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TRAINING PLAN – Maintenance Mechanic (YEAR 3)

Total Related Training Instruction (RTI) Hours: 144

Learning Unit	Hrs. of Instruction
Unit 3-1: Machine Shop: Grinding <ul style="list-style-type: none"> ➤ Grinding Processes and Theory ➤ Surface Grinder Set Up and Operation ➤ Cylindrical Grinder Set Up and Operation ➤ Centerless Grinder Set Up and Operation 	36.5
Unit 3-2: Mechanical Fundamentals <ul style="list-style-type: none"> ➤ Forces of Machines ➤ Power Transmission ➤ Bearings, Springs, Belt Drives, and Gear Applications. ➤ Mechanical Power Variables 	24.5
Unit 3-3: Welding for Maintenance <ul style="list-style-type: none"> ➤ Welding Processes ➤ Weld Types ➤ Symbols and Codes ➤ Fabrication 	28
Unit 3-4: Hydraulics and Pneumatics: Level 1 <ul style="list-style-type: none"> ➤ Fluid Systems ➤ Hydraulic and Pneumatic Components ➤ Fittings for Fluid Systems ➤ PM for Fluid Systems ➤ 	20
Unit 3-5: Electric Fundamentals <ul style="list-style-type: none"> ➤ Electrical units, circuits, and magnetism. ➤ NEC Overview ➤ Electrical Instruments ➤ AC and DC power Sources ➤ Series and Parallel Circuit Calculations 	35



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Unit 3-1: Machine Shop: Grinding

The learning unit introduces a worker to the various types of grinding processes and machines commonly found in a machine shop. This unit includes an overview of surface, cylindrical, and centerless grinding processes, including set up and operations.

Learning Outcomes and Content

1. Describe different types of grinding, Identify the correct grinding method for various types of workpieces
2. Explain ways to reduce scrap parts and increase productivity during the grinding process
3. Explain how proper coolant application can optimize wheel performance and improve finished parts, reducing scrap and tool cost
4. Identify a surface grinding machine and describe how it functions
5. Describe how to correctly and efficiently set up a surface grinding operation
6. Describe the steps and considerations for surface grinding a part from start to finish
7. Identify a cylindrical grinding machine and describe how it functions
8. Describe how to correctly and efficiently set up a cylindrical grinding operation
9. Describe the steps and considerations for cylindrical grinding a part from start to finish
10. Identify a centerless grinding machine and describe how it functions.
11. Describe how to correctly and efficiently set up a centerless grinding operation
12. Describe the steps and considerations for centerless grinding a part from start to finish
13. Describe how an understanding of grinding variables and their impact is essential to reducing manufacturing costs and increasing quality
14. Describe how to properly grind ferrous metals
15. Describe how to properly grind nonferrous metals
16. Explain why the properties of the abrasive grains and bond material are important factors in the grinding operation
17. Explain how Improper dressing or truing can lead to poor surface finish, improper tolerances, scrapped parts, and wheel failure
18. Explain how an incorrect or incompatible grinding wheel can lead to scrapped parts, damaged wheels or machines, and wasted time and money
19. Describe common wheel geometries and the applications appropriate for each

Learning Modules

Module	Hrs. of Instruction	Provider
<u>Grinding Processes</u> – This learning module provides a comprehensive overview of the various types of grinding used in modern manufacturing environments. Surface, cylindrical, centerless, and internal grinding processes are commonly used for workpieces of various shapes.	1.5	ToolingU-SME
<u>Basic Grinding Theory</u> – This learning module provides an overview of the general process of grinding. Grinding occurs at the point of contact between an abrasive wheel and a workpiece. Like any other cutting process, grinding removes material in the form of chips. In order for a wheel to grind properly, its abrasive grains must wear and self-sharpen at a consistent rate.	1.5	ToolingU-SME
<u>Introduction to Grinding Fluids</u> - This learning module provides an overview of the uses, types, and selection considerations of grinding fluids, or coolants, used in various machining operations. Appropriate grinding fluid use depends	1.5	ToolingU-SME



