

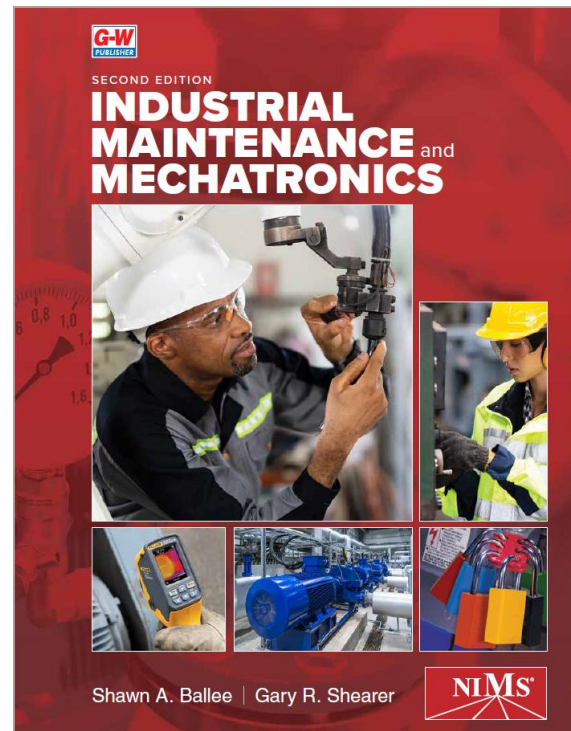


Correlation of
Industrial Maintenance and Mechatronics,
Shawn A. Ballee and Gary R. Shearer
 Goodheart-Willcox Publisher ©2024
 to
NIMS (National Institute for Metalworking Skills)
 Classic Credential:
Basic Hydraulic Systems

Industrial Maintenance and Mechatronics carries NIMS' exclusive endorsement and supports attainment of NIMS credentialing in Industrial Technology Maintenance (ITM).

The textbook is designed to work hand-in-glove with the NIMS Standards for Industrial Technology Maintenance. The standards-based learning package will help students pass the testing and performance requirements for NIMS credentialing.

The correlation below lists the standards for a specific NIMS Classic ITM Credential. The Classic ITM areas covered in *Industrial Maintenance and Mechatronics* include Maintenance Operations, Basic Mechanical Systems, Basic Hydraulic Systems, Basic Pneumatic Systems, Electrical Systems, Electronic Control Systems, Process Control Systems, and Maintenance Piping.



Standards	G-W Content
Duty Title: 3.01. Adhere to fluid power systems safety rules.	
Identify roles and responsibilities for safety, health, and environment.	Textbook: pg. 13, 24-28, 36-44, 70
Adhere to OSHA, NIOSH, EPA, and other federal and state safety requirements for the workplace.	Textbook: pg. 18, 24-25, 43-44
Identify and recognize common industrial hazards, per OSHA standards (including, ergonomics, laser safety, NFPA arc flash, confined space, gases and combustibles, steam and compressed air).	Textbook: pg. 24-26
Define elements of a lockout/tagout (LOTO) program, describe the LOTO process and test to ensure a zero energy state.	Textbook: pg. 28-32 Lab Workbook: Activity 2-1, Lockout/Tagout Procedure

Standards	G-W Content
Identify and explain how to select the appropriate personal protective equipment (eyes, head, breathing air apparatus, body, feet, hands, ears) for a job.	Textbook: pg. 13, 32-35 Lab Workbook: Activity 2-2, Personal Protective Equipment
Explain how to locate a material Safety Data Sheet (SDS) and describe how you interpret the information.	Textbook: pg. 24-27
List and select proper fall protection for working at heights and using ladders, scaffolding, and lifts.	Textbook: pg. 37
Identify and recognize hazardous situations and apply proper procedures (includes following guidelines to prevent spread of bloodborne pathogens, spill control, proper storage, handling, protection of equipment, first aid).	Textbook: pg. 28-32, 36-43
Describe the process used to perform a job safety analysis.	Textbook: pg. 43 Lab Workbook: Activity 2-3, Job Safety Analysis
Explain the principles of 6S program (Sort, Sweep, Sanitize, Set-to-order, Sustain, Safety).	Textbook: pg. 43
Identify fuel source and selection of correct extinguisher class.	Textbook: pg. 43
HS Specific:	
Identify required machine guarding for fluid power systems.	Textbook: pg. 317, 321, 360
Describe safe procedures for removing stored hydraulic or pneumatic energy, including systems with accumulators and compressed air reservoirs, perform zero energy verification.	Textbook: pg. 345 Lab Workbook: Activity 17-3, System Start-Up and Operational Checks
Describe procedures for safe handling and disposal of lubricants, hydraulic oil and other hydraulic/pneumatic components.	Textbook: pg. 224-227 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Describe dangers of personal contact with pressurized hydraulic or pneumatic streams.	Textbook: pg. 321, 358, 412 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Define procedures to avoid oil fire hazards.	Textbook: pg. 42-43, 226 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Adhere to guidelines to avoid contact with hot surfaces in fluid power system.	Textbook: pg. 35 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit

