the most widely used power tools. It has many uses and is simple to operate. Electric drills can be found in a variety of shapes and sizes, from a light household duty to the heavy-duty industrial grade hand drill and drill press. One variation of the electric drill is the hammer drill or rotary hammer. The hammer drill is a tool used for making holes in concrete and masonry.

Grinders are commonly used for shaping and finishing metal and other materials. Hand grinders are available in sizes ranging from those designed to do the intricate work of the die grinder to that of the 7-inch heavy-duty disc grinder. Bench grinders are standard equipment in most shops, ranging from a 6-inch bench model to the heavy-duty 12-inch pedestal grinder.

Objectives

When a student completes this study unit, he and she will be able to:

- Safely set up and operate a portable electric drill, electric drill press, and electric hammer.
- Choose the proper drill bit for many drilling applications.
- Set up and use a variety of hand and bench grinders.
- Safely use the proper grinder for various jobs.
- Follow the necessary steps for proper tool maintenance.
- Purchase the proper drilling tool for your application.

Contents

Electric Drills; Drill Presses; Drill Bits; Hammer Drills and Rotary Hammers; Electric Grinders; Abrasives.

186055

Power Cutting Tools

Duration:

5 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)
Practical Measurements (Block X22)
Trades Safety: Getting Started (186001)

What Students Learn:

Preview

Power cutting tools fall into two categories: portable and stationary. Portable and stationary cutting tools perform many similar operations, but portable tools, carried easily by hand, are used most often at the job site. Stationary tools are used in workshops and on plant tools. Stationary saws range in size from small shop jigsaws to huge band saws used in paper mills to saw large trees into lumber. This unit introduces students to the most common portable power saws used in construction and repair work, namely circular, saber, jig-, and reciprocating saws, and the stationary cutting tools found in most maintenance and fabrication shops.

Objectives

When a student completes this study unit, he and she will be able to:

- Identify the most common portable and stationary power saws.
- Identify the various parts of a saw and explain how they work.
- Discuss the types of cuts made by each type of saw.
- Choose the most appropriate saw and blade for the type of work being done.
- Recognize a portable circular saw, name its parts, and (with practice) operate it safely.
- Select and (with practice) use the proper saw; saber saw, portable band saw, reciprocating saw, cut-out saw, cut-off saw, for a given application.
- Operate (with practice) the stationary circular, radial, band and scroll saws safely.
- Observe the various safety precautions when using power saws and stationary power tools.

Contents

Power Saw Safety; Portable Power Saws; Stationary Circular Power Saws; Other Stationary Power Saws.

186056

Pneumatic Hand Tools

Duration:

5 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)
Practical Measurements (Block X22)
Trades Safety: Getting Started (186001)

What Students Learn:

Preview

Pneumatic tools are used in many areas of maintenance, construction, and production work. These tools harness the power of compressed air and convert this power to useful work. Compressed air can be a very powerful energy source. However, due to this power, you must be extremely careful when using these tools.

Pneumatic tools are normally made much heavier than standard-duty hand and power tools. You will notice this fact as soon as you lift an impact wrench or framing nailer. The cases of the tools are made intentionally heavy to contain the stresses of the impact hammers or piston and to absorb the normal day-to-day abuse that the tool takes. You have probably seen someone remove a tire's lug nuts with a pneumatic impact wrench. The operator picks up the wrench and blasts off four or five bolts. Next, the wrench is dropped the six inches or so to the floor while the operator's hands move to quickly grab the wheel and rim. Come back to this same shop a year later, and you will probably see the same wrench being used after thousands of tires have come and gone. The tool's case may be nicked and grooved, but if properly cleaned and lubricated, the tool could last for many thousand more tires.

This text discusses the selection, use and safe practices of using different types of pneumatic tools.

Objectives

When a student completes this study unit, he and she will be able to:

- Describe the various pneumatic tools used for plant maintenance.
- Identify and describe the safe use of impact, cutting, and grinding tools.
- Explain how pneumatic hammers, nailers, and staplers are selected and used in a safe manner.
- Describe the use of pneumatic assembly tools such as grinders, sanders, screwdrivers, and drills and how other types of production tools are selected and used.
- Identify the proper procedures for pneumatic tool and system care.
- Identify safe tool use procedures and how vibration and excess noise can cause bodily injury.

Contents

Pneumatic Tools for Maintenance; Pneumatic Tools for Construction; Pneumatic Tools for Production and Assemble; Pneumatic Tool Care; Using Pneumatic Tools Safely.

006026

Electricians' Tools

Duration:

10 hours (includes 1 test)

Course Prerequisites:

Electrical Wiring Practices (086E02)

What Students Learn:

Electricians' Equipment: Basic Hand Tools; Wire-Working Tools; Conduit-Working Tools; Power Tools; Knowledge as a Tool with Basic Introduction to the Metric System; Units of Electricity; Static Electricity; Electric Current, Measuring Instruments, and the Symbols and Terminology Used by Electricians.

Special Notes:

- This updated course replaces, Electricians' Tools, course 4401.
- This study unit is primarily appropriate for residential and commercial electricians and electrical contractors.

186057

Tool Grinding and Sharpening

Duration:

5 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)
Practical Measurements (Block X22)
Trades Safety: Getting Started (186001)

What Students Learn:

Preview

Trades people must keep their hand tools in good working condition. They must follow a regular maintenance schedule for servicing them. Tools with cutting edges must have the edges sharpened. Other tools must be trued and shaped for their special uses. Screwdrivers, chisels, punches, snips, and twist drills are shaped or sharpened on a grinding machine.

Objectives

When a student completes this study unit, he and she will be able to:

- Use a grinding machine, following all safety procedures.
- Hone or whet tools with an oilstone.
- Explain the procedures for grinding metal stock.
- Compare the methods used in grinding screwdrivers, snips, chisels, plane irons, and twist drills.

Contents

Tool Sharpening Equipment; Grinding and Sharpening Procedures.

186058

Woodworking Hand Tools

Duration:

5 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)
Practical Measurements (Block X22)
Trades Safety: Getting Started (186001)

What Students Learn:

Preview

A person who does not really know the workings of industry might think that hand tools are not used that much any more. That is not so; in a maintenance job, trades people will use hand tools to do many different tasks. Hand tools are necessary for superior craftsmanship, and ideal for many maintenance operations. With hand tools, you supply the power and guide the tool.

This study unit focuses on the basic hand tools used when working with wood. Which woodworking hand tool you use will depend on the work you are doing. Often the same job can be done equally well with different tools.

Objectives

When a student completes this study unit, he and she will be able to:

- Distinguish between the types of hand saws and use them correctly.
- Bore and drill holes in wood.

- Explain the differences between planes and use planes effectively.
- Use abrasive tools correctly.

Contents

Layout Tools, Saws, and Hammers; Wood Boring and Removal Tools.

186059

Routers, Power Planers, and Sanders

Duration:

5 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)

Practical Measurements (Block X22)

Trades Safety: Getting Started (186001)

What Students Learn:

Preview

The correct use of routers, power planers, and sanders will be important to trades people in your maintenance job. You will cut contours and irregular shapes on both edges and surfaces with the portable router; or you will plane doors, lumber, and assembled work accurately with the portable power planer. Trades people will also finish wood, metal, and plastic, and prepare surfaces for painting with power sanders.

Objectives

When a student completes this study unit, he and she will be able to:

- Operate (with practice) the portable router.
- Outline the procedures for using a portable power planer.
- Recognize by sight the common stationary power sanders and compare their operation.
- Choose the right portable sander for a given job, and operate (with practice) the portable belt sander.

Contents

Routers; The Portable Power Planner; Power Sanders and Sanding Operations.

186060

Jacks, Hoists, and Pullers

Duration:

5 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)

Practical Measurements (Block X22)

Trades Safety: Getting Started (186001)

What Students Learn:

Preview

Maintenance work involves hoisting or lifting and moving machines, and other heavy loads. A new machine may have to be moved in, and installed on its foundation; a broken machine may have to be hoisted and taken to the maintenance area for repair. For such work, trades people will need hoisting equipment, plus certain accessories, such as rope and chain slings. Therefore, it is important for trainees to be familiar with the common types of hoisting equipment and slings.

In maintenance work, you will often have to remove parts, such as gears and bearings, from an assembly. Pullers are very useful tools for such purposes. The commonly used pullers are of the jaw and push types.

Objectives

When a student completes this study unit, he and she will be able to:

- Identify the many forms of jacks and hoists.
- Safely operate jacks and hoists.
- Understand the construction details of fiber ropes, wire ropes, and chains.
- Properly use and maintain fiber-rope, wire-rope, and chain slings.
- Properly use jaw and push pullers.

Contents

Jacks; Hoists; Fiber Ropes; Wire Ropes; Hoisting Chains; Pullers.

286085

Preventive Maintenance

Duration:

5 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)

Practical Measurements (Block X22)

Trades Safety: Getting Started (186001)

What Students Learn:

Preview

The purpose of a preventive maintenance program is to locate possible machine or equipment faults before the machine fails.