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on the type of operation, machine tool, and combination of tool and workpiece materials		
Basics of the Surface Grinder – This learning module provides an overview of the components, considerations, and varieties of the surface grinding machine	1.5	ToolingU-SME
Setup for the Surface Grinder – This learning module provides a comprehensive overview of the steps and considerations involved in setting up a surface grinding machine. Setup includes selecting a grinding wheel, testing and preparing the wheel, selecting the correct workholding and/or fixtures.	1.5	ToolingU-SME
Surface Grinder Operation - This learning module provides step-by-step guidelines on how to grind a rectangular workpiece. Grinding each side of a workpiece requires wheel dressing and other preparatory steps, and then roughing and finishing passes.	1.5	ToolingU-SME
Basics of the Cylindrical Grinder – This learning module provides a comprehensive overview of the steps and considerations involved in setting up a cylindrical grinding machine.	1.5	ToolingU-SME
Setup for the Cylindrical Grinder - This learning module provides a comprehensive overview of the steps and considerations involved in setting up a cylindrical grinding machine. Setting up a cylindrical grinding machine includes selecting a grinding wheel, dressing and truing the wheel.	1.5	ToolingU-SME
Cylindrical Grinder Operation - This learning module provides a detailed overview of the steps needed to perform the various types of operations possible on a cylindrical grinder. Operations performed on the cylindrical grinder include plunge, traverse, center-type, chucking-type, ID, profile, and taper grinding.	1.5	ToolingU-SME
Centerless Grinder Operation - This learning module explains the basic procedures required to properly operate a centerless grinder. To avoid lobing and increase workpiece roundness, a centerless grinder should have the correct workpiece rotational speed, as well as an accurately positioned work rest blade, work guides, and workpiece centerline relative to the wheel centerline	1.5	ToolingU-SME



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<p><u>Basics of the Centerless Grinder</u> – This learning module explains how to set up a centerless grinder for typical outer diameter (OD) operations.</p>	1.5	ToolingU-SME
<p><u>Setup for the Centerless Grinder</u> - This learning module explains how to set up a centerless grinder for typical outer diameter (OD) operations. The class explains the necessary setup for the work rest blade and regulating wheel angle of inclination.</p>	1.5	ToolingU-SME
<p><u>Grinding Variables</u>- This learning module provides a detailed overview of the different variables involved in any given grinding operation. The parameters of any grinding operation, including tolerances and surface finish, guide the variables of the operation.</p>	1.5	ToolingU-SME
<p><u>Grinding Ferrous Metals</u> - This learning module provides an in-depth overview of the considerations involved with grinding various ferrous metal workpiece materials.</p>	1.5	ToolingU-SME
<p><u>Grinding Nonferrous Metals</u> - This learning module provides an in-depth overview of the considerations for grinding nonferrous workpiece materials.</p>	1.5	ToolingU-SME
<p><u>Grinding Wheel Materials</u>- This learning module provides a detailed overview of the various abrasive and bond materials used in grinding wheels.</p>	1.5	ToolingU-SME
<p><u>Dressing and Truing</u>- This learning module provides a guide to performing necessary grinding wheel preparations</p>	1.5	ToolingU-SME
<p><u>Grinding Wheel Selection</u>- This learning module provides a guide on selecting the ideal grinding wheel from a grinding wheel manufacturer's catalog.</p>	1.5	ToolingU-SME
<p><u>Grinding Wheel Geometry</u>- This learning module provides an overview of common grinding wheel geometries according to American National Standards Institute (ANSI) standards.</p>	1.5	ToolingU-SME
<p><u>Grinding Practical</u> – This learning module will teach a worker how to plan for a grinding operation and develop the skills required to use various grinding equipment, including a surface grinder, cylindrical grinder, and a pedestal/tool & cutter machine grinder. Safe working procedures and standard work will be emphasized when setting up and operating the grinder.</p>	8	Facility



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The session will also discuss routine maintenance responsibilities required on grinding equipment.		
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Unit 3-2: Mechanical Fundamentals

The learning unit introduces various aspects of mechanical systems, including mechanical forces and power variables. The unit of instruction explores various mechanical applications such as belt drives, gears, springs, and bearings.

