

State Ind Mech & Flu Maint Committee • Madison WI
 Lubrication Technician • 2-699687018-04-T
 Exhibit A - Program Provisions

DRAFT

TERM OF APPRENTICESHIP: The term of apprenticeship shall be Time-based, which has been established to be 2 years of not less than 4,000 hours. Hours of labor shall be the same as established for other skilled employees in the trade.

PROBATIONARY PERIOD: The probationary period shall be the first 6 months of employment, but in no case shall it exceed twelve calendar months. During the probationary period, this contract may be cancelled by the apprentice or the sponsor upon written notice to the Department, without adverse impact on the sponsor.

SCHOOL ATTENDANCE: The apprentice shall attend the Wisconsin Technical College System or other approved training provider, as assigned, for paid related instruction four hours per week or the equivalent and satisfactorily complete the prescribed course material for a minimum of 288 hours, unless otherwise approved by the Department. The employer must pay the apprentice for attended related instruction hours at the same rate per hour as for services performed.

WORK PROCESS SCHEDULE: In order to obtain well-rounded training and thereby qualify as a skilled worker in the trade, the apprentice shall have experience and training in the following areas. This instruction and experience shall include the following operations but not necessarily in the sequence given. Time spent on specific operations need not be continuous.

<u>Work Process Description</u>	<u>Approximate Hours</u> (Min - Max)
Adhere to industry and employer safety standards. A. Complete employer orientation and safety training. B. Wear appropriate personal protective equipment. C. Properly use tools and equipment.	100
Apply lubricants to machinery and components according to need and site requirements. A. Grease B. Oil C. Hydraulic fluid D. Glycol E. Synthetics F. Other	1000
Perform general lubrication practices. A. Perform routine inspections and housekeeping. B. Monitor lubrication and system operating parameters according to employer practices. C. Identify leakage; contamination; loose, damaged or missing parts; and vibration. D. Obtain oil samples for analysis, according to best practices. E. Perform minor pipe fitting; install oil sight glasses, breathers, drain plugs, tubing, etc.	1000
Perform preventative maintenance inspections according to maintenance schedule. A. Familiarize self with lubrication routes and practices for all areas. B. Print weekly route schedules. C. Complete route(s) and provide recommendations for continuous improvement. D. Record and maintain information in database for area of responsibility.	662

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Monitor, inspect, and operate hydraulic and central lube oil systems.	500
A. Monitor visual oil quality.	
B. Perform oil analysis and determine whether to filter or replace the oil.	
C. Drain and change oil.	
D. Change oil filters and reservoir breather filters.	
E. Maintain proper oil level, temperature, flow rates, etc.	
Identify, handle and store new and used lubricants according to employer's procedures.	250
Perform general duties.	200
A. Write work orders to correct machinery lubrication problems.	
B. Write purchase requisitions for tools, supplies, etc.	
C. Obtain lubrication information from OEM manuals and employer standards.	
Paid Related Instruction	288
TOTAL	4000

The above schedule is to include all operations and such other work as is customary in the trade.

MINIMUM COMPENSATION TO BE PAID:

N/A

Base skilled wage rate N/A per hour.

If at any time the base skilled wage rate rises or falls, the apprentice's wage shall be adjusted proportionately. The wage rate of apprentices employed in this trade and this firm shall be based on the base skilled wage rate stated above.

All apprentices are covered by State and Federal Wage and Hour Standard requirements. All apprentices shall be paid no less than the minimum wage established under regulations.

CREDIT PROVISIONS: The apprentice, granted credit at the start or during the term of the apprenticeship, shall be paid the wage rate of the pay period to which such credit advanced the apprentice.

Work credit hours approved: N/A

School credit hours approved:
Paid related instruction: N/A

Unpaid related instruction: N/A

Total credit hours to be applied to the term of the apprenticeship: N/A

SPECIAL PROVISIONS:

The apprentice must successfully complete the Transition to Trainer course in his or her final year.

The apprentice may be required by the employer to obtain basic First Aid and CPR certifications and maintain them throughout the program.



Lubrication Technician Apprenticeship Related Instruction Project Overview

IMFM State Apprenticeship Advisory Committee Meeting – April 2016

Project Goals:

1. Conduct a program review with WTCS college coordinators and instructors.
2. Verify hours for on-the-job and related instruction with state committee and BAS.
3. Review best practices and common approaches to related instruction used by the colleges for MMMP trades.
4. Revise and update WTCS statewide curriculum standards for related instruction in the Oiler Lubricator Apprenticeship.
5. Examine strategies for more consistent curriculum implementation in related instruction.
6. Align learning outcomes across colleges and in support of program expansion.
7. Create/Update/Revise course outcome summaries as needed.
8. Engage state advisory committee members throughout the project.

Key Activities:

- Project funding approved in November 2015.
- Conducted project specific planning discussions with MSTC and the WTCS (November 2015).
- Project launch and introductory webinar for 6 colleges (December).
- Facilitated three curriculum review and alignment workshop (December - February).
- Coordinate college participation including MSTC, NTC, NATC, NWTC, FVTC, and LTC.
- Brief IMFM state committee at their spring 2016 meeting.
- Facilitate next steps with colleges following review and approval phase by the WTCS.
- Complete new curriculum reports for related instruction courses taught by the technical colleges by May 2016.
 - Reports include program design summary, course configuration model, program alignment to MMMP trades, and Course Outcome Summaries for each course required for PRI.
- Host review webinars following workshops to verify draft curriculum documents as needed.
- Update WTCS curriculum standards for 2015-16 (May 2016).
- Post key documents on WTCS state curriculum repository and publish to the colleges.
- Communicate curriculum standards with technical college and instructors (spring TBD).

Respectfully submitted,

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WTCS Repository Program Design Summary & Curriculum Standards [2015-16]

50-423-7 LUBRICATION TECHNICIAN APPRENTICE

Program Information

Alternate Title	OILER/LUBRICATOR APPRENTICE Related Instruction
Instructional Level	Technical Diploma
Career Cluster	Architecture and Construction
CIP Code	47.0303

Description

Lubrication Technician apprentices work with industrial machinery and equipment components to apply lubricants required to proper operation. Apprentices will learn to adhere to safety and industry standards and demonstrate safe work practices. In related instruction, apprentices will learn to compare greases, oils, hydraulic fluids and other lubricants; perform general lubrication, operate hydraulic and central lube oil systems; and perform preventative maintenance. MSTC is the only college approved to offer this program at this time.

WTCS Program Outcomes

- 1 Adhere to industry and employer safety standards
- 2 Apply lubricants to machinery and components
- 3 Perform general lubrication practices
- 4 Monitor hydraulic and central lube oil systems
- 5 Inspect hydraulic and central lube oil systems
- 6 Operate hydraulic and central lube oil systems
- 7 Perform preventative maintenance inspections according to schedules
- 8 Handle new and used lubricants according to employer requirements
- 9 Perform other general duties related to correcting machinery lubrication problems

WTCS Program Configuration Model

50-423-7 Lubrication Technician Apprenticeship Related Instruction [2015-16]

Description

WTCS coursework for related instruction aligns with state training standards for Lubrication Technician Apprentice as approved by WI DWD-BAS in 2015. This program configuration provides a statewide model that colleges may use to plan courses locally. Colleges are encouraged to adopt the statewide model but may interpret and implement the model as needed to meet local needs.

The following recommendations for a statewide apprenticeship for Lubrication Technician were developed in July 2015 (Source: DWD-BAS):

- Apprenticeship length is two years of not less than 4,000 hours
- Apprenticeship requires 288 hours of paid related instruction
- Term is time-based
- Lube Tech apprentices registered to sole sponsors attend selected courses from the Millwright curriculum
- Apprentices may skip one or more topics within a semester or skip an entire semester
- Lube Tech apprentices may complete PRI up to 2 years after they complete OJT
- Attendance in paid related instruction shall be 4 hours per week or the equivalent
- Apprentice shall satisfactorily complete the prescribed course materials unless otherwise approved by the department

Credits & Hours

1 - Occupation Specific 9.00 credits & 288 hours

2 - Occupation Supportive 0.00 credits & 8 hours

Total Credits 9.00 credits & 296 hours

Related Instruction - Term 1

Course #	Course Title	Credits & Hrs.	Course Descriptions
50-423-717	Hydraulics for MMMP Trades (C-8)	0.75 20 hrs.	This course provides instruction to apprentices concerning many aspects of inspecting, servicing, and troubleshooting hydraulic systems and components. Apprentices will learn safety related issues and be taught proper safety procedures for working with hydraulic systems and components. It was formerly the C-8 module for the MMMP apprenticeship program.
50-423-718	Pneumatics & Compressed Air for MMMP Trades (C-9)	0.75 20 hrs.	This course was formerly the C-9 module for the MMMP apprenticeship. It provides instruction to apprentices concerning many aspects of inspecting, servicing, and troubleshooting pneumatic systems and components. Apprentices will learn safety related issues and be taught

			proper safety procedures for working with pneumatic systems and components.
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Related Instruction - Term 2

Course #	Course Title	Credits & Hrs.	Course Descriptions
50-423-720	Pipefitting and Valves for MMMP Trades (C-11)	0.75 24 hours	Course introduces apprentices to pipe sizes, materials and schedules, examines fittings, tubing and valves, and develops skills related to layout, installation, and maintenance. This course was formerly the C-11 module for the MMMP apprenticeship program.
50-423-722	Packings, Seals, Gaskets for MMMP Trades (C-13)	0.50 16 hours	Apprentices will examine packing, seals, and gaskets and compare materials and applications. Then skills in layout, cutting, inspecting, removing, and installing these components will be developed. This course was the former C-13 module for the MMMP apprenticeship program.
50-423-732	Pumps for the MMMP Trades (M-3)	0.75 24 hours	Course compares different pump types and their applications. Apprentices will complete a field inspection of pumps and learn how to troubleshoot, remove, overhaul, install and perform preventative maintenance on pumps. This course was formerly the M-3 module for related instruction in the MMMP apprenticeship programs.
50-423-736	Conveyors for the MMMP Trades (M-7)	0.25 8 hours	Course examines chain, belt, and other types of conveyors and related components. This course was formerly the M-7 module in related instruction for the MMMP apprenticeship programs.