Standards	G-W Content
Duty Title: 3.02. Interpret basic fluid power schematics.	
Identify and describe the basic hydraulic components given their NFPA/ ISO schematic symbol.	Textbook: pg. 130-132, 317, 322, 329, 354-355, 357, 403 Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components
Directional control valves, pressure control valve, flow control valves, cylinders, motors, instrumentation, pumps, various types of operators, filters.	Textbook: pg. 133, 316-322, 342, 351-357, 358-364, 403 Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components
Describe the operation of circuits using single stage and two stage hydraulic directional control valves with manual and electrical operators, various types of spool centers, 2-position/3-position and 2/3/4 way designs.	Textbook: pg. 130, 132-134, 321, 353-355 Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components
Describe the operation of hydraulic circuits that use accumulators, pump unloading, remote pressure control, rapid traverse slow feed and pilot-operated check valves.	Textbook: pg. 353, 357-358,
Interpret hydraulic line types on a schematic.	Textbook: pg. 126, 130-132
Interpret the operation of a basic hydraulic circuit given a schematic.	Textbook: pg. 130-134, 317, 365 Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 16-3, Compensated and Noncompensated Flow Control Lab Workbook: Activity 16-4, Meter-In and Meter-Out Circuits Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components
Identify and describe the basic pneumatic components given their NFPA/ ISO schematic symbol.	Textbook: pg. 130-134, 322, 329, 355, 357, 385-386, 389, 403, 417
Directional control valves, pressure control valves, flow control valves, cylinders, motors, instrumentation, compressors, various types of operators, filters.	Textbook: pg. 133, 316-322, 342, 351-357, 358-364, 379-381, 385-386, 403
Interpret pneumatic line types on a schematic.	Textbook: pg. 130-132, 134
Interpret the operation of a basic pneumatic circuit given a schematic.	Textbook: pg. 130-134, 391-393 Lab Workbook: Activity 18-2, Basic Pneumatic Circuits 1 Lab Workbook: Activity 18-3, Basic Pneumatic Circuits 2

Standards	G-W Content
Duty Title: 3.03. Start up and shut down a hydraulic system and adjust system pressure	
Safely start up a hydraulic power system including pre-start inspection.	Textbook: pg. 350 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit
Safely shut down a hydraulic power system.	Textbook: pgs. 51-55 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Use manufacturer's documentation per specific application to determine correct operating pressure.	Textbook: pg. 352-353 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit
Read a pressure gauge.	Textbook: pg. 318 Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 16-3, Compensated and Noncompensated Flow Control Lab Workbook: Activity 16-4, Meter-In and Meter-Out Circuits Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components Lab Workbook: Activity 18-3, Basic Pneumatic Circuits 2
Adjust the system operating pressure using a relief valve.	Textbook: pg. 316-318, 322, 351-352 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components
Operate manual valves to direct system flow.	Textbook: pg. 355-357, 392
Adjust the pressure of a pressure reducing valve.	Textbook: pg. 352-353 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit
Adjust the system operating pressure.	Textbook: pg. 316-318, 349, 350 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 16-3, Compensated and Noncompensated Flow Control
Describe the pressure-flow characteristics of types of relief valves, direct and pilot operated.	Textbook: pg. 351-353,