Learning Outcomes and Content

1. Identify various types of simple machine, as well as explain their components, function, and mechanical advantage
2. Identify different types of forces, the physical laws that define them, and the ways in which they are measured
3. Describe the components used to transmit mechanical energy
4. Identify different types of industrial lubricants and explains the importance of proper lubrication procedure
5. Explain how to accurately select bearings and take the measures necessary to ensure optimal bearing life
6. Identify the different spring types, their limitations and uses, and safe practices to follow for maintenance and installation
7. Describe how to select appropriate belt drives and perform the maintenance necessary to ensure optimal belt drive life
8. Identify different gears, understand gear drive abilities, and possess the knowledge to safely operate gear systems
9. Describe the basic involute design of gears, its purpose, and define necessary terms for gear specifications
10. Identify different types of clutches and brakes
11. Describe the operating conditions in which clutch and brakes are used, installed and serviced
12. Describe the variables involved in mechanical power transmission and how they affect industrial processes

Learning Modules

Module	Hrs. of Instruction	Provider
Introduction to Mechanical Systems – This learning module provides a foundational overview of mechanical systems. Simple machines, such as the lever, incline planed, and wheel, are the building blocks of even the most complex mechanical systems.	1.5	ToolingU-SME
Forces of Machines - This learning module provides a comprehensive overview of the physical forces behind machine functions. All machines are based on the science of mechanics, which deals with the effects of different forces that either cause or prevent motion.	1.5	ToolingU-SME
Power Transmission Components – This learning module discusses the process of mechanical power transmission and describes the components used to transmit mechanical energy.	1.5	ToolingU-SME



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<p>Lubricant Fundamentals – This learning module describes different types of industrial lubricants and explains the importance of proper lubrication procedure.</p>	1.5	ToolingU-SME
<p>Bearing Applications - This learning module provides an overview of the many different types of bearings used in mechanical applications. Bearings are an essential part of many applications because they provide movement and reduce friction.</p>	1.5	ToolingU-SME
<p>Spring Applications – This learning module provides an overview of the many different types of springs used in mechanical systems</p>	1.5	ToolingU-SME
<p>Belt Drive Applications - This learning module provides an overview of the many belts used in mechanical systems. Belt drives are essential to many applications since they transmit power, torque, and speed. A variety of belt types are available.</p>	1.5	ToolingU-SME
<p>Gear Applications - This learning module provides an overview of the many different types of gears and gear drives used in mechanical applications.</p>	1.5	ToolingU-SME
<p>Gear Geometry – This learning module discusses various types of gears used in industry, including information on how gears are used, maintained, and classified.</p>	1.5	ToolingU-SME
<p>Clutch and Brake Applications – This learning module describes different types of clutches and brakes, the operating conditions in which they are used, and installation, maintenance, and safety concerns.</p>	1.5	ToolingU-SME
<p>Mechanical Power Variables – This learning module discusses the variables involved in mechanical power transmission and how they affect industrial processes.</p>	1.5	ToolingU-SME
<p>Mechanical Fundamentals - This learning module provides hands-on instruction focused on the mechanical elements of power transmission including gears, levers, chains, belts, pulleys, shafts and couplings are introduced. Component application and maintenance is included. Safety will continuously be addressed throughout each topic.</p>	8	Facility



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Unit 3-3: Welding for Maintenance

The learning unit introduces the worker to the fundamentals of welding. Instruction includes an overview of the different welding processes, as well as weld types, welding symbols, and weld discontinuities. This unit also introduces basic fabrication best practices for industrial maintenance.

Learning Outcomes and Content

1. Describe different welding processes as well as their general attributes and applications
2. Identify the most commonly used welding processes
3. Describe why defects or discontinuities may occur as well as the ways in which welders may rectify them
4. Identify common welding symbols and their characteristics, as well as the welding codes and specifications used in the welding industry
5. Describe how to develop a fabrication plan and complete a fabrication project
6. Describe gas metal arc welding process and its equipment
7. Describe the basic theories and practices of shielded metal arc welding (SMAW), as well as common operational procedures
8. Describe the flux-cored arc welding (FCAW) process and its equipment