Objectives

When a student completes this study unit, he and she will be able to:

- Describe the function of inspection and scheduled maintenance as the basis of preventive maintenance.
- Explain why preventive maintenance is performed and how it's scheduled.
- Identify those within industry who should be part of preventive maintenance planning and execution.
- Discuss the causes, effects, and goals of a successful preventive maintenance program.

- Explain how a computerized preventive maintenance program can be developed and implemented.

Contents

Introduction To Preventive Maintenance; Why Perform Preventive Maintenance?; Scheduling Preventive Maintenance; PM Program Personnel; PM Program Goals; Computerized PM Programs.

PM Of Power Transmission Systems; PM Of Electric Motors And Controllers; PM Of Pneumatic Systems; PM Of Conveyors; PM Of Vertical Lifts; PM Of Vacuum And Fluid Pumps; PM Of Electronic Controllers; PM Of Robots.

286086

Preventive Maintenance Techniques

Duration:

5 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)
 Practical Measurements (Block X22)
 Trades Safety: Getting Started (186001)

What Students Learn:

Preview

How to implement a preventive maintenance (PM) program is just as important as the why and when of such a program. It doesn't pay to create a well thought out and scheduled PM program only to have the lubrication, inspection, or repair tasks performed improperly. The objective of this unit is to show you how to perform these tasks safely and properly. This will include showing you typical PM tasks as they are performed on common industrial equipment.

Objectives

When a student completes this study unit, he and she will be able to:

- Explain how to inspect and properly maintain a belt, chain, and gearbox power transmission system.
- Discuss why proper alignment is necessary when operating a power transmission system.
- List the steps needed to properly maintain an AC or DC motor.
- Explain how to perform a start-up or bump test of a motor.
- Describe how to perform PM tasks on pneumatic systems.
- Describe how to maintain both floor and elevated conveyor systems.
- Identify the types of elevators and vertical lifts in your plant and the proper PM procedures for this equipment.
- Explain how to maintain liquid and vacuum pump systems.
- Describe how to perform a basic alignment of in-line shafts.
- List the proper PM procedures for electronic controllers and robot systems.

Contents

Block X08

Basic Machining Skills

Duration:

56 hours (includes 3 tests)

Course Prerequisites:

Introduction to Algebra, Geometry, and Trigonometry (Block X02)
 Industrial Safety (Block X23)
 Hand and Power Tools (Block X24)

What Students Learn:

This block presents the trainee with a broad overview of the basic industrial skills and knowledge needed by an entry level machinist. Skilled workers, such as electricians, pipefitters, and mechanics, whose duties include the maintenance and repair of machine tools, can benefit through cross training, from taking this course. The course starts with shop math and measurements, and applies these concepts to shop drawings, blueprint reading, layout, and metal cutting. On-the-job tasks, such as working with metal cutting machinery - milling machines, drilling machines, lathes, grinders, and CNC machine tools - are described in detail. Safety procedures relating to job tasks using metal shop machinery are an essential part of this course.

Components:

Practical Shop Math, Part 1 (X0801)
 Practical Shop Math, Part 2 (X0802)
 Practical Shop Measurement (X0803)
 Safe Shop Practices (X0804)
 Properties and Classifications of Metals (X0805)
 Progress Examination (X0821)
 Using Shop Drawings, Process, and Routing Sheets, Part 1 (X0806)
 Using Shop Drawings, Process, and Routing Sheets, Part 2 (X0807)
 Layout (X0808)
 Progress Examination (X0822)
 Metal Cutting and Machine Tooling, Part 1 (X0809)
 Metal Cutting and Machine Tooling, Part 2 (X0810)
 Metal Cutting Machinery, Part 1 (X0811)
 Metal Cutting Machinery, Part 2 (X0812)
 Fundamentals of Grinding (X0813)
 CNC Machine Tool Features and Applications (X0814)
 Progress Examination (X0823)
 Progress Examination Booklet (X0820)

X0801

Practical Shop Math, Part 1

Objectives:

- Learn the basics of shop mathematics as they relate to machine technology.
- Add, subtract, multiply, and divide fractions and decimal values of whole units such as inches, and feet.
- Derive the square root of fractions and decimals.
- Compute a machine drive ratio for a given speed.
- Make calculations using the metric or SI system of measurement.

X0802***Practical Shop Math, Part 2*****Objectives:**

- Learn the fundamentals of geometry and trigonometry as they apply to machine shop calculations.
- Compute the areas of rectangles, triangles, circles, parallelograms, and other common shapes.
- Compute the volumes of solid figures such as cubes, cylinders, cones, rectangles, and combinations of these.
- Use the principles of geometry and trigonometry to analyze and solve various kinds of triangles and their parts.
- Plot coordinates of a point using both the rectangular (Cartesian) and the polar systems.
- Present the fundamentals of calculator operations as they apply to shop work.

X0803***Practical Shop Measurement*****Objectives:**

- Teach the terminology of linear (length) and angular dimensioning.
- Learn which tools and measuring instruments are commonly used to determine the size and dimensions of a sample workpiece.
- Use a steel rule to measure the length of a part in inches or millimeters.
- Measure the sizes of parts to 1/10,000 inch using a vernier caliper.
- Use a micrometer to measure diameters and thicknesses of workpieces.
- Make angular measurements using various instruments.

X0804***Safe Shop Practices*****Objectives:**

- List the proper safety equipment to be worn when performing machine shop tasks.
- State the environmental hazards most commonly encountered in a machine shop.

- Teach the fundamental safety measures for the machine shop environment and for the more popular types of machine tools used across industry.
- State the method used to remove stock from a workpiece mounted in a lathe, milling machine, and drill press.
- Name one method used to protect the worker from harmful fumes when cutting fluids are used.

X0805***Properties and Classifications of Metals*****Objectives:**

- Understand the four basic methods of manufacturing iron and steel.
- Discuss the fundamental properties of metals.
- Recognize standard identification of various steels and alloys.
- Know the characteristics and applications of particular steels and alloys.
- Realize the effects and limitations of heat treatment.
- Be familiar with materials testing methods.
- Differentiate between hot-working and cold-working metal processes.

X0821***Progress Examination***

X0806***Using Shop Drawings, Process, and Routing Sheets, Part 1*****Objectives:**

- Understand the uses of industrial blueprints.
- Learn how to read shop drawings, process, and routing sheets.
- Recognize surfaces, object lines, and object points on a blueprint.
- Recognize front, top, and right-side views of an object.
- Identify lines on a drawing and explain their use.
- Read and understand sectional views and apply information from them to other views.
- Identify and read auxiliary and double auxiliary lines.
- Understand tolerances and apply them to dimensions, and read different tolerancing systems.
- Introduce the trainee to the language of print reading.

X0807

Using Shop Drawings, Process, and Routing Sheets, Part 2

Objectives:

- Recognize and read a geometric drawing.
- Understand the system of geometric dimensioning and tolerancing used in industrial shop drawings.
- Understand variations used on geometric drawings.
- Locate and correctly read a drawing block, and apply its information to a drawing.
- Recognize and read a process sheet, and use the information it contains.
- Understand the baseline dimensioning system.
- Understand the Cartesian coordinate system.
- Understand the fixed or floating zero system.

X0808 Layout

Objectives:

- Prepare a work surface and know the types and uses of layout compounds.
- Identify and use common layout tools.
- Identify and use measuring instruments used in layout.
- Identify and use precision layout tools.
- Perform basic layout operations and construct various geometric shapes.

X0822 Progress Examination

X0809 Metal Cutting and Machine Tooling, Part 1

Objectives:

- Describe metal cutting, how it is accomplished, and whether a cutting tool is performing properly.
- Identify a variety of cutting tools.
- Understand how a cutting tool cuts and separates material by using the three kinds of cutting edges.
- Identify the three major types of chips a cutting tool produces.
- Name the key parts of a twist drill.
- Describe the applications of a counterbore, countersink, and combination countersink/centerdrill.
- State the differences between reamers for machine and hand use.
- Explain the differences between taps used for hand tapping and machine tapping methods.
- Describe the dies used to produce threads by both hand and machine methods.

- Identify the different machine attachments and tooling components needed for tap and die threading on production machinery.

X0810 Metal Cutting and Machine Tooling, Part 2

Objectives:

- Define the major parts of a lathe tool bit.
- Identify the types and applications of turning, boring, and milling tools used in machining operations.
- Describe the different styles of end mills available.
- Identify the different horizontal end mills.
- Explain the difference between the mounting methods used for horizontal and end mill style cutters.
- Understand the differences among the various cutting tool materials used.
- Describe the reasons for using a tool coating on a cutting tool or cutting insert.
- Describe the effects of coolants on the cutting point.
- Identify the major methods of applying cutting fluids.

X0811 Metal Cutting Machinery, Part 1

Objectives:

- Identify the different types and applications of drilling machines used in industry and their important operating parts.
- Describe the major accessories and workholders used on drilling machines.
- Explain the difference between horizontal and vertical milling machines.
- Describe the different types of horizontal and vertical milling machines available.
- Understand numerical control and computerized numerical control of machine tools and differentiate between them.
- Distinguish a machining center from an ordinary milling machine.
- Understand the differences among the four designs of automatic toolchangers.