Related Instruction - Term 3

Course #	Course Title	Credits & Hrs.	Course Descriptions
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50-423-760	Lubrication Fundamentals for Apprentices	1.25 44 hours	Course learning outcomes include interpreting oil test analyses, examining automated lubrication technologies, exploring ultrasound testing, comparing filtration technologies and exploring other fundamental concepts involved in lubrication technologies. Course is intended for apprentices enrolled in related instruction, and the fundamental concepts presented in this course will be applied to industrial equipment and machines & trade work practices. <i>High school level math skills are suggested as a prerequisite to this program.</i>
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Related Instruction - Term 4

Course #	Course Title	Credits & Hrs.	Course Descriptions
50-423-730	Bearings for the MMMP Trades (M-1)	0.75 24 hours	Apprentices will examine bearing types and applications, and compare equipment bearings. Then learners will develop skills related to bearing inspection, selection, removal, mounting, lubrication and diagnosing bearing failures. Course was formerly the M-1 module in related instruction for the MMMP apprenticeship.
50-423-731	Couplings & Alignment for the MMMP Trades (M-2)	1.00 36 hours	Course compares different coupling types and examines common misalignment problems. Apprentices will develop skills related to inspecting, troubleshooting, and preparing couplings for removal and installation, and also aligning and lubricating couplings. This course was formerly the M-2 module for related instruction in the MMMP apprenticeship programs.

Related Instruction - Term 5

Course #	Course Title	Credits & Hrs.	Course Descriptions
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50-423-733	Belts, Sheaves, Pulleys and Drives for the MMMP Trades (M-4)	0.75 24 hours	Course compares different belt types and drive components. Apprentices will develop skills related to inspecting, troubleshooting, removing, selecting, and installing belt drive systems. This course was formerly the M-4 module for related instruction in the MMMP apprenticeship programs.
50-423-734	Gears, Gearboxes, Gear Assemblies for the MMMP Trades (M-5)	0.75 24 hours	Course compares gear types and applications. Apprentices will develop skills inspecting gear assemblies, troubleshooting gear problems, removing gears and components, and reassembling gear drive systems. This course was formerly the M-5 module in related instruction for the MMMP apprenticeship programs.
50-423-735	Mechanical Power Transmission for the MMMP Trades (M-6)	0.75 24 hours	Course examines drive transmission systems and their applications, including roller chains. Apprentices will develop skills inspecting power transmission systems and troubleshooting mechanical drive systems. This course was formerly the M-6 module in related instruction for the MMMP apprenticeship programs.

Related Instruction Term 6

Course #	Course Title	Credits & Hrs.	Course Descriptions
47-455-455	Transition to Trainer: Your Role as a Journey Worker	0.00 8 hours	You will explore the skills that are necessary to be an effective trainer, discover how to deliver hands-on training, and examine the process for giving useful feedback. During the workshop you will build a Training Toolkit to take back to your work on the job.

50-423-717 Hydraulics for MMMP Trades (C-8) Course Outcome Summary

Course Information

Alternate Title	Maintenance Mechanic & Millwright Apprenticeship Related Instruction
Description	This course provides instruction to apprentices concerning many aspects of inspecting, servicing, and troubleshooting hydraulic systems and components. Apprentices will learn safety related issues and be taught proper safety procedures for working with hydraulic systems and components. It was formerly the C-8 module for the MMMP apprenticeship program.
Total Credits	0.75
Total Hours	20.00

Types of Instruction

Instruction Type	Credits/Hours
Lecture, discussion, demonstration & small group activities	20 hours

Course Competencies

1. Define the principles of hydraulics

Learning Objectives

- 1.a. Define the terms associated with hydraulics
- 1.b. Describe the relationship between pressure and flow
- 1.c. Explain the different methods of measuring flow rate and pressure in a hydraulic system
- 1.d. Describe the relationship between absolute pressure, gage pressure and vacuum pressure
- 1.e. Explain the laws of hydraulics including Charles law, Boyles law, and Pascal's law
- 1.f. Give examples of the relationship between force, area, and pressure
- 1.g. Explain what can cause pressure drop in a hydraulic circuit
- 1.h. Recognize the location(s) of potential pressure drop within a hydraulic circuit

2. Interpret hydraulic schematic diagrams

Learning Objectives

- 2.a. Match schematic symbols to actual components
- 2.b. Identify lockout points in a system on the diagram
- 2.c. List the differences between a standard and regenerative circuit. Give examples of where each might be used.
- 2.d. Describe the differences between hydraulic and pneumatic schematic symbols
- 2.e. Draw symbols and name the component it represents
- 2.f. Interpret a schematic for a basic hydraulic circuit

3. Analyze the function of hydraulic system components

Learning Objectives

- 3.a. Describe safety measures to be observed when working with hydraulic components
- 3.b. Explain the potential sources of stored energy in a hydraulic system
- 3.c. Describe construction, function and application of pressure control valves such as: relief, sequence, unloading, counterbalance, reducing
- 3.d. Describe the construction, function and application of directional control valves such as: 2-way, 3-way, 4-way, manual, pilot, and mechanically and electrically operated
- 3.e. Describe the construction, function and application of flow controls such as: pressure compensated and non-compensated
- 3.f. Explain the operation of cylinders such as: single acting, double acting, double rod, and rotary
- 3.g. Explain cushioning devices and how they function in cylinders
- 3.h. Explain the classifications "positive and non-positive" as related to hydraulic pumps
- 3.i. Explain the difference and purpose of fixed and variable displacement pumps
- 3.j. Describe the basic construction, operation and use of gear pumps, vane pumps, and piston pumps
- 3.k. Explain pump ratings by: displacement, GPM delivery, and rating conditions for fixed and variable displacement pumps
- 3.l. List pros and cons for pump types as they relate to certain applications
- 3.m. Explain the construction and operation of gear motors, vane motors, and piston motors
- 3.n. List pros and cons for motor types as they relate to certain applications

4. Apply troubleshooting principles to hydraulic systems

Learning Objectives

- 4.a. Describe each of the seven phases of troubleshooting: knowing the system, determining what the system is doing exactly, listing possible causes, isolating the fault, repairing the fault, testing the repair, documenting the work.
- 4.b. Identify sources of stored energy in systems and system components
- 4.c. Describe methods to lock out or block potential energy sources
- 4.d. Describe the safety practices to be observed when removing and installing hydraulic components
- 4.e. Explain the safety practices to be observed in operating hydraulic systems
- 4.f. Explain typical hazards found in selected hydraulic components
- 4.g. Identify at least five components in your hydraulic system layout and for each list component troubleshooting steps
- 4.h. List symptoms that would be present in your system is a specific component (selected by your instructor) failed or malfunctioned
- 4.i. Explain how to diagnose pump problems
- 4.j. Explain how to diagnose valve problems
- 4.k. Explain how to diagnose actuator problems
- 4.l. Diagnose seal, packing, and gasket leakage problems

5. Remove construct and install conductors and connectors

Learning Objectives

- 5.a. Explain applications for tubing, piping, and hose, and describe situations where you would choose each type including concerns for pressure and flows etc.
- 5.b. List the items to look for in proper cuts, deburrs, and bends for conductors
- 5.c. Cut, deburr, and bend tubing, or describe a step by step walk-through of cutting, deburring and bending
- 5.d. State safety concerns for specific tools
- 5.e. Construct a hydraulic hose using manufacturers specifications with the correct tools
- 5.f. Fabricate pipe for a specific application with the correct tools
- 5.g. Explain the criteria used in selecting each type of fitting
- 5.h. Locate the procedure for connectors and conductors installation
- 5.i. Install, or describe a step by step walk-through of installing connectors and conductors
- 5.j. List and describe the safety precautions for leak checks and check installation for leaks

6. Repair hydraulic components

Learning Objectives

- 6.a. Explain use and or application of the different types of seals used in hydraulic applications
- 6.b. Explain the use and or application of packings used in hydraulic systems
- 6.c. Explain the types of gasket materials used in hydraulic systems

- 6.d. Explain the desirable and undesirable aspects of leakage
- 6.e. Explain the general process of installing seals in hydraulic components
- 6.f. Rebuild a hydraulic component
- 6.g. Test a component after rebuild according to manufacturer's recommendations
- 6.h. Show where and how to locate information about seals, packings, gaskets, and lubricants
- 6.i. Describe various lubricants used with rebuilding components
- 6.j. Select Personal Protective Equipment (PPE) for a specific job and explain the proper use for that equipment