Learning Module

Module	Hrs. of Instruction	Provider
<u>Introduction to Welding</u> – This learning module provides the foundational understanding of welding and welding processes on top of which process-specific knowledge and a more comprehensive understanding of welding in general is built. The class introduces the different welding processes as well as their general attributes and applications.	1.5	ToolingU-SME
<u>Introduction to Welding Porcessess</u> - This learning module provides a comprehensive overview of the most commonly used welding processes, including oxyfuel welding, gas metal arc welding, gas tungsten arc welding, flux-cored arc welding, and shielded metal arc welding.	1.5	ToolingU-SME
<u>Overview of Weld Types</u> - This learning module provides an overview of different joints and types of welds as well as their applications. Common weld types such as fillet and groove welds, as well as combination, plug, slot, spot, and seam welds, are discussed.	1.5	ToolingU-SME
<u>Welding Symbols and Codes</u> - This learning module describes how welding blueprints represent welding requirements	1.5	ToolingU-SME
<u>Fabrication Process</u> - This learning module outlines the procedures that a project planner should follow when creating a product from start to finish.	1.5	ToolingU-SME



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Introduction to GMAW - This learning module provides a comprehensive overview of the gas metal arc welding process and its equipment.	1.5	ToolingU-SME
Introduction to SMAW - This learning module covers the basic theories and practices of shielded metal arc welding (SMAW), as well as common operational procedures.	1.5	ToolingU-SME
Introduction to FCAW - This learning module provides a comprehensive overview of the flux-cored arc welding (FCAW) process and its equipment.	1.5	ToolingU-SME
Welding for Maintenance Practical - This hands-on learning module provides practical application of various welding procedures and techniques commonly used during general maintenance, repair and fabrication.	16	Facility

Unit 3-4: Hydraulics and Pneumatics: Level 1

The learning unit teaches the worker about the fundamentals of hydraulic and pneumatic systems. This unit provides an overview of fluid systems, hydraulic and pneumatic components, fluid fittings and preventative maintenance.

Learning Outcomes and Content

1. Recognize how fluid systems function and explain the variables that affect them
2. Describe how the active and passive components of a hydraulic system work together to transmit power
3. Identify the components that affect each step of a pneumatic system
4. Identify the types of fluid conductors and their specific advantages and disadvantages within a fluid system
5. Identify the types of fittings used in a pneumatic system and how proper selection of a fitting will provide optimal efficiency within a system
6. Explain the benefits of a preventive maintenance approach for fluid systems
7. Identify different types of hydraulic fluid and the properties that make them ideal for certain applications

Learning Modules

Module	Hrs. of Instruction	Provider
Intro to Fluid Systems – This learning module introduces fluid power systems, including hydraulic and pneumatic components.	1.5	ToolingU-SME
The Forces of Fluid Power – This learning module presents a comprehensive overview of fluid power transmission systems. It offers a broad scope of	1.5	ToolingU-SME



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information, from fluid characteristics and basic energy forms to force multiplication and the effect of fluid flow rate in a system.		
Hydraulic Components – This learning module provides users with an overview of how the active and passive components of a hydraulic system work together to transmit power.	1.5	ToolingU-SME
Pneumatic Components – This learning module provides a comprehensive overview of pneumatic power and the elements that allow a pneumatic system to perform work.	1.5	ToolingU-SME
Fluid Conductors – This learning module provides a comprehensive overview of conductors in a fluid system, outlining the potential impact that each conductor has on a specific system.	1.5	ToolingU-SME
Fittings for Fluid Systems – This learning module provides a comprehensive overview of the types of fittings used to join or terminate a conductor run, as well as an overview of the maintenance and instillation of fittings	1.5	ToolingU-SME
Preventative Maintenance for Fluid Systems – This learning module provides an overview of the benefits of a preventive maintenance program for fluid systems.	1.5	ToolingU-SME
Hydraulic Fluid Selection – This learning module provides an overview of the types of hydraulic fluid and the properties that make them ideal for certain applications.	1.5	ToolingU-SME
Hydraulic Systems Practical: Part 1 - This learning module offers practical instruction time that will allow trainees to apply knowledge from previously completed eLearning courses towards the demonstration of skills under close instructional guidance. This module correlates fluid power principles with machine operation and daily maintenance duties. Procedures to ensure safety of maintenance personnel and prevent damage to machine will be covered. Fluid power symbols will be compared to the physical components. Location of components in a hydraulic system and proper adjustment procedures will be identified. Hands-on exercises will reinforce location, proper component connections, and effects of adjustments on system operation. Elimination of leaks by proper fitting selection and installation will be discussed. Significance of fluid cleanliness to system longevity and techniques to minimize ingress of contaminants will be presented.	8	Facility



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Unit 3-5: Electric Fundamentals

The learning unit introduces a worker to the fundamentals of electrical systems., including an overview of circuits, electrical measuring devices, and power sources.