X0812 Metal Cutting Machinery, Part 2

Objectives:

- Describe basic lathe construction.
- Describe the manual and automated turning machines used by industry.
- Recognize the uses of turning centers for mass-production applications.

- Differentiate between bar and chucking types of automatic screw machines.
- Identify turning machine accessories and workholders.
- State the differences between horizontal and vertical bandsaw configurations.
- Interpret the different tooth styles of bandsaws and the applications for each style.
- Describe conventional and vertical bandsaw cutting operations.
- Explain circular cold sawing, abrasive cutting, and friction sawing techniques.

X0813

Fundamentals of Grinding

Objectives:

- Explain the physical characteristics, setup, and operation of grinding wheels.
- Name the different types of abrasives and bonds.
- Define how structure applies to the grinding process.
- Recognize Standard Marking System symbols to choose the correct grinding wheel.
- Describe the major wheel types by shape and list specific applications for each.
- Describe how to put a grinding wheel into operation and keep it in good working order.
- State the various types of grinding fluids, what they are used for, and the different methods of applying them.
- List uses and nomenclature associated with utility grinders, surface grinders, and cylindrical grinders.
- Demonstrate safe practices when using grinders.

X0814

CNC Machine Tool Features and Applications

Objectives:

- Name the common machines adapted to computer numerical control.
- Describe how CNC machines operate and what processes they are capable of performing.
- State advantages of CNC over manual control.
- Name various CNC components and describe what each does.
- Explain the function of a feedback device.
- Understand the Cartesian coordinate system of measurement.
- Define tool length compensation and describe the process of zeroing a CNC machine.
- Demonstrate safe practices when operating CNC machines.
- Describe the job responsibilities of people involved in CNC operations.

X0823

Progress Examination

X0820

Progress Examination Booklet

186007

Machine Shop Safety

Duration:

5 hours (includes 1 test)

What Students Learn:

Preview

In this study unit, trainees will gain a better understanding of the work practices necessary to operate industrial machinery, such as a bench-top drill press or a ten ton mechanical power press, safely. You will learn how the principles and practices used to keep you safe from injury can be incorporated into your daily routine.

Providing a safe work environment is the responsibility of the employer. It is the employees responsibility to work safely at all times, especially when using power driven machinery. Awareness and sound practice of the safety procedures you'll learn offer your best defense against workplace injuries. In this study unit, students will learn the skills needed to become a productive and safe industrial machine operator.

Objectives

When a student completes this study unit, he and she will be able to:

- Recognize the basic machine motions that can present a hazard to workers.
- Recognize the types of machinery most likely to be hazardous to workers.
- Understand the types of injuries caused by accidents commonly associated with unsafe machine operating procedures.
- Discuss the importance of machine guarding and how to incorporate methods of guarding to avoid physical injury.
- Recognize the four basic types of machine guards commonly used in industry.
- Control various forms of hazardous machine energy through the use of lockout / tagout procedures.
- Understand how and why to properly use personal protective equipment for added protection when using industrial equipment.

Contents

Introduction to Machine Safety; Machine Safeguarding; Types of Machinery; Machine Controls and Control Equipment; Protective Equipment and Procedures.

286095

Fasteners

Duration:

10 hours (includes 1 test)

What Students Learn:

Preview

This study unit explains the use and properties of specialty and common fasteners used by maintenance technicians. It also covers many of those fasteners installed during automated assembly processes.

Objectives

When a student completes this study unit, he and she will be able to:

- Identify the types and properties of fastener material.
- Describe the components of threaded fastener systems including bolts, nuts, screws and washers.
- Discuss the anchoring systems used in industry.
- Identify rivets and riveting tools.
- Describe other non-threaded fasteners including keys, pins and retaining rings.
- Display fastener installation techniques including tensioning, torquing and lubrication.
- Discuss how to troubleshoot fastener failure.

Contents

Introduction to Fasteners; Fastener Materials; Threaded Designs; Threaded Fastening Systems; Nonthreaded Fasteners; Installing and Removing Fasteners; Industrial Adhesives.

Special Notes:

This updated course replaces 2542.

286093

Bearings and Seals, Part 1

Duration:

10 hours (includes 1 test)

What Students Learn:

Preview

Bearings of one type or another have been used since the invention of the most primitive machines. Bearings support rotating machine shafts as well as translating movement in machine components, and bearings keep the components in correct alignment.

This study unit, will primarily discuss plain bearings. However, so that students understand the fundamental differences, it will briefly cover antifriction bearing operation. Students will get a basic understanding of the differences between plain bearings and antifriction bearings. The study unit will then discuss the various types of plain bearings and their uses in greater detail.

Because bearings are used in such a wide range of applications, there are many factors to consider when selecting a bearing for a specific need. It is important that students understand these factors and the process for choosing the correct bearing and lubrication method for an intended application. In this study unit, students will also learn about the different techniques and tools used to properly install, lubricate, and remove bearings.

Objectives

When a student completes this study unit, he and she will be able to:

- Understand what friction is and how bearings help reduce it.
- Explain the difference between plain and antifriction bearings.
- List the different types of plain bearings.
- Understand the characteristics of plain bearings.
- Know the importance of proper handling and installation of bearings.
- Recognize the importance of proper bearing lubrication.
- List the different materials used to make plain bearings and how material type affects their use.
- Explain how to prevent premature bearing failure.

Contents

Introduction to Bearings; Journal Bearings; Other Types of Plain Bearings; Installing and Maintaining Plain Bearings; Plain Bearing Failure.

Special Notes:

This updated course replaces 2602.

286094

Bearings and Seals, Part 2

Duration:

10 hours (includes 1 test)

What Students Learn:

Preview

Bearings and seals are used in most every type of machine. This study unit will help you learn how to identify, lubricate, maintain, and replace antifriction bearings and seals.

As students know, there are two types of bearings, plain and antifriction. Plain bearings use a sliding motion to reduce friction, while an antifriction bearing contacts the shaft it supports with a rolling element. This rolling motion helps reduce friction. The rolling motion produces less friction than the sliding motion produced from plain bearings. Therefore, the rotation of a shaft is smoother with an antifriction bearing.

In this study unit, students will learn about the various types of antifriction bearings and their different parts. They will also learn about the basic characteristics of these bearings, and how to apply them to a particular shaft. The study unit will also cover proper installation and maintenance and properly applying them. An important part of proper application is correctly combining the various materials available in bearings with the material the shaft is made from.

This study unit will also help students better understand seals. They will learn what a seal does, the different types of seals available, and how they are used. Students will also learn; the various types of material that seals are manufactured from, their advantages, the importance of maintaining bearings, and how to replace seals when they fail.

Objectives

When a student completes this study unit, he and she will be able to:

- Identify the various elements used in antifriction bearings.
- Properly identify and correct problems in antifriction bearings.
- Choose the proper seal.
- Choose and apply the proper lubricants for seals and antifriction bearings.
- Understand the need for clearance and tolerances in bearings.
- Identify the various parts of a seal.

Contents

Antifriction Bearings; Antifriction Bearing Replacement; Maintaining Antifriction Bearings; Installing and Maintaining Lip Seals.

Special Notes:

This updated course replaces 2602.

286091

Lubrication, Part 1

Duration:

10 hours (includes 1 test)

What Students Learn:

Preview

Since the development of machinery, there has been a war against friction. Friction causes machinery to vibrate excessively, sound louder, use more energy to do a given job, and, most importantly, wear out faster. To counter friction, lubricants have been developed.

Lubricants were once basic animal fats and plant oils used on simple machines. Today's lubricants are chemical compositions specially designed for specific types of machines and their work environment. There are now hundreds of types of oils and grease to select from, each tailored specifically for the machine or an individual component of any given machine.

This study unit is designed to give students the information they need to understand how lubricants are blended into these very special compounds and how they are selected for various applications.

Objectives

When a student completes this study unit, he and she will be able to:

- Describe the various types of friction.
- Discuss how materials wear.
- List the various functions lubricants perform in industry.
- Explain how lubricants reduce friction.
- Classify lubricants depending upon their composition, properties, and additives.
- Understand why certain lubricants are chosen for certain tasks.
- Explain how to safely handle and store lubricants.

Contents

Friction and Wear; The Purpose of Lubricants; How Lubricants are Classified; How Lubricants Work; Proper Lubricant Selection; Handling and Storing Lubricants Safely.

Special Notes:

This updated course replaces 2531A.

286092

Lubrication, Part 2

Duration:

10 hours (includes 1 test)

What Students Learn:

Preview

Lubricating equipment is one of the most important industrial maintenance activities performed. Lubricants reduce friction, which saves on energy costs. They reduce wear, which saves on equipment maintenance costs. Proper lubrication significantly reduces machine downtime resulting from broken or worn out components. In addition, proper lubricating practices help keep a machine in tolerance for a longer period of time.

In today's world of twenty-four-hour-a-day, seven-days-a-week, plant operation, the role of lubrication takes on even greater importance. Equipment must be lubricated on a timely schedule, in the proper amounts, and with the correct lubricants to sustain long work cycles between planned shutdowns. This study unit will show you how to properly apply lubrication and maintain lubrication systems.