Standards	G-W Content
Describe the operation of a double-acting cylinder, motor, hydraulic sequence valve, and pressure reducing valve.	Textbook: pg. 320, 353, 365-366 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 16-3, Compensated and Noncompensated Flow Control Lab Workbook: Activity 16-4, Meter-In and Meter-Out Circuits
Describe the pressure-flow characteristics of fixed and variable displacement pumps.	Textbook: pg. 346, 875-876
Describe how to do pressure checks and charge accumulators.	Textbook: pg. 358 Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 16-3, Compensated and Noncompensated Flow Control
Describe the pressure vs. force/torque output characteristics of cylinders and motors.	Textbook: pg. 342, 362-363, 378, 380, 411
Describe Pascal's law and its importance in reading system pressure.	Textbook: pg. 319-320
Duty Title: 3.04. Adjust hydraulic actuator speed using a flow control valve.	
Adjust actuator speed using a needle valve.	Textbook: pg. 391-392 Lab Workbook: Activity 16-3, Compensated and Noncompensated Flow Control
Adjust actuator speed using non-compensated and compensated flow control valves.	Textbook: pg. 355-356, 391-392, Lab Workbook: Activity 16-3, Compensated and Noncompensated Flow Control Lab Workbook: Activity 16-4, Meter-In and Meter-Out Circuits
Adjust flow control valves in meter-in and meter-out configurations.	Textbook: pg. 391-392 Lab Workbook: Activity 16-4, Meter-In and Meter-Out Circuits Lab Workbook: Activity 18-3, Basic Pneumatic Circuits 2
Measure actuator speed.	Textbook: pg. 349-350 Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 16-3, Compensated and Noncompensated Flow Control Lab Workbook: Activity 16-4, Meter-In and Meter-Out Circuits

Standards	G-W Content
Describe the operation of a needle valve, flow control valve, compensated flow control valve, and meter-in and meter-out circuits.	Textbook: pg. 320, 360, 391-392, Lab Workbook: Activity 16-3, Compensated and Noncompensated Flow Control Lab Workbook: Activity 16-4, Meter-In and Meter-Out Circuits Lab Workbook: Activity 18-3, Basic Pneumatic Circuits 2
Describe the flow vs. speed characteristics of a hydraulic cylinder and a motor.	Textbook: pg. 358-359, 362, 391-392, Lab Workbook: Activity 16-3, Compensated and Noncompensated Flow Control Lab Workbook: Activity 16-4, Meter-In and Meter-Out Circuits
Calculate pump flow rate requirements given actuator speeds and sizes.	Textbook: pg. 316-317, 349-351
Calculate pump flow rate given pump size and speed.	Textbook: pg. 316-317, 349-351
Duty Title: 3.05. Service a hydraulic filter.	
Interpret filter specifications and models to determine correct filter.	Textbook: pg. 329, 331, 374-377 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Use manufacturer's documentation to determine frequency of change.	Textbook: pg. 328, 331 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Determine when to replace a filter base on pressure differential across the filter.	Textbook: pg. 328-331, 374 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Measure pressure differential across a filter.	Textbook: pg. 318
Replace a spin-on filter.	Textbook: pg. 330, Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Replace a cartridge filter.	Textbook: pg. 329-330 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Define or describe symptoms of a required strainer.	Textbook: pg. 328-329,
Replace a strainer.	Textbook: pg. 329-330 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing

Standards	G-W Content
Duty Title: 3.06. Service hydraulic fluid.	
Inspect fluid levels through level gauge and determine when to add fluid.	Textbook: pg. 343–344, 806-807 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit Lab Workbook: Activity 15-3, Sampling and Servicing Hydraulic Fluid
Add fluid to a hydraulic system.	Textbook: pg. 327-328, 344-345 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit Lab Workbook: Activity 15-3, Sampling and Servicing Hydraulic Fluid
Replace hydraulic fluid using a filter cart.	Textbook: pg. 328-330 Lab Workbook: Activity 15-3, Sampling and Servicing Hydraulic Fluid
Inspect fluid through sight, touch, and smell to determine if it should be replaced.	Textbook: pg. 327 Lab Workbook: Activity 15-3, Sampling and Servicing Hydraulic Fluid
Inspect fluid for water and visible contaminants.	Textbook: pg. 325-328 Lab Workbook: Activity 15-3, Sampling and Servicing Hydraulic Fluid
Remove water and contaminants from a hydraulic system including but not limited to flushing and refilling system.	Textbook: pg. 328-329, 350 Lab Workbook: Activity 15-3, Sampling and Servicing Hydraulic Fluid
Interpret oil specifications to determine if an oil meets the specifications specified by the machine manufacturer.	Textbook: pg. 327 Lab Workbook: Activity 15-3, Sampling and Servicing Hydraulic Fluid
Use manufacturer’s documentation to determine the correct oil to use in a hydraulic system.	Textbook: pg. 325-326 Lab Workbook: Activity 15-3, Sampling and Servicing Hydraulic Fluid
Take a fluid sample and prepare for submittal to a testing lab.	Textbook: pg. 346 Lab Workbook: Activity 15-3, Sampling and Servicing Hydraulic Fluid
Duty Title: 3.07. Install hydraulic conductors.	
Interpret pipe, hose, and tubing specifications.	Textbook: pg. 332-333 Lab Workbook: Activity 15-4, Hydraulic Tubing and Fittings
Identify type and size of hose, tubing, and hydraulic fittings given a sample.	Textbook: pg. 332-333 Lab Workbook: Activity 15-4, Hydraulic Tubing and Fittings