Learning Outcomes and Content

1. Describe the fundamentals of electricity and the vocabulary used to describe it.
2. Describe circuit components, circuit diagrams, and the rules that govern circuits
3. Describe the relationship between electricity and magnetism
4. Identify different circuit components and describe when and why they are used
5. Describe the structure of the National Electric Code(R), as well as its major guidelines that impact electrical maintenance in production facilities
6. Describe electrical flow in an alternating current circuit and the impact alternating current has on electrical variables
7. Describe how to use electrical measuring instruments to safely and accurately measure electrical variables
8. Describe direct current and the different power sources that produce it
9. Describe the common power sources used to generate alternating current (AC)
10. Describe the rules and formulas used to calculate and predict electrical quantities and capacity
11. Describe the factors by which batteries are rated and other considerations that go into selecting an appropriate battery

Learning Modules

Module	Hrs. of Instruction	Provider
Electrical Units - This learning module provides a foundational overview of electricity, including fundamental measures and terminology used to discuss electricity. Electricity is the flow of electrons, which are negatively charged particles.	1.5	ToolingU-SME
Introduction to Circuits - This learning module provides a foundational overview of electrical circuitry. Whether wired in series, parallel, or a combination of the two, all circuits consist of a source, path, control, and load.	1.5	ToolingU-SME
Introduction to Magnetism - This learning module provides a thorough overview of magnetism and how it relates to electricity. Magnetism is a force of attraction and repulsion that occurs when the molecules in a material align.	1.5	ToolingU-SME
DC Circuit Components -This learning module provides a comprehensive overview of the different parts that appear in DC circuits, including source, path, control, and load. DC power sources include batteries, generators, and piezoelectricity.	1.5	ToolingU-SME



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NEC Overview – This learning module provides information on the contents, purpose, history, and applications of the National Electrical Code.	1.5	ToolingU-SME
AC Fundamentals – This learning module discusses alternating current (AC) as the most common form of electrical power.	1.5	ToolingU-SME
Electrical Instruments – This learning module describes the various roles of electrical testing instruments in maintaining the safety of electrical workers.	1.5	ToolingU-SME
DC Power Sources – This learning module provides a foundational overview of direct current and the different power sources that produce it.	1.5	ToolingU-SME
AC Power Sources – This learning module describes the common power sources used to generate alternating current (AC).	1.5	ToolingU-SME
Series Circuit Calculations – This learning module provides a comprehensive overview of the rules and formulas used to calculate and predict electrical quantities and capacity.	1.5	ToolingU-SME
Parallel Circuit Calculations – This learning module provides a comprehensive overview of the rules and formulas used to calculate electrical quantities and capacity.	1.5	ToolingU-SME
Battery Selection – This learning module discusses the factors by which batteries are rated and other considerations that go into selecting an appropriate battery.	1.5	ToolingU-SME
Industrial Electrical Fundamentals – This learning module will teach a worker the fundamentals and principles of AC and DC electric. Electrical safety procedures, lock out/tag out, and OSHA compliance are reviewed. The operation and use of relay contacts, input / output devices and measuring instruments are then covered.	8	Facility
Troubleshooting Electrical Systems with Schematics – This learning module will teach a worker the step by step methodology to enable one to troubleshoot electrical systems. Fundamentals of basic electrical theory along with understanding symbols and circuits will set a foundation for the beginning of the course. Meters and their use are covered next with lots of hands-on work. The use of measurement devices combined with knowledge of circuits then becomes the focus of the course. This knowledge is used to understand	9	Facility



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and troubleshoot relays and motors, power distribution and quality, motor controls, electric motor drives, and more.		
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