Objectives

When a student completes this study unit, he and she will be able to:

- Explain how to manually apply various types of lubricants in an industrial environment.
- Describe total-loss lubrication.

- Identify a nonloss lubrication system's components and describe their operation.
- Explain how to maintain a nonloss lubrication system.
- Identify the proper lubrication procedures to use for special industrial applications including sealed bearings, oil-impregnated bearings and food-processing plants.
- Explain how lubricant-conditioning systems work and how to maintain them.
- Describe how automatic lubrication systems work and how to maintain them.
- List the tasks involved in preventive and predictive lubrication maintenance.

Contents

Manual Methods of Lubrication; Lubricating Total-Loss Systems; Nonloss Lubrication Systems; Lubrication in Special Environments; Lubrication Conditioning; Automatic Lubrication Systems; Preventive and Predictive Lubrication Maintenance.

Special Notes:

This updated course replaces 2531B.

3501 Layout

Duration:

10 hours (includes 1 test)

What Students Learn:

Marking Devices: Punches, Scribes, Dividers, Calipers, Gages, Beam Trammels, Combination Sets, Bevel Protractors, Keyseat Clamps; Scribing Problems; Use of Bench Plates, Surface Plates, Parallels, V Blocks, and Arbors; How to Draw Horizontal, Vertical, and Inclined Lines; How to Draw a Circle or Circular Arc; Layout Problems: Location of Holes in a Plate; Location of Boundaries of Flat Surfaces; Marking of Lines on Curved Surfaces; Locating the Center of a Circle in an Opening; Subdividing a Circle into a Number of Equal Parts; Determining Required Length of Stock for Forming a Bent Part; Laying Out of Keyways, Templates, Castings, Cams, and Sprockets.

Special Notes:

Covers subject at an advanced, in-depth level.

386050, 386051 Drilling, Parts 1 & 2

Duration:

20 hours (includes 2 tests)

What Students Learn:

PART 1 (386050). Drilling Process; Upright Drill Press; Multiple-Spindle Drill Press; Radial Drill Presses; Numerical Control Drill Presses; Drilling Tools; Reconditioning of Drills.

PART 2 (386051). Work-Holding Devices; Tool-Holding Devices; Drill Press Setup; Cutting Fluids; Related Tools and Practices; Care of Equipment.

Special Notes:

Covers subject at an advanced, in-depth level.

2512 Materials Handling

New Course Available:

386E03

Duration:

10 hours (includes 1 test)

What Students Learn:

Introduction; Sealing Equipment; Trucks; Conveyors; Pneumatic Systems; Bulk Handling Systems and Components; Grab Attachments; Long Distance Transportation; Auxiliary Equipment; Specialized Components.

386E05 Sheet Metal Technology

Duration: 25 hours (includes 5 exams)

Course Prerequisites:

Basic Industrial Math (Block X21)

Practical Measurements (Block X22)

What Students Learn:

This course introduces the materials, tools, and machines that are most often used in sheet metal work. It explains how to interpret material identifiers, how to lay out a simple job, how to use some complex machinery, and how to interpret some very detailed sheet metal drawings. When the trainee has completed this course, he or she will possess a sound understanding of part layout, material selection, and forming/joining techniques.

Part 1 - 386917

Lesson 1 (386838) Introduction to Sheet Metal Work

- Describe how sheet metal work is important to construction and manufacturing industries.
- Safely use the hand tools, machines, and equipment found in a typical sheet metal shop.
- Explain the differences between crimping and bending, and the differences between various types of sheet metal.

Lesson 2 (386839) Basic Sheet Metal Materials and Operations

- Explain the difference between wire cloth, expanded metal, and cane metal.
- Describe the applications of oxyacetylene, arc, MIG, TIG, and spot welding processes.
- Learn to select the best tool or machine for the job, demonstrate a flexible rule, a circumference rule, sheet metal snips, pipe crimper, a nibbler, and different types of shears.
- Describe how to make a riveted sheet metal seam and explain how to remove rivets without damaging the sheet metal.

Lesson 3 (386840) Sheet Metal Machine Processes

- Explain how to work with a bar folder and a bending brake.
- Sketch and calculate material allowances for grooved, standing, Pittsburgh, double, and dovetail seams.
- Describe the use of forming, crimping, and beading operations in and discuss the differences between plain forming machines and slip roll forming machines.

Part 2 - 386918

Lesson 4 (386841) Sheet Metal Soldering and Pattern Work

- Soldering different types of metals and seams properly.
- Identify and use a scale, T-square, triangle, and protractor.
- Layout, notch, and clip a pattern correctly on sheet metal.

Lesson 5 (386842) Advanced Sheet Metal Topics

- Parallel line development.
- Develop a pattern for rectangular duct and round pipe, and explain the triangulation process.
- Explain how true lengths and radial line development can be identified and used in a drawing or pattern.
- Identify and lay out basic ductwork materials and fittings, including elbows, S offsets, and transitions.

Special Notes:

This course consists of a textbook and two supplemental study guides.

5807 Machine Sketching

Duration:
10 hours (includes 1 test)

What Students Learn:
Sketches of Machine Details; Drawing Straight and Curved Lines; Finish Marks; Surface Roughness; Arrangement of Dimensions; Partial Section; Conventional Sections; Shaft Coupling; Spur Gear; Bevel Gear; Pieces Requiring More Than Two Views; Foreshortening; Measurements; Curved Outlines and Fillets; Pictorial Sketching; Isometric Drawing; Oblique Drawing; Conventional Symbols; Piping Diagrams.

286007 Principles of Mechanics, Part 1

Duration:
10 hours (includes 1 test)

Course Prerequisites:
Basic Industrial Math (Block X21)
Practical Measurements (Block X22)
Practical Geometry and Trigonometry (5567)

What Students Learn:
Matter and Energy; Scope of Mechanics; Forms of Matter; Forms of Energy; Physical Properties of Bodies; Motion of Bodies; Velocity; Acceleration and Retardation; Weight and Mass; Work and Energy; Coordinate Systems; Precision in Computations; Newton's Laws of Motion; Uniform Motion; Variable Motion.

Special Notes:

- This updated course replaces course 6426A.
- The entire course consists of study units 286007-286008.

286008 Principles of Mechanics, Part 2

Duration:
10 hours (includes 1 test)

Course Prerequisites:
Basic Industrial Math (Block X21)
Practical Measurements (Block X22)
Practical Geometry and Trigonometry (5567)

What Students Learn:
Friction; Nature of Friction; Sliding Friction; Rolling Friction; Machine Elements; Levers; Inclined Plane; Wedges and Screw Threads; Wheel and Axle; Tackle; Pulleys; Gearing; Belts and Chains; Simple Harmonic Motion Centrifugal Force.

Special Notes:

- This updated course replaces course 6426B.
- The entire course consists of study units 286007-286008.

286101***Mechanical Power Transmission,
Part 1*****Duration:**

10 hours (includes 1 test)

What Students Learn:

- Physical principles that govern mechanical power transmissions
- Identify type of shaft misalignment and select coupling to compensate for it
- Coupling types, including resilient and metallic, components, and their functions
- Belt-drive system configurations, components, and applications
- Computing speed ratios
- Installing, servicing, and troubleshooting various types of belt drives

This three-study-unit course replaces and expands on 286015.

286102***Mechanical Power Transmission,
Part 2*****Duration:**

10 hours (includes 1 test)

What Students Learn:

- Various chain drive configurations and their unique operating characteristics
- Install chain coupling links and setting chain tension
- Interpret chain drive system ratings
- Servicing and lubricating Chain Drives
- Brake and clutch types, applications, and rating systems
- Selecting multimedia drives
- Predictive-maintenance for mechanical power transmission systems

This three-study-unit course replaces and expands on 286015.

286103***Mechanical Power Transmission,
Part 3*****Duration:**

10 hours (includes 1 test)

What Students Learn:

- Gear types and their operating characteristics
- Removing or mounting a gear from its shaft
- General dimensions in gearing and gear-drive systems
- Interpret gear and gearbox ratings
- Recognize different types of gearboxes and explain the applications for which each suited
- Selecting lubricants and lubricating gearboxes

This three-study-unit course replaces and expands on 286015

2607A-B***Belt Power Transmission*****Duration:**

20 hours (includes 2 tests)

Course Prerequisites:

Introduction to Algebra, Geometry, and Trigonometry (Block X02)

What Students Learn:

PART 1 (2607A). General Considerations on Belt Drives; Basic Theory of Belt Power Transmission; Types of Belt Drives; Application of V-Belt Drives; Application of Flat Belt Drives; Belt Drive Installation and Maintenance; Appendix. PART 2 (2607B). Application of Special Belt Drives; Additional Considerations in Belt Drive Applications; New Developments in Belt Drives.