Standards	G-W Content
Use safety procedures to make sure pressure is removed before disconnecting conductors.	Textbook: pg. 318, 346 Lab Workbook: Activity 15-4, Hydraulic Tubing and Fittings
Describe proper fitting tightening and describe the consequences of over-tightening.	Textbook: pgs. 332 Lab Workbook: Activity 15-4, Hydraulic Tubing and Fittings
Attach and tighten hydraulic steel tubing using wrenches and ferrule fittings.	Lab Workbook: Activity 15-4, Hydraulic Tubing and Fittings
Attach and tighten hydraulic fittings to components with threaded ports using wrenches and applicable thread sealant.	Lab Workbook: Activity 15-4, Hydraulic Tubing and Fittings Lab Workbook: Activity 16-2, Hydraulic Component Replacement
Attach and tighten hydraulic hose using wrenches and swivel fittings.	Lab Workbook: Activity 15-4, Hydraulic Tubing and Fittings
Attach and tighten hydraulic hose using wrenches and straight thread O-ring fittings.	Lab Workbook: Activity 15-4, Hydraulic Tubing and Fittings Lab Workbook: Activity 16-2, Hydraulic Component Replacement
Adjust the position and alignment of conductors for proper operation.	Lab Workbook: Activity 15-4, Hydraulic Tubing and Fittings
Describe how to make hydraulic hose using proper fittings.	Textbook: pg. 332-334
Describe the operation of an O-ring.	Textbook: pg. 384, 408 Lab Workbook: Activity 16-2, Hydraulic Component Replacement
Install an O-ring.	Textbook: pg. 363 Lab Workbook: Activity 16-2, Hydraulic Component Replacement
Describe how O-rings are specified.	Textbook: pg. 384
Duty Title: 3.08. Install and test components in a basic hydraulic circuit.	
Install and connect hydraulic components in basic functional circuit given a schematic.	Textbook: pg. 317, 364-365 Lab Workbook: Activity 15-4, Hydraulic Tubing and Fittings Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 16-3, Compensated and Noncompensated Flow Control Lab Workbook: Activity 16-4, Meter-In and Meter-Out Circuits Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components

Standards	G-W Content
Replace subplate-mounted directional, flow and pressure control valves in a hydraulic system.	Textbook: pg. 402, 404–406, 408 Lab Workbook: Activity 16-2, Hydraulic Component Replacement
Replace a threaded port valve.	Lab Workbook: Activity 16-2, Hydraulic Component Replacement Lab Workbook: Activity 18-2, Basic Pneumatic Circuits 1
Mount and align a hydraulic cylinder or a motor.	Textbook: pg. 358-359
Describe types of cylinder and motor mounting methods and their applications.	Textbook: pg. 358-359
Operate a hydraulic system to determine that it is performing correctly.	Textbook: pg. 317–318, 366 Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components
Follow proper bleeding procedures of a hydraulic system after component replacement.	Textbook: pg. 362 Lab Workbook: Activity 16-2, Hydraulic Component Replacement
Duty Title: 3.09. Troubleshoot a basic hydraulic circuit.	
Troubleshoot basic components (cylinder, motor, directional valve, relief valve, pressure reducing valve, sequence valve, flow control valve, fixed/variable pump, and check valve) in a hydraulic circuit using in-circuit tests.	Textbook: pg. 318, 322, 364-366, 414-416 Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components
Use flow and pressure instruments to take hydraulic circuit readings during in-circuit testing.	Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components
Describe the flow vs. pressure drop characteristics of components and conductors and their impact on system operation.	Textbook: pg. 321-322, 377-378, 383 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Use systematic methodologies to troubleshoot basic hydraulic circuits with linear and rotary actuators with these symptoms: <ul style="list-style-type: none"> Actuator will not move Actuator moves at incorrect speed Actuator moves erratically No or low system pressure 	Textbook: pg. 366, 393, 406-408, 413-414 Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components

Standards	G-W Content
Describe types of failures of basic hydraulic component.	Textbook: pg. 326-327, 342, 402, 404 Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components