7. Select hydraulic fluids

Learning Objectives

- 7.a. List the types of hydraulic fluid
- 7.b. Identify safety concerns on the MSDS for particular fluids
- 7.c. Cross reference fluids between manufacturers
- 7.d. Explain the consequences of installing the incorrect type of fluid in a system
- 7.e. Describe the characteristics of old or contaminated fluid
- 7.f. Compare and contrast the characteristics of the different types of fluid
- 7.g. Select the exact type of fluid for a specific application
- 7.h. Demonstrate techniques to prevent fluid contamination

8. Perform preventive maintenance on hydraulic systems

Learning Objectives

- 8.a. Explain how "lock out tag out", system interlocks, etc. have to be dealt with
- 8.b. Define preventive maintenance
- 8.c. Describe the importance of record keeping
- 8.d. Determine and describe the factors to be considered when developing a preventive maintenance program for a hydraulic system
- 8.e. Explain the preventive maintenance tasks for components versus those for the system
- 8.f. Service a hydraulic component(s)

50-423-718 Pneumatics & Compressed Air for MMMP Trades (C-9)

Course Outcome Summary

Course Information

Alternate Title	Maintenance Mechanic & Millwright Apprenticeship Related Instruction
Description	This course was formerly the C-9 module for the MMMP apprenticeship. It provides instruction to apprentices concerning many aspects of inspecting, servicing, and troubleshooting pneumatic systems and components. Apprentices will learn safety related issues and be taught proper safety procedures for working with pneumatic systems and components.
Career Cluster	Manufacturing
Instructional Level	Technical Diploma
Total Credits	0.75
Total Hours	20.00

Types of Instruction

Instruction Type	Credits/Hours
Lecture, discussion, demonstration & small group activities	20 hours

Course Competencies

1. Define the principles of pneumatics

Learning Objectives

- 1.a. List the basic differences between hydraulic and pneumatic systems and explain them
- 1.b. Define the terms associated with pneumatics
- 1.c. Describe the relationship between pressure, flow rate and volume of air
- 1.d. Explain the different methods of measuring pressure in a pneumatic system
- 1.e. Describe the relationship between absolute pressure, gage reading and vacuum reading
- 1.f. Explain the laws of pneumatics including: Charle's law, Boyle's law, and Pascal's law
- 1.g. Give examples of the relationship between force, area, and pressure
- 1.h. Explain what can cause pressure drop in a pneumatic circuit
- 1.i. Recognize the location(s) of potential pressure drop within a pneumatic circuit

2. Interpret pneumatic schematic diagrams

Learning Objectives

- 2.a. Match schematic symbols to actual components.
- 2.b. Identify lockout points in the system or diagram.
- 2.c. List the differences between different types of pneumatic circuits. Give examples of where each might be used.
- 2.d. Describe the differences between hydraulic and pneumatic schematic symbols
- 2.e. Draw symbols and name the component it represents
- 2.f. Interpret a schematic for a basic pneumatic circuit

3. Analyze the function of pneumatic system components

Learning Objectives

- 3.a. Describe the safety measures to be observed when working with pneumatic components
- 3.b. Describe construction, function and application of pressure control valves such as: relief, sequence, pressure reducing, and dump/exhaust valves etc.
- 3.c. Describe the construction, function and application of directional control valves such as: 2-way, 3-way, 4-way, the manual, pilot and mechanically and electrically operated
- 3.d. Describe the construction, function and application of flow control valves
- 3.e. Inspect pneumatic valves for proper operation
- 3.f. Perform service and adjustments on pneumatic valves
- 3.g. Explain the operation of cylinders such as: single acting, double acting, double rod, and rotating
- 3.h. Explain the difference between differential and non-differential cylinders
- 3.i. Explain the use of cushioning devices and how cushions work in a cylinder
- 3.j. Explain the construction and operation of vane motors and piston motors
- 3.k. List pros and cons for motor types as they relate to certain applications

4. Service an Filter-Regulator-Lubricator (FRL) unit

Learning Objectives

- 4.a. Describe the safety procedures to be followed and explain how to apply them in FRL service
- 4.b. Define "FRL"
- 4.c. Explain the function of each component in an FRL in a pneumatic system
- 4.d. Name the parts of a typical FRL and explain what each does
- 4.e. Describe the air flow to and through an FRL
- 4.f. List the proper order and placement of the FRL's in the system
- 4.g. Look up parts and service procedures in manufacturers publications

5. Apply troubleshooting principles to pneumatic systems

Learning Objectives

- 5.a. Describe each of the seven phases of troubleshooting: knowing the system, determining what the system is doing exactly, listing possible causes, isolating the fault, repairing the fault, testing the repair, documenting the work.
- 5.b. Identify sources of stored energy in systems and system components
- 5.c. Describe methods to lock out or block potential energy sources
- 5.d. Explain the safety practices to be observed in operating pneumatic systems
- 5.e. Explain typical hazards found in selected pneumatic components
- 5.f. Describe the safety practices to be observed when removing and installing pneumatic components
- 5.g. List safety rules that should be followed when working with pneumatic systems
- 5.h. Identify at least five components in your pneumatic system layout and for each list component troubleshooting steps
- 5.i. List symptoms that would be present in your system is a specific component (selected by your instructor) failed or malfunctioned
- 5.j. Explain how to diagnose air reservoir problems
- 5.k. Explain how to diagnose valve problems
- 5.l. Explain how to diagnose cylinder problems
- 5.m. Diagnose seal, packing and gasket leakage problems

6. Service pneumatic conductors and connectors

Learning Objectives

- 6.a. Explain applications for the tubing, piping and hose
- 6.b. Describe situations where you would choose tubing or piping or hose and why
- 6.c. Locate the procedure for fitting installation
- 6.d. Install, or describe a step by step walk-through of installing a fitting
- 6.e. State safety concerns for specific tools
- 6.f. Construct a pneumatic hose using manufacturers specifications and selecting the correct tools
- 6.g. Construct a pneumatic tubing using manufacturers specifications and selecting the correct tools
- 6.h. Fabricate pipe for a specific application selecting the correct tools
- 6.i. Cut, deburr, and bend tubing, or describe a step by step walk-through of cutting, deburring and bending

- and list the items to look for in proper cuts, deburrs, and bends
- 6.j. Explain the criteria used for selecting each type of fitting
- 6.k. List and describe the safety precautions for leak checks and check installation for leaks

7. Repair pneumatic components

Learning Objectives

- 7.a. Explain the use and or application of the different types of seals used in pneumatic applications
- 7.b. Explain the use and or application of packings used in pneumatic systems
- 7.c. Explain the types of gasket materials used in pneumatic systems
- 7.d. Explain the desirable and undesirable aspects of leakage
- 7.e. Explain the general process of installing seals in pneumatic components
- 7.f. Rebuild a pneumatic component
- 7.g. Test a component after rebuild according to manufacturer's recommendations
- 7.h. Show where and how to locate information about seals, packings, gaskets, and lubricants
- 7.i. Describe various lubricants used with rebuilding components
- 7.j. Select Personal Protective Equipment (PPE) for a specific job and explain the proper use for that equipment

8. Perform preventive maintenance on pneumatic systems

Learning Objectives

- 8.a. Explain how "lock out tag out", system interlocks, etc. have to be dealt with
- 8.b. Define preventive maintenance
- 8.c. Describe the importance of record keeping
- 8.d. Determine and describe the factors to be considered when developing a preventive maintenance program for a pneumatic system
- 8.e. Explain the preventive maintenance tasks for components versus those for the system
- 8.f. Service a pneumatic component

9. Examine air compressor systems, components and equipment

Learning Objectives

- 9.a. Define terms associated with air compressors and systems.
- 9.b. Identify common tools used by the trade when working on air compressors.
- 9.c. Review safety rules and regulations applicable to compressed air.
- 9.d. Explore testing requirements.
- 9.e. Examine installation practices.
- 9.f. Explore servicing equipment and components.
- 9.g. Compare repair and replacement practices.
- 9.h. Apply predictive and preventative maintenance concepts.