286060***Hydraulic Power Basics*****Duration:**

10 hours (includes 1 test)

Course Prerequisites:

Introduction to Algebra, Geometry, and Trigonometry (Block X02)

Introduction to Fluid Power (Block Y01)

What Students Learn:

Introduction to Hydraulic Power; Physical Principles of Hydraulic Power and Energy; Pascal's Law; Bernoulli's Principle; Work and Power; Horsepower and Loss; Hydraulic Power Systems; Basic Components of Hydraulic Systems; Basic Hydraulic System Accessories; Fittings and Couplings; Characteristics of Hydraulic Systems; Comparing Power Systems; Requirements for Hydraulic Systems; Properties of Hydraulic Fluid; Fluid Storage, Handling, and Maintenance; Filters and Strainers; Heat Exchangers; Eliminating Air; Examples of Hydraulic Systems; Proportional Displacement; Hydraulic System Operation; Working Safely with Hydraulic Systems.

Special Notes:

The entire course consists of study units 286060, 286061, 286062, 286063, 286064 and 286065.

286061

Hydraulic Components: Actuators, Pumps, and Motors

Duration:

10 hours (includes 1 test)

Course Prerequisites:

Introduction to Algebra, Geometry, and Trigonometry (Block X02)

Introduction to Fluid Power (Block Y01)

What Students Learn:

Actuator Design, Detail, and Operation; Linear Actuators; Hydraulic Actuator Components; Rotary Actuators; Pumping Principles; Slippage; Pump Classifications; Gear Pumps; Vane Pumps; Double Pumps; Gear and Vane Pump Lubrication and Capabilities; Piston Pumps; Screw-type Pumps; Supercharging Pumps; Variable-displacement Pump Control Fundamentals; Hydraulic Motors; Comparing Pumps and Motors; Gear Motors; Screw Motors; Vane Motors; Piston Motors; Abutment-type Motors; Losses through Fluid Motors; Deceleration and Braking.

Special Notes:

The entire course consists of study units 286060, 286061, 286062, 286063, 286064 and 286065.

286062

Hydraulic Components: Conductors, Conditioners, and Fluids

Duration:

10 hours (includes 1 test)

Course Prerequisites:

Introduction to Algebra, Geometry, and Trigonometry (Block X02)

Introduction to Fluid Power (Block Y01)

What Students Learn:

Reservoirs and System Components; Types of Reservoirs; Reservoir Volume; Reservoir Components; Reservoir Interior Care and Auxiliary Tanks; Reservoir in Use; Practical Tips for Reservoir Selection and Maintenance; Conductors, Fittings, and Seals; Maintenance Tips for Conductors, Fittings, and Seals; Choice of Conductor Size and Materials; Types of Heat Exchangers; Automatic Temperature Control; Effective System Cooling Tips; Accumulators; Circuits Using Accumulators; Accumulator Safety; Hydraulic Fluids; Petroleum-based Fluids; Viscosity; Demulsibility; Oxidation Stability; Lubricating Value; Corrosion and Rust Prevention; Fire-resistant Fluids.

Special Notes:

The entire course consists of study units 286060, 286061, 286062, 286063, 286064 and 286065.

286063

Hydraulic Power System Control

Duration:

10 hours (includes 1 test)

Course Prerequisites:

Introduction to Algebra, Geometry, and Trigonometry (Block X02)

Introduction to Fluid Power (Block Y01)

What Students Learn:

Explain the Function of Control Components in a Typical Hydraulic System; Identify Control Valves by Pressure, Flow, or Directional Type; Explain the Operating Principles and Typical Internal Parts of Pressure, Flow, and Directional Valves; Interpret Schematic Symbols which represent Control Valve Configurations.

Special Notes:

The entire course consists of study units 286060, 286061, 286062, 286063, 286064 and 286065.

286064

Interpreting Hydraulic System Schematics

Duration:

10 hours (includes 1 test)

Course Prerequisites:

Introduction to Algebra, Geometry, and Trigonometry (Block X02)

Introduction to Fluid Power (Block Y01)

What Students Learn:

Typical Schematic Layout; Recognizing Standard Schematic Symbols; Interpreting Control Configuration from Schematic Symbols; Evaluating System Operating Characteristics from Schematics.

Special Notes:

The entire course consists of study units 286060, 286061, 286062, 286063, 286064 and 286065.

286065***Hydraulic Power System Troubleshooting*****Duration:**

10 hours (includes 1 test)

Course Prerequisites:

Introduction to Algebra, Geometry, and Trigonometry (Block X02)

Introduction to Fluid Power (Block Y01)

What Students Learn:

Sizing Components to meet Requirements; Measuring and Evaluating System Operation; Assessing Motor and Pump Capacity and Performance; Special System Control including Servos and Pressure, Temperature, and Limit Switches; Performing Periodic Maintenance and Analyzing Inspection Information; Troubleshooting System Faults; Typical Hydraulic System Faults and Failures.

Special Notes:

The entire course consists of study units 286060, 286061, 286062, 286063, 286064 and 286065.

286001***Pumps, Part 1*****Duration:**

10 hours (includes 1 test)

Course Prerequisites:

Hydraulic Components: Actuators, Pumps, and Motors (286061)

What Students Learn:

Modern Centrifugal Pumps; Operating Principles of Pumps; Classifications and Types of Pumps; Fundamental Pump Terms: pressure, vapor pressure, head, losses, cavitation, net positive suction head, specific speed, viscosity; Centrifugal Pump Performance Curves; Types of Pumping System Curves.

Special Notes:

- This updated course replaces course 2530A.
- The entire course consists of study units 286001, 286002, and 286003.

286002***Pumps, Part 2*****Duration:**

10 hours (includes 1 test)

Course Prerequisites:

Hydraulic Components: Actuators, Pumps, and Motors (286061)

What Students Learn:

Construction details of Centrifugal Pumps; Applications of Centrifugal Pumps; Installation and Maintenance of Centrifugal Pumps; Troubleshooting problems associated with Centrifugal Pump Operation.

Special Notes:

- This updated course replaces course 2530A.
 - The entire course consists of study units 286001, 286002, and 286003.
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286003***Pumps, Part 3*****Duration:**

10 hours (includes 1 test)

Course Prerequisites:

Hydraulic Components: Actuators, Pumps, and Motors (286061)

What Students Learn:

Rotary Pumps: classifications, installation and operating principles; Reciprocating Pumps: classifications, installation and operating principles; Power Pumps; Applications of Rotary and Reciprocating Pumps; Troubleshooting Rotary and Reciprocating Pumps.

Special Notes:

- This updated course replaces course 2530B.
 - The entire course consists of study units 286001, 286002, and 286003.
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6623***Pneumatics*****Duration:**

10 hours (includes 1 test)

What Students Learn:

Atmospheric Pressure; Barometers; Properties of Gases; Relative Unit Pressure; Laws Relating to Change of State; Boyle's Law; Gay-Lussac's Laws; Combination of Boyle's and Gay-Lussac's Laws; Mixtures of Gases; Pneumatic Machines and Devices; The Air Pump; Apparatus Showing Weight and Pressure of Atmosphere; Siphon; Air Compressors.

286M01

Pneumatic Instrumentation for the Technician

Duration:

35 hours (includes 7 tests)

Course Prerequisites:

Basic Industrial Math (Block X21)

What Students Learn:

Lesson 1 - Pneumatic Instrumentation for Industry:

- Instrument Systems; How Fluid Power Works; Pneumatic Instruments; Link Mechanisms: Components and Adjustments; Calibration Standards, Procedures and Programs.

Lesson 2 - Pressure and Liquid Level Measuring Instruments:

- Principles of Pressure; Sensing Pressure; Bourbon Elements; Compensation and Calibration; Liquid-Level Instruments; Differential Pressure Instruments: Manometers, Bellows and Diaphragm Instruments, Displaces.

Lesson 3 - Flow-Measuring Instruments:

- Principles of Operation; Orifice Flow; Meter Types and Mechanisms; The Square-Root Problem; Integrators.

Lesson 4 - System Components, Part 1:

- Self-Balancing Instruments; Error Detectors; Pilot Valves; Relay Functions and Variations; Moment-Balance Pressure, Temperature and Differential-Pressure Transmitters; Moment Balance Positioners.

Lesson 5 - System Components, Part 2:

- True Force-Balance Instruments, Transmitters and Positioners; Motion-Balance Principle and Applications; Angle Motion-Balance Positioners; Linear Motion-Balance Instruments.

Lesson 6 - Pneumatic System Control, Part 1:

- Control Valve Maintenance; Control Theory and Fundamental Controllers; Gain, Feedback and Response.

Lesson 7 - Pneumatic System Control, Part 2:

- Controller Functions, Types and Components; Range and Gain Mechanisms; Foxboro, Honeywell, Taylor, and Fisher and Porter Controllers; Universal Controllers; Process Control.

Special Notes:

This course consists of a textbook and supplemental study guide.

286016

Fundamental Principles of Rigging Technology

Duration:

10 hours (includes 1 test)

What Students Learn:

The purpose of this series of study units on rigging is to tell you where and how to stand, to tell you about the basic tools that are available, and to show you how to use the tools to move heavy or awkward objects in a safe and efficient manner. In short, the purpose is to help you understand the basic principles of rigging you'll need in your daily activities on the job.

This first study unit in the rigging series presents an overview of rigging - what it is, what kind of work is involved, who does it - and provides you with a fundamental knowledge of the basic mechanisms used in rigging and of the concepts of mechanical advantage, friction, center of gravity, and weight. Recognizing that the metric system of measurements is widely accepted, we've provided an Appendix which gives metric conversion factors for the English system units used in this text.

When you complete this study unit, you will be able to:

- Describe the theoretical principles of the seven basic mechanisms - inclined plane, wedge, screw, lever, wheel and axle, pulley, and hydraulic ram.
- Solve basic mechanism problems using the concepts of mechanical advantage.
- Solve basic mechanism problems using the concepts of friction loss.
- Calculate the weights of geometric solids.
- Determine the center of gravity of simple plane and solid shapes.

Introduction To Rigging; Basic Mechanisms Used In Rigging; Weight And Center Of Gravity.

Special Notes:

- This updated course replaces course 5030A.
- The entire course consists of study units 286016, 286017, 286018, 286019, 286020 and 286021.

286017

Planning the Rigging Operation

Duration:

10 hours (includes 1 test)

What Students Learn:

Equalizing and Distributing Loads; Reasons for and Examples of Load Equalization and Distribution: Basic Methods of Equalizing and Distributing Loads; Planning and Executing a Rigging Job; What You Must Know before starting a Sample Rigging Operation; Safety in Rigging; Rigging Hazards; How to Reduce Hazards.

Special Notes:

- This updated course replaces course 5030B.
- The entire course consists of study units 286016, 286017, 286018, 286019, 286020 and 286021.

286018

Working with Rigging Tools, Part 1

Duration:

10 hours (includes 1 test)

What Students Learn:

In this study unit, you'll study some of the basic tools and pieces of equipment that are used in typical rigging operations. This unit deals with wire and fiber ropes, and chains. In particular, you'll study about the characteristics and requirements of these common rigging and hoisting tools, and about the procedures and precautions required in their use. Also included are inspection methods, rope splicing, and fiber knot tying.

In the selection of tools and rigging equipment, it pays to obtain quality items. Also, before using any tool or piece of equipment, the rigger is cautioned to become familiar with its operating characteristics and limitations, and the proper handling techniques and required maintenance for the tool. The more complex the tool or piece of equipment, the more certain the rigger should be of its characteristics.

When you complete this study unit, you'll be able to:

- Describe and classify the various types of wire rope and discuss the factors which influence wire rope construction.
- Define the term safety factor and discuss how it relates to safe working load limit.
- Discuss the factors which need to be considered when inspecting wire rope slings.
- Identify the various types of end attachments and describe their application in the rigging operation.
- List the five common types of fiber ropes and discuss their inherent advantages and disadvantages to the rigging operation.
- Contrast the advantages and disadvantages of chain slings with those of wire rope slings.
- Discuss the factors which need to be considered when inspecting chain slings.
- List safety consideration necessary when utilizing wire rope, fiber rope, and chain slings.

Working with Wire Rope, Fiber Ropes, and Chains; Explains the Proper Handling and Care of these Common Rigging Tools; Details Correct Rope Splicing and End-Attachment Procedures.

Special Notes:

- This updated course replaces course 5030C.
- The entire course consists of study units 286016, 286017, 286018, 286019, 286020 and 286021.

286019

Working with Rigging Tools, Part 2

Duration:

10 hours (includes 1 test)

What Students Learn:

In this study unit, you'll learn how riggers use simple and complex rigging tools to complete a task. This unit explains how slings, hitches, hoists, and various other types of rigging hardware are sized, selected, inspected, and positioned by riggers as they prepare to lift a load. You'll learn how to combine the reeving hardware you've already learned about into safe, effective reeving systems. You'll be introduced to the types of equipment riggers use to move a load along a floor or roadway and learn how they support these loads. This study unit includes an overview of wood grading and inspecting practices. Many riggers must be able to select wooden supports and other items used during lifting or supporting operations. Finally, the unit ends with an in-depth discussion of ladder and scaffold types and specifications.

When you complete this study unit, you'll be able to:

- Identify the various types of slings and recommend where each type can be most effectively utilized for rigging operations.
- Describe the common types of sling hardware and discuss how they're used in the rigging operation.
- Demonstrate how to calculate the efficiency of a reeving system.
- Discuss the use of supporting equipment and demonstrate how to calculate the distribution of pressure.
- Explain the proper use of levers, side plates, rollers, and other equipment in the horizontal movement of a load.
- Describe the various types of ladders and scaffolding and discuss how they can be correctly employed.

Slings And Hitches; Rigging Hardware; Hoists; Reeving; Supporting Equipment; Horizontal Movement Equipment; Knowledge Of Woods Needed By Rigger; Ladders; Scaffolds.

Special Notes:

- This updated course replaces course 5030D.

- The entire course consists of study units 286016, 286017, 286018, 286019, 286020 and 286021.

286020

Rigging: Lifting Equipment and Applications, Part 1

Duration:

10 hours (includes 1 test)

What Students Learn:

In this study unit, you'll learn about cranes and other types of equipment used for heavy lifts. This study unit isn't intended to make you a knowledgeable equipment operator, because every manufacturer's equipment is different, and specialized training on specific types of equipment is always necessary. Rather, the unit is intended to make you familiar with the range of equipment available in the marketplace and help you understand the benefits and limitations of each category of lifting equipment. Some of the more widely used pieces of equipment are described in additional detail so that you'll know more about their inner workings and operation.

When you complete this study unit, you'll be able to:

- Understand the basic principles of crane safety.
- Identify the more common types of cranes and their components.
- Identify the drive members for a crawler-type mobile crane.
- Identify and give the functions of the various parts of a truck-type mobile crane.
- Know how to use crane rating charts.
- Select the correct mobile crane attachment for a particular function.
- Describe a dragline setup and distinguish its parts.
- Describe in general how to set up a boom.
- Select a suitable crane if given a set of specific lift conditions and crane capacity rating tables.

Introduction To Lifting Equipment; Crane Rating Charts; Small Lifting Equipment; Mobile Cranes; Mobile Crane Attachments, Operation And Setup.

Special Notes:

- This updated course replaces course 5030E.
- The entire course consists of study units 286016, 286017, 286018, 286019, 286020 and 286021.

286021

Rigging: Lifting Equipment and Applications, Part 2

Duration:

10 hours (includes 1 test)

What Students Learn:

This study unit continues the review of lifting equipment. In Part 1, we focused on small lifting equipment (hoists, aerial work platforms, and lift trucks) and on various types of mobile cranes (crawlers, truck-type, floating cranes).

In Part 2, we describe the remaining types of equipment, grouped simply as limited travel cranes, derricks, and specialty cranes. We then present a series of case studies that show how some of the lifting equipment we have studied are actually used in the workplace. The emphasis is on particularly challenging or noteworthy lifts. When available, we have also included information on the rigging techniques employed for these lifts.

After reviewing Lifting Equipment and Applications, Parts 1 and 2, you should have a good general understanding of the range of lifting equipment that you, as a rigger, will encounter at industrial and construction work sites, how this equipment works, and the advantages and limitations of these lifting devices.

When you complete this study unit, you'll be able to:

- Describe the various types of limited travel cranes.
- Distinguish between the functions of derricks in common use.
- Identify the importance of two types of specialty cranes.
- Understand why certain cranes were used in various lifting situations.

Limited Travel Cranes; Derricks; Specialty Cranes; Lifting Equipment Applications; Appendix: Rigging And Lifting Resources.

Special Notes:

- This updated course replaces course 5030F.
- The entire course consists of study units 286016, 286017, 286018, 286019, 286020 and 286021.

286096

Air Compressors, Part 1

Duration:

10 hours (includes 1 test)

What Students Learn:

Preview

Most, if not all, manufacturing and industrial facilities use some application of compressed air. Many personnel in these industries refer to compressed air as the "fourth utility," in line with electricity, gas, and water. Because compressed air is considered a major utility in most manufacturing and industrial settings, its operational functions demand understanding, as well as continuous monitoring and maintenance.

Just as the unintentional loss of electricity, gas, or water can shut down processes, so can the loss of compressed air. It is common for major facilities that depend on compressed air in production and control, to have at least one backup compressor for every main line compressor. These backup compressors are usually not allowed to sit idle while the main line compressor or compressors do all the work. In fact, most systems or facilities are set up to either exercise these backup machines on a regularly scheduled basis, or to alternate their operation with the main line compressor or compressors. This way, operational and environmental wear is divided equally between all machines in the system.

Compressor outlet piping systems are often designed so that the flow of compressed air can be shifted from one compressor to another automatically. Alternately, in some less-complex systems, the shifting of flow may be accomplished manually by opening and closing specific valves to redirect the flow.

This study unit will discuss the fundamentals of compressed air systems, types of air compressors, and the proper methods of selecting a compressor for specific compressed air requirements. It will cover determining the cost efficiency associated with operating compressed air systems, and the major auxiliary equipment used with compressed air systems. This study unit should provide a good introduction and background knowledge that will be required to complete the study unit, *Air Compressors, Part 2*. The second study unit will cover installation, preventative maintenance, and major repairs on reciprocating air compressor systems.