50-423-720 Pipefitting and Valves for MMMP Trades (C-11)

Course Outcome Summary

Course Information

Alternate Title	Maintenance Mechanic & Millwright Apprenticeship Related Instruction
Description	Course introduces apprentices to pipe sizes, materials and schedules, examines fittings, tubing and valves, and develops skills related to layout, installation, and maintenance. This course was formerly the C-11 module for the MMMP apprenticeship program.
Total Credits	0.75
Total Hours	24.00

Types of Instruction

Instruction Type	Credits/Hours
Lecture discussion demonstration & small group activities	24 hours

Course Competencies

1. Examine pipe sizes, materials and schedules

Learning Objectives

- 1.a. Define pipe
- 1.b. Identify pipe by size both standard and metric
- 1.c. Identify different thread types
- 1.d. Identify pipe materials and their uses

2. Examine types of pipe fittings

Learning Objectives

- 2.a. Identify different types of fittings including: nipples, unions, elbows, etc.
- 2.b. Explain the difference between straight and tapered thread
- 2.c. Explain applications for different fittings
- 2.d. Describe where different types of fittings are used in a system

3. Examine different types of tubing and their related components

Learning Objectives

- 3.a. Identify tubing by use
- 3.b. Identify tubing by type
- 3.c. List strength and weaknesses of various tubing types
- 3.d. Select valves related to tubing for a specific application
- 3.e. Inspect valves related to tubing

4. Install tubing with fittings

Learning Objectives

- 4.a. Explain how tubing is sized
- 4.b. Describe sizing and other common difference in foreign tubing and fittings
- 4.c. Explain proper use of cutting/deburring/flaring/bending tools
- 4.d. Cite the correct flaring angles for tubing type
- 4.e. Select the proper fittings for a particular type of tube and application

- 4.f. Cut and deburr tubing
- 4.g. Flare tubing according to material type
- 4.h. Assemble tubing and fittings
- 4.i. Explain the considerations for bending tubing

5. Examine different types of valves and their related components

Learning Objectives

- 5.a. Identify and explain the operation of various valves including: globe, gate, ball, plug, check, flow control, etc.
- 5.b. List safety precautions and procedures necessary when working with valves
- 5.c. Explain lockout/tagout safety precautions and procedures necessary when working with valves
- 5.d. Identify valve materials and their applications
- 5.e. Define and use valve terminology
- 5.f. Describe how to disassemble and repair valves
- 5.g. Describe how to install packings and seals on valve stems
- 5.h. Inspect valves
- 5.i. Explain reasons for valve problems and failures
- 5.j. Select valves for a specific application

6. Layout a piping system

Learning Objectives

- 6.a. Match piping material to the fluids and pressure with which it is compatible
- 6.b. Explain the proper joining process for a specific piping application
- 6.c. Explain lockout/tagout safety precautions and procedures necessary when working with piping systems
- 6.d. List the safety precautions for the particular system
- 6.e. Explain flow, direction, pitch, and pressures for the system
- 6.f. Identify pipe routing, support, and hanging requirements
- 6.g. Select the proper valve to use for given quantity and or material
- 6.h. Identify schematic symbols and their meanings

7. Install a piping system

Learning Objectives

- 7.a. Install pipefitting accessories
- 7.b. Assemble components as needed
- 7.c. Assemble tools required for the job
- 7.d. Explain each safety consideration for a piping system installation
- 7.e. Explain lockout/tagout safety precautions and procedures necessary for piping system installation
- 7.f. Prepare components for assembly
- 7.g. Assemble components according to the layout
- 7.h. Test the system for proper operation
- 7.i. Adjust the system as needed to operate properly
- 7.j. Install a valve
- 7.k. Install plastic piping
- 7.l. Cut pipe for threading
- 7.m. Cut pipe for welding

8. Maintain piping systems

Learning Objectives

- 8.a. Explain what each component in the system is doing
- 8.b. Describe safety procedures to follow while inspecting and repairing the system
- 8.c. Explain lockout/tagout safety precautions and procedures necessary when inspecting and repairing the system
- 8.d. Identify leaks and defects
- 8.e. Determine what needs to be done to correct a specific problem
- 8.f. Make needed repairs and adjustments
- 8.g. Test the system
- 8.h. Inspect pipe systems for defects
- 8.i. Maintain valves

- 8.j. Troubleshoot valve problems
- 8.k. Remove a valve



50-423-722 Packings, Seals, Gaskets for MMMP Trades (C-13)

Course Outcome Summary

Course Information

Alternate Title	Maintenance Mechanic & Millwright Apprenticeship Related Instruction
Description	Apprentices will examine packing, seals, and gaskets and compare materials and applications. Then skills in layout, cutting, inspecting, removing, and installing these components will be developed. This course was the former C-13 module for the MMMP apprenticeship program.
Total Credits	0.50
Total Hours	16.00

Types of Instruction

Instruction Type	Credits/Hours
Lecture, discussion, demonstration and small group activities	16 hours

Course Competencies

1. Examine types of packing, seals, and gaskets

Learning Objectives

- 1.a. Explain what packings are and the purpose they serve.
- 1.b. Explain what seals are and the purpose they serve.
- 1.c. Explain what gaskets are and the purpose they serve.
- 1.d. Explore different types of packings and explain their applications.
- 1.e. Explore different types of seals and explain their applications.
- 1.f. Explore different types of gaskets and explain their applications.

2. Examine packing, seal, and gasket materials and applications

Learning Objectives

- 2.a. Examine the different types of packing materials, their shapes, and explain their uses.
- 2.b. Examine the different types of sealing materials, their shapes, and explain their uses.
- 2.c. Examine the different types of gasket materials, their shapes, and explain their uses.
- 2.d. Describe some of the applications for various types of seals, packings, and gaskets including food stuffs, petroleum products, caustic, etc.

3. Layout and cut gaskets

Learning Objectives

- 3.a. Describe the materials available that can be used for gaskets and list their pros and cons.
- 3.b. Select the correct type of material for a gasket.

- 3.c. Select the correct tools for layout and cutting of a gasket.
- 3.d. Layout a gasket template.
- 3.e. Explain the safety precautions to be followed when cutting gaskets.
- 3.f. Check a gasket for defects after cutting.

4. Inspect packings, seals, and gaskets

Learning Objectives

- 4.a. Select packing, seal or gasket for a specific application.
- 4.b. Describe some of the common defects found such as: incorrect installation, damaged in manufacture or shipping, incorrect size or material, etc.
- 4.c. Describe some of the common failures found such as: wear, cuts, cracks, etc.
- 4.d. Inspect seal, gasket, and/or packing for defects or failures.

5. Remove packings, seals, and gaskets

Learning Objectives

- 5.a. Describe methods that can be used to identify problems with packings, seals, and gaskets.
- 5.b. Explain the importance of cleanliness.
- 5.c. Describe how the sealing of a gasket, packing or seal is affected by contaminants.
- 5.d. Explain the cleanliness procedures to be followed when removing packings, seals, and gaskets.
- 5.e. Explain the safety precautions to be followed when removing packings, seals, and gaskets.
- 5.f. Select the correct tools and related equipment for the removal of packings, seals, and gaskets.
- 5.g. Describe the procedure to disassemble a given component that contains a packing, seal, or gasket.
- 5.h. Check the component disassembled for damage and cleanliness.

6. Install packings, seals, and gaskets

Learning Objectives

- 6.a. Describe methods that can be used to identify problems with packings, seals, and gaskets.
- 6.b. Explain the safety precautions to be followed when installing packings, seals, and gaskets.
- 6.c. Describe how the sealing of a gasket, packing or seal is affected by contaminants.
- 6.d. Explain the cleanliness procedures to be followed when working with packings, seals, and gaskets.
- 6.e. Select the correct tools and related equipment for the installation of packings, seals, and gaskets.
- 6.f. Describe the procedure to assemble a given component that contains a packing, seal, or gasket.
- 6.g. Check the component for damage and cleanliness prior to installation.
- 6.h. Select the proper packing, seal, or gasket for a particular component.
- 6.i. Reassemble component or components as required.
- 6.j. Test the component for proper operation and the packing, seal, or gasket for proper operation.
- 6.k. Explain the importance of lubricants in the assembly and installation of a packing, seal, or gasket as appropriate to the application.
- 6.l. Select the proper sealant for gasket installation as appropriate to the application.

50-423-730 Bearings for the MMMP Trades (M-1)

Course Outcome Summary

Course Information

Alternate Title	MMMP Related Instruction Module M-1
Description	Apprentices will examine bearing types and applications, and compare equipment bearings. Then learners will develop skills related to bearing inspection, selection, removal, mounting, lubrication and diagnosing bearing failures. Course was formerly the M-1 module in related instruction for the MMMP apprenticeship.
Total Credits	0.75
Total Hours	24.00

Types of Instruction

Instruction Type	Credits/Hours
Lecture discussion demonstration & small group activities	24 hours
On Campus Lab	

Course Competencies

1. Examine different bearing types and their applications

Learning Objectives

- 1.a. Identify types of bearing loads such as radial, axial, thrust etc.
- 1.b. Identify the types of bushings, sleeves and explain their uses.
- 1.c. Identify bearing nomenclature and the numbering/lettering scheme.
- 1.d. Examine the shaft and what it is doing and explain how this drives the type of bearing used.
- 1.e. Examine bearing application and describe specifications for shields, heat, speed, seal types, etc.
- 1.f. Explain why there are different types of bearings and examine the many types including, thrust bearing, radial, roller, ball, needle, ceramic, solid, floating vs held, tapered bearings, etc.
- 1.g. Explain why some bearings have matched parts/sets and why this is important.

2. Handle equipment bearings

Learning Objectives

- 2.a. Describe the importance of bearing cleanliness and relate it to bearing life.
- 2.b. Explain how handling a bearing with bare hands can cause damage.
- 2.c. Explain what proper bearing storage is.
- 2.d. Describe the damage that is caused by various impacts such as dropping.
- 2.e. Explain what to do with a damaged bearing.
- 2.f. Unwrap a bearing in an environment where it will not be contaminated.

3. Inspect a bearing

Learning Objectives

- 3.a. Identify common types of defects such as pitting, spalling, discoloration, etc.
- 3.b. Examine for condition such as cracking, peeling, etc.