Objectives

When a student completes this study unit, he and she will be able to:

- Define the terms and concepts related to the delivery of compressed air to industrial systems.
- Describe the two major classifications of air compressors.
- Identify the types of air compressors used in industry.
- Apply a checklist in the process of selecting an air compressor for a specific industrial application.
- Identify the auxiliary equipment associated with compressed air systems and list the functions of this equipment.

Contents

Compressor Fundamentals: What Is Compressed Air?; Types of Compressed Air Services; General Terminology; Pressure; Temperature; Converting Fahrenheit to Celsius; Converting Celsius to Fahrenheit; Volume or Capacity; Loading and Unloading; Stages / Single and Multiple; Types of Compressors: Dynamic Air Compressors; Centrifugal Compressors; Surging; Applications; Axial Compressors; Positive Displacement Air Compressors; Rotary Compressors; Rotary Sliding Vane; Liquid Piston; Reciprocating Compressors; Single- and Multiple-Stage; Single- and Double-Acting; Cooling Methods; Cooling Water Treatment and Flow; Selecting and Efficiently Operating an Air Compressor: Factors in Selecting an Air Compressor; Operating Efficiency and Cost; Auxiliary Equipment: Intake Filters; Silencers; Separators and Traps; Receivers; Dryers.

286097

Air Compressors, Part 2

Duration:

10 hours (includes 1 test)

What Students Learn:

Preview

Air Compressors, Part 1 discussed what compressed air is, types of air compressors, basic rules for selecting the right air compressor for a particular application, and the auxiliary equipment sometimes installed in compressed air systems.

New technology now offers oil-free reciprocating air compressors in which the internal parts are protected from wear by using sealed crankshaft and rod bearings, and pistons that move on alloyed heat-resistant filled Teflon guide and compression rings. However, many of the new and existing single-acting compressors are still of the lubricated, air-cooled, crankcase style.

Air Compressors, Part 2 focuses on the installation, design and operating fundamentals, major components, maintenance, and troubleshooting of small- to medium-sized single-acting, lubricated reciprocating air compressors.

Objectives

When a student completes this study unit, he and she will be able to:

- Identify the factors that must be considered before installing a single-acting reciprocating air compressor.
- Describe the reciprocating air compressor cycle and the functions of the major components.
- Understand lubrication systems of single-acting, air-cooled, lubricated reciprocating air compressors.
- Follow specific guidelines and procedures in the startup, operation, maintenance, and troubleshooting of single-acting, air-cooled, lubricated reciprocating air compressors.

Contents

Installation: Location; Ambient Temperature; Ventilation; Foundation; Compressor Room; Piping And Distribution Layout; Design And Operating Fundamentals: Compressor Classifications; The Compression Cycle; Main Components – Design And Repair; Housing Or Crankcase; Crankshaft; Main Bearings; Connecting Rod And Rod Bearings; Piston And Piston Rings; Cylinder; Valves And Cylinder Heads; Lubricating System; Compressor Startup, Operation, Maintenance, And Troubleshooting; Prestart and Startup; Operation; Extended Shutdown; Maintenance; Scheduled Inspections; Alignment; Troubleshooting.

286025

Fundamentals of Welding, Part 1

Duration:

10 hours (includes 1 test)

What Students Learn:

Introduction to Welding; Definitions of Weld, Braze, and Braze Weld; Oxyfuel Gas Welding (OFW); Arc Welding (AW); Resistance Welding (RW); Solid-State Welding (SSW); The Brazing Welding Process; Soldering Process; Other Welding Processes.

Special Notes:

- This updated course replaces course 6151.
- The entire course consists of study units 286025 and 286066.

286066

Fundamentals of Welding, Part 2

Duration:

10 hours (includes 1 test)

What Students Learn:

Recognize basic joint designs used in welding – Butt, Corner, "T", Lap, and Edge; Selecting the best types of grooves for welding applications; Proper procedures for working on various positions when welding joints on pipes; Interpreting welding symbols, dimensions, and schematics.

Special Notes:

The entire course consists of study units 286025 and 286066.

186004

Safe Handling of Pressurized Gasses and Welding

Duration:

5 hours (includes 1 test)

What Students Learn:

Preview

This study unit will teach students important safety facts and practices involving the high pressure and low pressure gases used in welding. Covered are the fundamentals of electric arc welding, equipment requirements and proper operating procedures. Trainees will learn general welding safety and specific practices. You will learn about controlling heat sources from welding operations to protect yourself from harm and your facility from fire.

Objectives

When a student completes this study unit, he and she will be able to:

- Identify common welding gases and understand how they are used in welding operations.
- Point out the hazards associated with welding gases.
- Safely handle and store different types of gas cylinders.
- Safely operate a basic gas welding setup.
- Recognize the safety considerations involved in the setup and operation of electric arc welding equipment.
- Identify welding equipment malfunctions and take corrective action.
- Utilize fire prevention and protection methods specific to welding operations.
- Discuss the importance of the hot work permit program in your facility.
- Explain the correct use of protective clothing and equipment for welding.
- Utilize proper ventilation when welding.
- Effectively deal with confined spaces when performing welding operations.

Contents

Safety in Welding and Cutting; Safe Handling and Storage of Gas Cylinders; Use of Oxy-fuel Welding and Cutting Systems; Safe Operation of Welding Equipment; Safe Use of Electric Arc Welding Equipment; Protection of Welders and Welding Facilities.

6276A-C

Gas Welding Techniques

Duration:

30 hours (includes 3 tests)

Course Prerequisites:

Fundamentals of Welding, Part 1 (286025)

Fundamentals of Welding, Part 2 (286066)

Gas Welding Equipment (6272A-B)

What Students Learn:

PART 1 (6276A). Instructions for Practice Welds; Joint Preparation; Corner Joints, Butt Joints, Lap and Tee Joints, and Fillet Welds; Tests to Make on Practice Welds; Welding with Single and Two or More Weld Layers; Progress Tests and Supplementary Heating; Welding Production Data; Application to Estimating and Calculation of Costs.

PART 2 (6276B). Weight and Schedule Systems of Classifying Pipe; Positions in Which Pipe is Welded, the Joint Preparation, and the Techniques to Use; Changes in Direction with Commercial Fittings, by Bending, and with Fabricated Fittings; Stress Relieving Tests and Tables of Weld Requirements; Advantages and Disadvantages of Braze Welding; Filler Metals; Fluxes; Joint Preparations; Braze Welding Techniques; Groove Preparations; Fluxes; Heat Treatment; Joint Preparation; Estimating Requirements; Welding Cast Iron with Cast Iron Welding Rods and Braze Welding Cast Iron; Malleable Iron Welding.

PART 3 (6276C). Welding Procedures for Medium Carbon, High Carbon, and Stainless Steels; Preheating and Supplementary Heating; Welding Rods, Fluxes, and Joint Designs for Copper and Copper Alloys; Using Oxyacetylene and Oxyhydrogen for Welding Aluminum and Aluminum Alloys; Welding Rods, Fluxes, Joint Designs, and Techniques; Welding Procedures, Joint Designs, Fluxes, Welding Rods, and Techniques of Welding Magnesium and Magnesium Alloys, Nickel and Nickel Alloys, and Lead; Weld Sequence; Jigs and Fixtures; Joint Design; Drum Heading; Pre-deforming to Control Distortion.

286030

Shielded Metal Arc Welding Techniques, Part 1

Duration:

10 hours (includes 1 test)

Course Prerequisites:

Practical Measurements (Block X22)
Fundamentals of Welding, Part 1 (286025)
Fundamentals of Welding, Part 2 (286066)
Arc Welding Equipment, Part 1 (286032)
Arc Welding Equipment, Part 2 (286033)
Arc Welding Equipment, Part 3 (286053)

What Students Learn:

Equipment and Materials; Weld Metal Testing; Welding Applications of Covered Mild-Steel Electrodes; Basic Arc Welding Operations; Single V-Groove Butt Welds.

Special Notes:

- This updated course replaces course 3536A.
- The entire course consists of study units 286030-286031.

286031

Shielded Metal Arc Welding Techniques, Part 2

Duration:

10 hours (includes 1 test)

Course Prerequisites:

Practical Measurements (Block X22)
Fundamentals of Welding, Part 1 (286025)
Fundamentals of Welding, Part 2 (286066)
Arc Welding Equipment, Part 1 (286032)
Arc Welding Equipment, Part 2 (286033)
Arc Welding Equipment, Part 3 (286053)

What Students Learn:

The Vertical Position; The Horizontal Position; The Overhead Position; Fillet Welds: Welding Heavy Metal Plates; Sheet-Metal Welding.

Special Notes:

- This updated course replaces course 3536B.
- The entire course consists of study units 286030-286031.

286028

Common Thermal Cutting Processes

Duration:

10 hours (includes 1 test)

Course Prerequisites:

Fundamentals of Welding, Part 1 (286025)
Fundamentals of Welding, Part 2 (286066)

What Students Learn:

Introduces the Process of using Heat to Cut Metal and other Materials; Describes the Common Thermal Cutting Processes used in Industry and the capabilities of each; The Tables to use when Estimating Requirements for specific Cutting Operations; Describe the types of Equipment used for Oxyfuel Gas Cutting; Identify the appropriate Procedures used in Oxygen Cutting Processes.