- 3.c. Check clearances on the bearing.
- 3.d. Inspect the mounting condition of the bearing.
- 3.e. Identify the parts to be inspected such as the housing, shaft, end caps, spacers, locking devices, flanges, etc.
- 3.f. Identify the proper cleaning methods to be used in cleaning a specific bearing.
- 3.g. Flush out lubricants and contaminants with proper cleaning solutions.
- 3.h. Explain why the final cleaning should be done with filtered proper cleaning solution.
- 3.i. Describe the applications of different types of cleaners such as ultra-sonic etc.
- 3.j. Demonstrate the proper use of an air hose being used with bearings.
- 3.k. Comply with safety precautions related to skin exposure to cleaning solutions, eye protection, proper use of air hose, etc.
- 3.l. Explain the hazards of spinning bearings with compressed air.

4. Analyze bearing failures

Learning Objectives

- 4.a. Interview operator as applicable for clues to problem.
- 4.b. Use all senses when inspecting a bearing temperature, sounds, smells, etc.
- 4.c. Explain what the various bearing failures are such as overheating, bad housing fit, contamination, inside mount, outside mount, shaft failure, lubrication etc.
- 4.d. Inspect associated equipment for failure and ensure that it is not the cause of the failure.
- 4.e. Pull guards and look for visual failures.
- 4.f. Examine vibration analysis data (if available) to pinpoint where problem is occurring.
- 4.g. Narrow list down to the specific cause of bearing failure.

5. Remove a bearing

Learning Objectives

- 5.a. Explain the related safety procedures and how you would ensure compliance (lock out tagout, correct personal protective equipment PPE, blocking equipment).
- 5.b. Explain when a bearing must be returned to the manufacturer.
- 5.c. Identify the correct removal procedure to be used for each application.
- 5.d. Identify ways to prevent damage during a removal.
- 5.e. Describe tool choice and special equipment choice and their uses before beginning the removal.
- 5.f. Explain the value of a used bearing and why they should be properly handled.

6. Select a bearing

Learning Objectives

- 6.a. Identify bearing nomenclature and the numbering/lettering scheme.
- 6.b. Explain how to identify a correct replacement.
- 6.c. Describe ways to identify a bearing and places to research bearing information such as equipment manual etc.
- 6.d. Measure shaft, bore, depth of bearing mount, etc.
- 6.e. Identify the specific bearing application including the amount and type of load, rpm, heat, pre-load, sealed bearing, lubrication requirements, lubrication differences, etc.
- 6.f. Identify the resources available for cross referencing and cross reference the bearing number.

7. Mount a bearing

Learning Objectives

- 7.a. Explain the various locking devices and the applications they are designed for.
- 7.b. Take measurements within accuracy called for by the application.
- 7.c. Grind, shim, or machine spacers or caps to get within the required pre-load.
- 7.d. Select the proper tools and associated equipment for installing bearings.
- 7.e. Locate manufacturer's specifications for the bearing application.
- 7.f. Explain the proper mounting procedures from the manufacturer.
- 7.g. Explain the needs for and uses of heat and cold in bearing mounting.
- 7.h. Describe the safety precautions with liquid nitrogen, dry ice, heaters etc.

8. Lubricate a bearing

Learning Objectives

- 8.a. Explain the proper type of lubrication for each type of bearing.
- 8.b. Describe the applications for higher speed and lower speed bearings such as oil mist, grease or heavy oils etc.
- 8.c. Explain how contamination can enter a bearing externally or through the lubrication process.
- 8.d. Locate manufacturer's specifications and formula for speed and the amount of lubrication required.
- 8.e. Explain the problems associated with over lubricating how it shortens life.
- 8.f. Explain when to and when not to lubricate a bearing.
- 8.g. Describe run-in requirements and why they are necessary

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50-423-731 Couplings & Alignment for the MMMP Trades (M-2)

Course Outcome Summary

Course Information

Alternate Title	Maintenance Mechanic & Millwright Apprenticeship
Description	Course compares different coupling types and examines common misalignment problems. Apprentices will develop skills related to inspecting, troubleshooting, and preparing couplings for removal and installation, and also aligning and lubricating couplings. This course was formerly the M-2 module for related instruction in the MMMP apprenticeship programs.
Total Credits	1.00
Total Hours	36.00

Types of Instruction

Instruction Type	Credits/Hours
Lecture discussion demonstration & small group activities	36
On Campus Lab	

Course Competencies

1. Examine different coupling types and misalignment

Learning Objectives

- 1.a. Identify different coupling types both flexible and rigid including spring, lovejoy, universal, etc. and how they are linked.
- 1.b. Explain the application that each type of coupling is used in and the reasons it might be selected.
- 1.c. Describe why high speed applications (over 3000 rpm) require precision alignment such as with a laser.
- 1.d. Describe the misalignment allowed for each type of coupling.
- 1.e. Explain how thermal growth affects alignment.
- 1.f. Explain how coupling size affects its characteristics.
- 1.g. Describe how misalignment affects seals, bearings, and vibration.
- 1.h. List and explain the basic types of misalignment.
- 1.i. For a bad coupling describe the reasons why it failed and list some next possible steps.
- 1.j. Explain different alignment techniques and their related accuracy.

2. Inspect couplings

Learning Objectives

- 2.a. Pull guards and look for visual failures.
- 2.b. Determine if misalignment is occurring.
- 2.c. Use multiple senses when inspecting a coupling: temperature, sounds, smells, etc.
- 2.d. Look for failure clues during inspection disassembly (example gear coupling).
- 2.e. Examine vibration analysis data to pinpoint where problem may be occurring.

3. Troubleshoot couplings

Learning Objectives

- 3.a. Interview operator as applicable for clues to problem.
- 3.b. Pull guards and look for visual failures.
- 3.c. Use multiple senses when inspecting a coupling: temperature, sounds, smells, etc.
- 3.d. Examine vibration analysis data (if available) to pinpoint where problem is occurring.
- 3.e. List causes for failure.
- 3.f. Isolate specific cause of failure.
- 3.g. Inspect associated equipment for failure and ensure that it is not the cause of the failure.
- 3.h. Narrow list down to the specific cause.
- 3.i. Make repair and test it to ensure proper operation.
- 3.j. Document repair work performed.

4. Prepare for a coupling removal or installation

Learning Objectives

- 4.a. Explain the related safety procedures and how you would ensure compliance (lock out tagout, correct personal protective equipment PPE, blocking equipment).
- 4.b. Identify exactly what to avoid damaging during a removal.
- 4.c. Explain tool choice and its use before beginning the removal or installation.
- 4.d. Use tools that are sized correctly and applicable for the job.
- 4.e. Explain how coupling power is transferred using keys etc.
- 4.f. Examine base and ensure integrity and cleanliness
- 4.g. Define alignment terms such as: soft foot, axial alignment, radial alignment, etc.
- 4.h. Prepare the shaft and keyway ensuring cleanliness
- 4.i. Remove high spots on the coupling and the shaft.
- 4.j. Measure coupling bore and shaft size to ensure correct sizing.
- 4.k. Check shaft runout.
- 4.l. Explain the different types of fits such as interference, slip fit, etc. for the coupling type.
- 4.m. Explain the uses for and applications of different types of anti-seize.
- 4.n. Explain the various types of set screws and keys.
- 4.o. Fit parts to shaft on both sides of coupling.
- 4.p. Determine set screw and key placement and fits.
- 4.q. Explain how the final fit comes together for various coupling types.

5. Align a coupling

Learning Objectives

- 5.a. Describe the progression from straightedge to dial to laser based upon the accuracy the application requires
- 5.b. Check axial misalignment and determine if equipment needs to be moved
- 5.c. Adjust axial and radial alignment to meet manufacturers specifications
- 5.d. Visually align coupling by sight
- 5.e. Demonstrate use of coupling wedge
- 5.f. Describe the use for and limitations of the dial indicator
- 5.g. Mount the alignment tools applicable for a given job
- 5.h. Describe the various types of shims and their uses
- 5.i. Apply laser targets to the shaft
- 5.j. Follow menu on the control box of laser alignment tool
- 5.k. Take required measurements and enter data into laser alignment tool
- 5.l. Follow laser safety precautions concerning eye sight and eye damage

6. Lubricate couplings

Learning Objectives

- 6.a. Inspect seals for condition and wear
- 6.b. Inspect gaskets for condition and wear
- 6.c. Identify the types of grease or lubricant used with couplings
- 6.d. Identify the types of couplings that need lubrication and those that do not
- 6.e. Explain the importance of not over greasing or over lubricating
- 6.f. Add the amount of lubrication as specified by the manufacturer
- 6.g. Name the frequency required for lubrication

50-423-732 Pumps for the MMMP Trades (M-3)

Course Outcome Summary

Course Information

Alternate Title	Maintenance Mechanic & Millwright Apprenticeship
Description	Course compares different pump types and their applications. Apprentices will complete a field inspection of pumps and learn how to troubleshoot, remove, overhaul, install and perform preventative maintenance on pumps. This course was formerly the M-3 module for related instruction in the MMMP apprenticeship programs.
Total Credits	0.75
Total Hours	24.00

Types of Instruction

Instruction Type	Credits/Hours
Lecture discussion demonstration & small group activities	24 hours

Course Competencies

1. Examine different pump types and their application

Learning Objectives

- 1.a. Describe the different pump types and applications.
- 1.b. Explain the basic parts of a pumps and their purpose.
- 1.c. Describe pump theory i.e. pressure, flow, vacuum.
- 1.d. Describe how different types of fluids/materials affect pump operation.
- 1.e. Explain the drive methods for pumps.
- 1.f. Determine the horsepower requirements to drive a pump.
- 1.g. Explain how viscosity affects pump operation.
- 1.h. Explain the applications of different drives and relate r.p.m. to application.
- 1.i. Apply Pascals law to pumps.
- 1.j. Explain how pressure relates to pump output and vice versa.

2. Complete a field inspection of pumps

Learning Objectives

- 2.a. Explain safety considerations for a field inspection.
- 2.b. Examine the pump and equipment for proper operation.
- 2.c. Interview operator if available and as needed.
- 2.d. Check condition of hoses, pipes, tubing and fittings etc.
- 2.e. Check pressures, pump flows, vibrations, cavitation, abnormal leaks, reservoir fluid levels, filters etc.
- 2.f. Describe what to look for in shaft leakage.
- 2.g. Describe the different requirements in inspecting hydraulic, centrifugal and vacuum pumps.
- 2.h. Describe the parameters that determine the PM requirements for various equipment and or operations.
- 2.i. Describe what actions should be taken if defects are found.

3. Troubleshoot pumps

Learning Objectives

- 3.a. Explain reasons why pumps fail.
- 3.b. Interview operator for clues to problem.
- 3.c. Determine how the pump operates as part of a system and refer to the schematic or appropriate manuals to assist in troubleshooting.
- 3.d. Describe safety precautions to comply with when troubleshooting pumps.
- 3.e. Inspect associated equipment for failure and determine whether the pump or system is at fault.
- 3.f. Use senses when inspecting pumps for determining the pump symptoms such as: heat, noise, leaks etc.
- 3.g. Select and use appropriate tools for troubleshooting problems such as: gauges, flowmeters etc.
- 3.h. Examine vibration analysis data (if available) to pinpoint where problem is occurring.
- 3.i. List possible causes for failure and narrow list down to specific cause.
- 3.j. Make repair and test it to ensure proper operation.
- 3.k. Document repair work performed.

4. Remove a pump

Learning Objectives

- 4.a. Describe safety precautions to comply with when removing pumps.
- 4.b. Lockout the pump power source prior to removal.
- 4.c. Check for interlocks and ensure isolation of stored energy sources by reference to schematics and or other documents.
- 4.d. Explain lockout / tagout procedures.
- 4.e. Ensure all equipment is in "safe" position.
- 4.f. Prepare pump for removal by gathering the required parts and tools.
- 4.g. Disconnect and seal open lines during removal to ensure cleanliness.
- 4.h. Disconnect the coupling.
- 4.i. Remove pump according to manufacturer's specifications.

5. Overhaul a pump

Learning Objectives

- 5.a. Identify the pump manufacturer, model number, available kits, and parts sources.
- 5.b. Locate any applicable service manuals.
- 5.c. Inspect the pump for failures.
- 5.d. Determine root cause failure.
- 5.e. Determine when additional expert advice is required.
- 5.f. Describe how disassembly procedure is critical to pump operation.
- 5.g. Disassemble a pump.
- 5.h. Complete precision inspections of pump parts.
- 5.i. Decide what can be repaired, what must be replaced or if a replacement pump is the best alternative.
- 5.j. Order required parts or repair parts as needed.
- 5.k. Assemble pump.
- 5.l. Test pump operation or explain how and where to ship a pump for testing.
- 5.m. Complete required records.

6. Install a pump

Learning Objectives

- 6.a. Prepare equipment for installation by ensuring cleanliness, required parts and tools are at hand.
- 6.b. Make all required connections, hoses, pipes, etc.
- 6.c. Check pump rotation.
- 6.d. Align pump and equipment.
- 6.e. Prime a pump per manufacturer's specifications.
- 6.f. Inspect for leaks and operation after installation.
- 6.g. Ensure that system pressure and or flows are re-established.
- 6.h. Perform a vibration analysis if equipment is available or explain the concepts and procedures to re-establish a baseline.
- 6.i. Inspect for leaks and operation after a run-in period.

7. Perform pump preventive maintenance

Learning Objectives

- 7.a. Explain safety considerations for a PM inspection.
- 7.b. Check leakage by doing a case drain inspection as applicable and according to the manufacturer's recommendation.
- 7.c. Check the coupling or specific drive connection.
- 7.d. Check for plumbing for leaks and repair as needed.
- 7.e. Check for packing and seals for leaks and repair as needed.
- 7.f. Check mounting hardware.
- 7.g. Complete a laser alignment check if equipment is available or explain the concepts and procedures.
- 7.h. Check pressures and pump flows.
- 7.i. Examine the pump and equipment for proper operation as part of the pump PM.

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50-423-733 Belts, Sheaves, Pulleys and Drives for the MMMP Trades (M-4)

Course Outcome Summary

Course Information

Alternate Title	Maintenance Mechanic & Millwright Apprenticeship
Description	Course compares different belt types and drive components. Apprentices will develop skills related to inspecting, troubleshooting, removing, selecting, and installing belt drive systems. This course was formerly the M-4 module for related instruction in the MMMP apprenticeship programs.
Total Credits	0.75
Total Hours	24.00

Types of Instruction

Instruction Type	Credits/Hours
Lecture discussion demonstration and small group activities	24 hours
On Campus Lab	

Course Competencies

1. Examine different types of belts and their related components

Learning Objectives

- 1.a. Define terms related to belts
- 1.b. List safety precautions necessary when working with belts and related components
- 1.c. Describe the construction of various belt types and relate this to selection for specific applications
- 1.d. Explain the proper handling and storage techniques for various belt types and related components
- 1.e. Describe various sheave types and related drives

2. Inspect belt drive systems

Learning Objectives

- 2.a. Explain the types of damage or defects to look for upon inspection of belts and sheaves
- 2.b. Explain the importance of belt drive preventive maintenance procedures
- 2.c. Describe belt drive shutdown and inspection procedures
- 2.d. Describe the importance of using multiple senses during inspection such as: sight, sound, smell, touch
- 2.e. Inspect belts for wear and damage such as fraying, hardening, cracks, etc. during preventive maintenance
- 2.f. Inspect sheaves for wear/groove depth during preventive maintenance
- 2.g. Inspect idlers and tensionometers for wear during preventive maintenance
- 2.h. Check for alignment and identify misalignment

3. Troubleshoot belt drive systems

Learning Objectives

- 3.a. Explain belt drive troubleshooting procedures
- 3.b. Describe various troubleshooting tools used in belt drive inspections

- 3.c. Determine the cause of misalignment in various cases of misaligned belts
- 3.d. Determine the cause of sheave wear and damage in various cases of damaged sheaves
- 3.e. Determine the cause of belt wear and damage in various cases of damaged belts
- 3.f. Determine the cause of drive component wear and damage in various cases of damaged drive components

4. Remove belt drive components

Learning Objectives

- 4.a. Explain and then demonstrate the removal of guards
- 4.b. Describe and then select a removal method for a variety of belts and related components
- 4.c. Explain the importance of inspecting parts for wear during removal procedure
- 4.d. Identify the cause of malfunction of parts or components during the removal procedure as appropriate

5. Select a belt for a belt drive system

Learning Objectives

- 5.a. Interpret belt numbering systems
- 5.b. Identify belt match numbers
- 5.c. Select replacement belts considering size, material, construction, etc.
- 5.d. Calculate belt lengths
- 5.e. Cross reference belt numbers
- 5.f. Describe and demonstrate the use of belt and sheave gauges

6. Install a belt in a belt drive system

Learning Objectives

- 6.a. List and explain three methods for belt installation
- 6.b. Draw a belt system showing proper installation of belt components including sheaves and idlers
- 6.c. Explain the importance of inspecting components before installation
- 6.d. Describe the types of tensioning systems
- 6.e. Check new sheaves for damage, proper bore, and key and keyway size
- 6.f. Explain and then demonstrate the procedures for tensioning belts
- 6.g. Explain alignment procedures for belt and drive components
- 6.h. Install a belt in a belt drive system
- 6.i. Align belts using a variety of methods
- 6.j. Recognize correct shaft and sheave alignment
- 6.k. Describe two ways to splice flat belts; by mechanical means and vulcanization
- 6.l. Calculate drive shaft speed changes
- 6.m. Describe minor changes that could improve belt drive performance
- 6.n. Explain "QD" sheave bushing installation

50-423-734 Gears, Gearboxes, Gear Assemblies for the MMMP Trades (M-5)

Course Outcome Summary

Course Information

Alternate Title	Maintenance Mechanic & Millwright Apprenticeship
Description	Course compares gear types and applications. Apprentices will develop skills inspecting gear assemblies, troubleshooting gear problems, removing gears and components, and reassembling gear drive systems. This course was formerly the M-5 module in related instruction for the MMMP apprenticeship programs.
Total Credits	0.75
Total Hours	24.00

Types of Instruction

Instruction Type	Credits/Hours
Lecture discussion demonstration & small group activities	24
On Campus Lab	

Course Competencies

1. Examine different gear types and their applications

Learning Objectives

- 1.a. Identify different gear types such as: bevel, herringbone, worm, etc.
- 1.b. Describe the consequence of a particular gear ratio.
- 1.c. Examine advantages and disadvantages for various gear types.
- 1.d. Identify the different uses for gears.
- 1.e. Define backlash, pitch, pre-load, matched sets, diametral pitch, and other gear related terms.
- 1.f. Identify various gearbox configurations.
- 1.g. Explain the purpose for and uses of nomenclature found on gearbox nameplate i.e. ratios, torque, etc.