Block D20

Industrial Plumbing and Pipefitting

Duration:

40 hours (includes 8 tests)

What Students Learn:

The eight lessons in this block provide the trainee with the skills and knowledge needed to perform those tasks associated with the trades of plumber and pipefitter. The program includes coverage of the most widely accepted materials used for pipe, fittings, and valves. The trainee will learn how to use the tools of the trades, with an emphasis on safety. In addition, the methods used to join pipe, and the procedures for supporting, installing, and testing piping systems, are discussed in detail. Common plumbing fixture installation and maintenance, along with a review of tanks, pumps, and boilers, are covered.

Special Notes:

This updated course replaces Industrial Plumbing and Pipefitting, Block D10. Each study unit contains a progress examination.

Components:

The Trades of Plumbing and Pipefitting (286040)
Pipes, Fittings, and Valves (286041)
Plumbing and Pipefitting Tools (286042)
Joining and Assembling Pipes (286043)
Supporting, Installing, and Testing Pipes (286044)
Plumbing Fixtures and Appliances (286045)
Tanks, Pumps, and Boilers (286046)
Insulation for Piping and Ducting (286047)

286040***The Trades of Plumbing and Pipefitting*****Objectives:**

- Identify the differences between "plumbing" and "pipefitting."
 - Discuss the basic concepts of codes and standards.
 - Relate information about the different types of mechanical systems in buildings.
 - Demonstrate basic skills for blueprint reading.
 - Identify the terms: blueprints, architectural drawings, working drawings, manufacturers' specifications and job specifications.
 - Relate the basic concepts of blueprint reading.
 - Use a measuring scale.
 - Identify symbols and abbreviations used on working drawings.
 - Locate specifications pertaining to a specific material or system.
 - Explain how different types of plumbing and piping systems are categorized.
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286041***Pipes, Fittings, and Valves*****Objectives:**

- Identify and classify the different types of material that are used to manufacture pipes, fittings, and valves.
 - List the characteristics of the various types of pipes, fittings, and valves available.
 - Classify and identify pipe "markings."
 - Know how to "read" a fitting for ordering purposes.
 - Identify the various types of valves and know their components.
 - Perform basic valve maintenance and know proper installation techniques.
 - Select and specify pipes, fittings, and valves for a particular application.
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286042***Plumbing and Pipefitting Tools*****Objectives:**

- Identify the various tools available for various tasks by appearance.
 - Demonstrate your knowledge of job safety and tool safety.
 - Identify the tools required to join and assemble pipes of different material composition.
 - Determine when and how to use pipe-joint assembly tools.
 - Identify the tools required to perform layout, cutting, and boring tasks.
 - Identify the tools needed for testing and maintaining piping systems.
 - Determine when and how to use finishing, testing, and maintenance tools for piping systems.
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286043***Joining and Assembling Pipes*****Objectives:**

- List necessary precautions to be taken when working with materials or procedures to join pipes.
 - Cut pipe lengths manufactured from the various pipes materials, as required by a piping system layout.
 - Prepare and assemble the various pipe joints you learned earlier.
 - Identify the materials, tools, and equipment needed for pipe.
 - Perform basic pipe welding tasks.
-

286044***Supporting, Installing, and Testing Pipes*****Objectives:**

- Lay out, install, and align a piping system either inside a building or underground.
 - Properly support a piping system using the various available methods, taking into account thermal expansion and contraction.
 - Identify methods and materials used to protect piping installations.
 - Calculate pipe offsets to avoid obstructions when laying out and installing a piping system.
 - Test different types of piping systems for defective materials or faulty workmanship.
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286045

Plumbing Fixtures and Appliances

Objectives:

- Recognize trade terms used to categorize and describe plumbing components.
- Identify the different types of plumbing fixtures, trim, appliances, and appurtenances.
- Explain the procedures used for installing plumbing fixtures and trim.
- Discuss common maintenance problems and corrective action for plumbing components.

286046

Tanks, Pumps, and Boilers

Objectives:

- Identify and classify the various available tanks.
- Specify and size round and rectangular tanks, and sumps, for a particular application.
- Identify different pumps and know pump principles.
- Discuss pump installation, start-up, and maintenance procedures.
- List the characteristics of boilers and discuss their classifications.
- Identify boiler accessories and know basic boiler maintenance.

286047

Insulation for Piping and Ducting

Objectives:

- Identify and understand the function and types of different piping and ducting insulation materials.
- Select the proper insulation type, material, and thickness for a given piping system.
- Properly cut, form, and install insulation and shielding to piping and ducting.

286087

Predictive Maintenance

Duration:

5 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)
Practical Measurements (Block X22)
Trades Safety: Getting Started (186001)

What Students Learn:

Preview

Predictive technologies measure one or more characteristics of machine operation, calculate the expected life of the monitored system, and then estimate the condition of equipment and, therefore, the need for maintenance on that equipment. With this information passed along to a good preventive maintenance program, the preventive maintenance team can make informed decisions on task scheduling and make the most of its maintenance and inspection tasks.

Vibration analysis programs are the most commonly conducted PDM efforts. By performing inspection and repairs during downtime, uptime failures of the analyzed components are all but eliminated. PDM is more than vibration analysis, however; multiple technologies, such as infrared thermography, balance, alignment, and electrical signature analysis are part of many PDM programs. Because of these technologies, plants run better and are more competitive. PDM allows maintenance departments to predict when a unit will fail and plan its maintenance during a scheduled downtime, usually when the unit is cooler, cleaner, and not needed for the manufacturing process.

Objectives

When a student completes this study unit, he and she will be able to:

- Define what PDM is and how it can be used in industry.
- Identify the various types of technologies used in PDM.
- Explain what goals should be considered for a new and a maturing PDM program.
- Discuss the scope of basic mechanical PDM.
- Explain how a time waveform and a frequency spectrum can be used to identify machine faults.

Contents

What Is Predictive Maintenance?; Predictive Maintenance Program Goals; Basic Mechanical Predictive Maintenance; Forms Of PDM Data.

286088

Predictive Maintenance: Vibration Analysis

Duration:

5 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)
Practical Measurements (Block X22)
Trades Safety: Getting Started (186001)

What Students Learn:

Preview

When a company decides to begin a predictive maintenance (PDM) program, the first technology usually embraced is vibration analysis. Vibration analysis allows the technicians or other specially trained personnel to perform condition monitoring of equipment. Condition monitoring is used at first as a coarse comb to pull out those programs that will imminently cause downtime. Then the program can progress beyond condition monitoring to provide scheduling services for preventive maintenance and identification of redesigns that address repetitive faults.

This study unit will show you the basics of vibration analysis as performed with a data collector and a computer software program. These devices will be used to collect vibration measurement data and to store and display the results.

Objectives

When a student completes this study unit, he and she will be able to:

- Explain how vibration measurements are taken and the systems used to identify measurement points.
- Identify balance, looseness, and misalignment problems.
- Discuss the techniques used to diagnose rolling-element bearing faults.
- Explain how journal bearing condition monitoring and fault analysis is performed.
- Identify speed reducer faults that occur in the gear sets or the internal bearings.
- Describe how resonance can affect the operation of equipment.

Contents

Vibration Measurements; Analyzing Balance And Looseness Problems; Misalignment Of Inline And Overhung Drive Systems; Analyzing Rolling-Element Bearing Systems; Condition Monitoring Of Journal Bearings; Condition Monitoring Of Speed Reducers; Resonance.

Vibration analysis alone cannot perform sufficient condition monitoring to meet the needs of today's industry. Vibration analysis cannot easily find electrical faults, air leaks, electrical discharges, metal particles or contamination and breakdown of lubricants, or other important monitoring processes. Other technologies are needed for these tasks. This study unit will introduce you to these other technologies.

In this study unit, we will investigate many different technologies that can and should often be part of a good predictive maintenance program (PDM). This course is designed to discuss these technologies at a basic level. If you're considering working with one of these technologies, it's very important to understand how to operate the equipment involved and to gain additional equipment training from the manufacturer. These actions will provide you with a safe and profitable expanded PDM program.

Objectives

When a student complete this study unit, he and she will be able to:

- Explain the steps involved in performing balance and alignment on industrial machines.
- Discuss the use and operation of ultrasonic equipment to find problems such as electrical arcing, bearing faults, and internal and external air leaks in pneumatic systems.
- Describe the procedures used in electrical signature analysis (ESA) and how this inspection system can find motor problems.
- Explain how oil analysis can find lubricant problems and contamination.
- Describe how thermography can be used in a PDM environment.

Contents

Modern Balance And Alignment; Ultrasonic Testing; Electrical Signature Analysis; Oil Analysis; Infrared Thermography.

286089

Predictive Maintenance: Advanced Topics

Duration:

5 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)
Practical Measurements (Block X22)
Trades Safety: Getting Started (186001)

What Students Learn:

Preview