2. Inspect gear assemblies

Learning Objectives

- 2.a. Explain Lockout / Tag Out (LO/TO) procedures and the need for continual awareness of potential hazards.
- 2.b. Remove all applicable guards and/or covers.
- 2.c. Identify possible problems during an inspection including leaks, vibration, lubrication, noise, etc.
- 2.d. Inspect to see if the retainer system is correct.
- 2.e. Inspect for abrasive filings and/or foreign material.
- 2.f. Inspect a gear for wear.
- 2.g. Interpret gear wear patterns.
- 2.h. Inspect the gearshaft for alignment.
- 2.i. Inspect bearings for wear.

- 2.j. Make recommendations for further work based on inspection results i.e. replacement, future maintenance,
- 2.k. Replace gaskets/seals as needed.
- 2.l. Reinstall all guards and/or covers.
- 2.m. Check for proper lubrication.

3. Troubleshoot gear and related problems

Learning Objectives

- 3.a. Describe processes for getting to the root cause of a problem.
- 3.b. Describe the normal operation for the gear, gearbox, or gear assembly.
- 3.c. Explain the importance of using senses when troubleshooting i.e. sight, smell, touch, hearing.
- 3.d. Describe the types of data that may be available such as vibration analysis reports, lubrication record, history, interview of operator, etc.
- 3.e. Explain how to assess data to determine the problem.
- 3.f. Identify possible reasons for gear failures including retaining system (keyways, lock washers etc.), bearings, alignment, etc.
- 3.g. Explain how to use the process of elimination to identify the cause(s) of a specific problem.

4. Remove gears and related drive components

Learning Objectives

- 4.a. Explain Lockout / Tag Out (LO/TO) procedures and the need for continual awareness of potential hazards.
- 4.b. Correctly remove all applicable guards and/or covers.
- 4.c. Describe how to determine the best / safest removal procedure using prints and assembly drawings if available.
- 4.d. Sketch drawings of the removal process for future reference whether or not prints or drawings are available.
- 4.e. Select the appropriate tools for disassembly.
- 4.f. Explain the importance of inspecting gears and related drive components for wear during the disassembly process.
- 4.g. Explain how to identify root cause of malfunction of components during removal as appropriate.
- 4.h. Describe the use and application of applicable technical/manufacturers manual.

5. Reassemble gear assemblies

Learning Objectives

- 5.a. Explain Lockout / Tag Out (LO/TO) procedures and the need for continual awareness of potential hazards.
- 5.b. Explain the importance of inspecting components before installation.
- 5.c. Explain the importance of cleanliness in the reassembly process.
- 5.d. Determine the type of lubricant and amount for a specific gear assembly.
- 5.e. Calculate mounting distance of mating gears.
- 5.f. Determine ratios to obtain output speed desired.
- 5.g. Describe common speed reducers used for drive components.
- 5.h. Determine specifications for gear replacement.
- 5.i. Explain gear installation procedures.
- 5.j. Explain alignment procedures for gears and related drive components.
- 5.k. Explain pre-loads and backlash.
- 5.l. Explain how to check for proper gear contact.
- 5.m. Correctly reinstall all guards and/or covers.

50-423-735 Mechanical Power Transmission for the MMMP Trades (M-6)

Course Outcome Summary

Course Information

Alternate Title	Maintenance Mechanic & Millwright Apprenticeship
Description	Course examines drive transmission systems and their applications, including roller chains. Apprentices will develop skills inspecting power transmission systems and troubleshooting mechanical drive systems. This course was formerly the M-6 module in related instruction for the MMMP apprenticeship programs.
Total Credits	0.75
Total Hours	24.00

Types of Instruction

Instruction Type	Credits/Hours
Lecture discussion demonstration & small group activities	24
On Campus Lab	

Course Competencies

1. Examine different drive transmission types and their applications

Learning Objectives

- 1.a. Describe screw type transmission systems and their applications.
- 1.b. Describe gear type transmission systems and their applications.
- 1.c. Describe belt type transmission systems and their applications.
- 1.d. Describe chain type transmission systems and their applications.
- 1.e. Explain reasons for using each type of transmission system.
- 1.f. Describe situations when a particular transmission system would be selected.

2. Examine different types of roller chains and their related components

Learning Objectives

- 2.a. List roller chain drive components including sprockets and describe their uses.
- 2.b. Match chain type to its correct sprocket.
- 2.c. Describe the common types of chain used in drives.
- 2.d. Measure chain for a given application.
- 2.e. Size chain for a given application.
- 2.f. Describe the tools and their use for roller chain maintenance.
- 2.g. Explain lockout/tagout and other safety procedures that apply to roller chain maintenance.
- 2.h. Describe the use of different Personal Protective Equipment (PPE) that is needed during roller chain maintenance.

3. Inspect transmissions and components

Learning Objectives

- 3.a. Explain lockout/tagout and other safety procedures that apply to transmission inspection.

- 3.b. Describe the use of different Personal Protective Equipment (PPE) that is needed during transmission inspection.
- 3.c. Describe the safety precautions associated with transmission inspection.
- 3.d. Identify different types of transmissions.
- 3.e. Describe the common items included in transmission inspection and why they are included such as: lubrication, leaks, speed, breathers, temperature, noise, looseness etc.
- 3.f. Locate service specifications for a given transmission system.
- 3.g. Explain advantages of periodic inspections.
- 3.h. Define what transmission ratios are and why they are used
- 3.i. Calculate transmission ratios

4. Troubleshoot mechanical drive systems

Learning Objectives

- 4.a. Describe necessary safety procedures needed for a given situation and explain how they will be or would be applied such as lockout/tagout etc.
- 4.b. Describe the use of different Personal Protective Equipment (PPE) that is needed during transmission troubleshooting.
- 4.c. Explain how all your senses can be used and how they play a part in effective troubleshooting.
- 4.d. Locate appropriate service information or technical manual resources as needed to assist in determining the problem(s).
- 4.e. Explain how to select and then use appropriate measuring equipment for a given troubleshooting situation.
- 4.f. Remove and install transmission components as required according to technical specifications and established procedures.
- 4.g. Describe how to apply a troubleshooting procedure as a logical step by step process.

50-423-736 Conveyors for the MMMP Trades (M-7)

Course Outcome Summary

Course Information

Alternate Title	Maintenance Mechanic & Millwright Apprenticeship
Description	Course examines chain, belt, and other types of conveyors and related components. This course was formerly the M-7 module in related instruction for the MMMP apprenticeship programs.
Total Credits	0.25
Total Hours	8.00

Types of Instruction

Instruction Type	Credits/Hours
Lecture discussion demonstration & small group activities	8

Course Competencies

1. Examine chain conveyors and their related components

Learning Objectives

- 1.a. Explain how to lock out a chain conveyor system and explain the safety precautions necessary to work on a conveying system
- 1.b. Describe the various types of conveyor chains such as: drag, bucket, conveying, transport, etc.
- 1.c. Describe the different materials used for making conveyor chains
- 1.d. List the common terms used with conveyors and explain their meaning such as: anti-runaway, anti-backup, expansion joint, etc.
- 1.e. Identify chain conveyor components
- 1.f. Explain (or demonstrate if equipment is available) chain tensioning
- 1.g. Explain the maintenance, repair, inspection, and preventive maintenance techniques used on chain conveyors such as: sag, wear limits, causes of failure etc.
- 1.h. Identify a chain conveyor system for a given application such as vertical drag or bucket, power and free, horizontal, inclined, overhead trolley, etc.

2. Examine belt conveyors and their related components

Learning Objectives

- 2.a. Explain how to lock out a belt conveyor system and explain the safety precautions necessary to work on a conveying system
- 2.b. Describe the various types of flat-top conveyor belts
- 2.c. Describe the different materials used for making conveyor belts
- 2.d. Identify belt conveyor components
- 2.e. Explain (or demonstrate if equipment is available) belt tensioning and tracking
- 2.f. Explain (or demonstrate if equipment is available) conveyor belt splicing
- 2.g. Identify a belt conveyor system for a given application
- 2.h. Explain the maintenance, repair, inspection, and preventive maintenance techniques used on belt conveyors such as: sag, wear limits, causes of failure etc.

3. Examine other conveyor types and their related components

Learning Objectives

- 3.a. Explain how to lock out other conveyor systems and explain the safety precautions necessary to work on those conveying system
- 3.b. Describe the various types of conveyor belts such as: wire-mesh, auger, magnetic, paddle, shaker, etc.
- 3.c. Describe the materials used in other conveyor systems
- 3.d. Identify conveyor system components that are used in conveyor systems such as: tensioners, tighteners, heads, pulleys, etc.
- 3.e. Explain (or demonstrate if equipment is available) tensioning and/or tracking as applicable
- 3.f. Explain the maintenance, repair, inspection, and preventive maintenance techniques used on conveyor systems such as: sag, wear limits, causes of failure etc. as applicable

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50-423-760 Lubrication Fundamentals for Apprentices Course Outcome Summary

Course Information

Alternate Title	LUBRICATION TECHNICIAN Apprenticeship Related Instruction
Description	Course learning outcomes include interpreting oil test analyses, examining automated lubrication technologies, exploring ultrasound testing, comparing filtration technologies and exploring other fundamental concepts involved in lubrication technologies. Course is intended for apprentices enrolled in related instruction, and the fundamental concepts presented in this course will be applied to industrial equipment and machines & trade work practices.
Career Cluster	Manufacturing
Instructional Level	Technical Diploma
Total Credits	1.25
Total Hours	44.00

Types of Instruction

Instruction Type	Credits/Hours
Classroom presentation, discussion, demonstration and small group activities	28 hours
On Campus lab, shop or hands-on training center	16 hours

Course Competencies

1. Apply lubrication fundamentals

Learning Objectives

- 1.a. Define terms involved in oils and lubricants.
- 1.b. Describe the role and function of lubricants.
- 1.c. Compare types of industrial lubricants.
- 1.d. Explain the critical criteria for measuring the properties of greases and oils.
- 1.e. Calculate the re-greasing interval for antifriction bearings, drives, and motors.
- 1.f. Interpret oil viscosity classification charts.
- 1.g. Explain the importance of oil operating temperatures and adhering to manufacturer's specifications.
- 1.h. Compare and contrast various lubricants including greases, oils, hydraulic fluids, glycols, synthetics and other specialty compounds.

2. Examine vibration analysis techniques used by the trade

Learning Objectives

- 2.a. Define terms and concepts involved in vibration analysis, and as they relate to oiler lubricator work practices.
- 2.b. Identify vibration analysis techniques which relate to lubrication.
- 2.c. Select lubrication procedures based on test results.
- 2.d. Describe the benefits of VA testing.
- 2.e. Summarize what VA testing involves.

3. Relate ultrasound testing procedures to grease and lubrication techniques

Learning Objectives

- 3.a. Describe equipment used by the trade when greasing equipment and using ultrasound technologies.
- 3.b. Examine greasing techniques using ultrasound equipment.
- 3.c. Describe the benefits of using ultrasound over traditional greasing methods.
- 3.d. Summarize how using ultrasound technologies can prevent damage to equipment and machines.
- 3.e. Explain the standard operating procedures employed by industry and the trade.
- 3.f. Explain the benefits of using a grease caddy.
- 3.g. Build skills using ultrasound equipment for bearing lubrication.

4. Examine automated lubrication systems and technologies

Learning Objectives

- 4.a. Identify chain lubricants, lubrication systems, components and match their role and function.
- 4.b. Compare lubrication pumps and pumping components.
- 4.c. Explain the role and function of spray systems.
- 4.d. Summarize machine and hydraulic tool lubricating devices.
- 4.e. Explain the role and function of reservoirs, sensors, instruments, and other accessory devices.
- 4.f. Categorize automated lubrication equipment according to its role and function in your plant.
- 4.g. Determine proper greasing intervals for industrial machines and equipment.
- 4.h. Identify the importance of proper filter locations for given hydraulic circuits.

5. Compare oil filtration concepts used in industrial applications

Learning Objectives

- 5.a. Describe industry standards for changing oil.
- 5.b. Explain industry standards for changing filters.
- 5.c. Interpret manufacturer's specifications for various oils & lubricants.
- 5.d. Identify oil filtration equipment, components and devices found in industrial systems.
- 5.e. Explain the role and function of desiccant filters and breathers.
- 5.f. Compare micron filter ratings and beta ratios, and their applications.
- 5.g. Interpret oil analysis tests and results.

6. Relate concepts of lubrication fundamentals to industrial equipment and machines

Learning Objectives

- 6.a. Describe equipment and devices used to control moisture control and remove water.
- 6.b. Identify contaminant sources and their effects on lubrication when changing/servicing oil & grease.
- 6.c. Explain bulk lubricant handling best practices, and filtering prior to use.
- 6.d. Summarize the proper procedures for oiling machines.
- 6.e. Summarize the proper procedures for greasing machines.
- 6.f. Examine industry lubricant standards.

6.g. Apply oil test results to lubricant serviceability.

7. Examine preventative maintenance requirements for equipment and machines

Learning Objectives

- 7.a. Compare and contrast routine, preventative and predictive maintenance concepts.
- 7.b. Identify lubrication routes and schedule requirements for preventative maintenance.
- 7.c. Explain lubrication practices for applicable areas.
- 7.d. Summarize the requirements for performing proper equipment inspections.
- 7.e. Compare methods for recording and maintaining preventative maintenance records.
- 7.f. Interpret manufacturer's specifications and/or company standards for preventative maintenance.
- 7.g. Interpret oil test analysis involved in preventative maintenance.

8. Compare methods for storing lubricants and preventing cross-contamination

Learning Objectives

- 8.a. Identify common contaminants.
- 8.b. Explain how contaminants reduce/interfere with lubricants.
- 8.c. Describe best practices in labeling and marking.
- 8.d. Explain best practices related to storing and inventorying.
- 8.e. Describe ways that lubricants can get contaminated.
- 8.f. Explain best practices for preventing cross-contamination of lubricants.

9. Perform oil sampling

Learning Objectives

- 9.a. Compare procedures used by industry for sampling oil.
- 9.b. Identify specific sampling requirements for equipment and conditions.
- 9.c. Compare sampling techniques for gear boxes, hydraulic systems, bearing reservoirs, recirculating tanks and other equipment.
- 9.d. List requirements for labeling, storage and handling of oil samples.
- 9.e. Match oil sampling to testing recommendations.
- 9.f. Describe safety and PPE requirements for oil sampling.
- 9.g. Build skills sampling oil following industry adopted best practices.

47-455-455 Transition to Trainer: Your Role as a Journey Worker Course Outcome Summary

Course Information

Description Apprenticeship training is a collaborative partnership: employer and employee associations, government, and educational institutions each play a part. In reality, most learning takes place through the daily interaction between an apprentice and his/her co-workers. Surveys have shown that the apprentices are least satisfied with the on-the-job portion of their training--particularly the ability of journey level workers and supervisors to pass on their knowledge of the trade.

You have already learned to use the tools of your chosen trade. In this workshop you will be introduced to a new set of basic tools--the tools of a jobsite trainer. You will explore the skills that are necessary to be an effective trainer, discover how to deliver hands-on training, and examine the process for giving useful feedback. During the workshop you will build a Training Toolkit to take back to your work on the job.

Total Hours 8.00

Types of Instruction

Instruction Type

Workshop

Credits/Hours

Course Competencies

1. Value your role as a journey worker trainer

Learning Objectives

- 1.a. Examine the apprentice training model.
- 1.b. Describe the role of the journey worker as trainer.
- 1.c. List benefits of acting as a journey worker trainer
- 1.d. Identify the responsibilities of a journey worker trainer.

2. Serve as a mentor and job coach

Learning Objectives

- 2.a. List the characteristics of a good mentor.
- 2.b. Identify the benefits of mentoring.
- 2.c. Identify employer and co-worker expectations.
- 2.d. Identify the expectations of the apprentice.
- 2.e. List the items to cover in an apprentice orientation.

3. Foster a positive work environment by acting as an ally/advocate

Learning Objectives

- 3.a. Describe a positive work setting
- 3.b. Define diversity
- 3.c. Recognize your own biases
- 3.d. Differentiate among perpetrator, target, bystander, and ally/advocate

- 3.e. Provide support for apprentices
- 3.f. Identify strategies for deterring inappropriate situations
- 3.g. Outline the chain of command for reporting

4. Provide hands-on skills training

Learning Objectives

- 4.a. Describe the process for teaching someone a skill: motivate, explain, demonstrate, try, evaluate.
- 4.b. Explain the importance of guided practice in the teaching process.
- 4.c. Describe how related instruction relates to the job.
- 4.d. List potential job hazards and other safety information that applies to a task.
- 4.e. Apply the training process steps to a situation.

5. Provide feedback on apprentice performance

Learning Objectives

- 5.a. Describe the importance of feedback to skill development.
- 5.b. Explain the importance of frequent feedback.
- 5.c. Examine a model for giving feedback.
- 5.d. Apply the model for giving feedback.

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WTCS Apprentice Soft Skills - Core Abilities

Course Outcome Summary

Course Information

Description While technical skills are essential to perform a job, it is often an individual's "soft skills" that determine whether s/he is ultimately successful on the job. Hard skills have to do with the trade and tradecraft. Soft skills have to do with the ability to communicate and relate to people. As such, they are the CORE Abilities across all trades and across society at large.

This scoring guide may be used multiple times throughout your apprenticeship experience and at the end of your apprenticeship program to assess how well you have met the criteria for soft skill core abilities related to communications and problem solving. To meet the requirements on the scoring guide, you will be asked to draw upon the skills and concepts that have been developed throughout your apprenticeship program and are necessary for successful long-term employment and advancement in your trade.

2009 Project Background: The Apprentice Soft Skills - Core Abilities Assessment is the result of work completed by a WTCS Apprenticeship Sub-Committee led by Jon Waldhuetter. In determining a common set of core abilities for Wisconsin apprentices, the Committee worked to designate core abilities and indicators that would be relevant for all WI apprenticeship trades. Pre-project analysis involved examining all WTCS college core abilities, the Manufacturing Core Critical Skills developed in 2004-2005, and additional core skill lists for a variety of apprentice/trades-related programs.

WTCS Contact: [Nancy Nakkoul](#)

Course Competencies

- 1. Work cooperatively with others, one-on-one and in a team environment**
- 2. Communicate effectively**
- 3. Work productively**
- 4. Adapt to change**
- 5. Apply problem-solving strategies**
- 6. Think critically**