Correlation of

Industrial Maintenance and Mechatronics,

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to

NIMS (National Institute for Metalworking Skills)

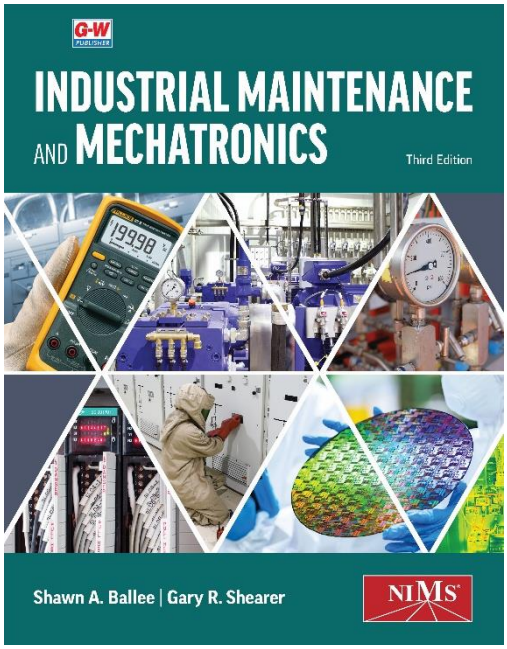
Classic Credential:

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: pgs. 12, 22–26, 33–41, 64–65
Adhere to OSHA, NIOSH, EPA, and other federal and state safety requirements for the workplace.	Textbook: pgs. 15–16, 22–25, 30-31, 40–41, 852–853, 857, 859, 868–869, 876–877
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: pgs. 22–25
Define elements of a lockout/tagout (LOTO) program, describe the LOTO process and test to ensure a zero energy state.	Textbook: pgs. 26–29 Lab Workbook: Activity 2-1, Lockout/Tagout Procedure

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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: pgs. 12, 29–33 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: pgs. 22–25
List and select proper fall protection for working at heights and using ladders, scaffolding, and lifts.	Textbook: pgs. 34
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: pgs. 26–29, 33–40
Describe the process used to perform a job safety analysis.	Textbook: pgs. 40–41 Lab Workbook: Activity 2-3, Job Safety Analysis
Explain the principles of 6S program (Sort, Sweep, Sanitize, Set-to-order, Sustain, Safety).	Textbook: pgs. 40–41
Identify fuel source and selection of correct extinguisher class.	Textbook: pgs. 39–40
HS Specific:	
Identify required machine guarding for fluid power systems.	Textbook: pgs. 284, 289, 321
Describe safe procedures for removing stored hydraulic or pneumatic energy, including systems with accumulators and compressed air reservoirs, perform zero energy verification.	Textbook: pgs.308 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: pgs. 202–205 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Describe dangers of personal contact with pressurized hydraulic or pneumatic streams.	Textbook: pgs.289, 320, 358, 369 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: pgs. 38–40, 204 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit Lab Workbook: Activity 15-2, Hydraulic Filter Servicing

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Standards	G-W Content
Adhere to guidelines to avoid contact with hot surfaces in fluid power system.	Textbook: pgs. 32 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit
Duty Title: 3.02. Interpret basic fluid power schematics.	
Identify and describe the basic hydraulic components given their NFPA/ ISO schematic symbol.	Textbook: pgs. 119–122, 284, 288, 293, 315–316, 319, 360 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: pgs. 121–122, 283–289. 306, 309–325, 360 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: pgs. 119–122, 287, 314–316 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 uploading, remote pressure control, rapid traverse slow feed and pilot-operated check valves.	Textbook: pgs. 314–316, 318–320
Interpret hydraulic line types on a schematic.	Textbook: pgs. 119–121, 284, 288, 360–361, 364–365
Interpret the operation of a basic hydraulic circuit given a schematic.	Textbook: pgs. 119–121, 284, 317, 325–327 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: pgs. 119–122, 288, 295, 317, 319, 344–345, 347, 360, 373
Directional control valves, pressure control valves, flow control valves, cylinders, motors, instrumentation, compressors, various types of operators, filters.	Textbook: pgs. 121–122, 283–289, 305, 313–325, 339–341, 343–345, 360
Interpret pneumatic line types on a schematic.	Textbook: pgs. 119–123

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Standards	G-W Content
Interpret the operation of a basic pneumatic circuit given a schematic.	Textbook: pgs. 119–124, 349–352 Lab Workbook: Activity 18-2, Basic Pneumatic Circuits 1 Lab Workbook: Activity 18-3, Basic Pneumatic Circuits 2
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: pgs. 312–313 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit
Safely shut down a hydraulic power system.	Textbook: pgs. 47–51 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Use manufacturer's documentation per specific application to determine correct operating pressure.	Textbook: pgs. 314–315 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: pgs. 285 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: pgs. 283–285, 288, 313–314 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: pgs. 317–318, 350
Adjust the pressure of a pressure reducing valve.	Textbook: pgs. 314–316 Lab Workbook: Activity 15-1, Starting a Hydraulic Power Unit

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Standards	G-W Content
Adjust the system operating pressure.	Textbook: pgs. 283–285, 311–312 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: pgs. 313–316
Describe the operation of a double-acting cylinder, motor, hydraulic sequence valve, and pressure reducing valve.	Textbook: pgs. 286–288, 314–315, 326–327 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: pgs. 309, 772–773
Describe how to do pressure checks and charge accumulators.	Textbook: pgs. 319–320 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: pgs. 305–306, 323–325, 338–339, 366–367
Describe Pascal's law and its importance in reading system pressure.	Textbook: pgs. 286
Duty Title: 3.04. Adjust hydraulic actuator speed using a flow control valve.	
Adjust actuator speed using a needle valve.	Textbook: pgs. 350 Lab Workbook: Activity 16-3, Compensated and Noncompensated Flow Control
Adjust actuator speed using non-compensated and compensated flow control valves.	Textbook: pgs. 316–318, 350 Lab Workbook: Activity 16-3, Compensated and Noncompensated Flow Control Lab Workbook: Activity 16-4, Meter-In and Meter-Out Circuits

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Standards	G-W Content
Adjust flow control valves in meter-in and meter-out configurations.	Textbook: pgs. 350 Lab Workbook: Activity 16-4, Meter-In and Meter-Out Circuits Lab Workbook: Activity 18-3, Basic Pneumatic Circuits 2
Measure actuator speed.	Textbook: pgs. 312 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 operation of a needle valve, flow control valve, compensated flow control valve, and meter-in and meter-out circuits.	Textbook: pgs. 288, 322, 349–350 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: pgs. 320–324, 350 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: pgs. 283–284, 312
Calculate pump flow rate given pump size and speed.	Textbook: pgs. 283–284, 312–313
Duty Title: 3.05. Service a hydraulic filter.	
Interpret filter specifications and models to determine correct filter.	Textbook: pgs. 295–296, 334–338 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Use manufacturer's documentation to determine frequency of change.	Textbook: pgs. 294–295, 297 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Determine when to replace a filter base on pressure differential across the filter.	Textbook: pgs. 294–295, 334 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing

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Standards	G-W Content
Measure pressure differential across a filter.	Textbook: pgs. 285
Replace a spin-on filter.	Textbook: pgs. 295 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Replace a cartridge filter.	Textbook: pgs. 295 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Define or describe symptoms of a required strainer.	Textbook: pgs. 293–295
Replace a strainer.	Textbook: pgs. 295 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Duty Title: 3.06. Service hydraulic fluid.	
Inspect fluid levels through level gauge and determine when to add fluid.	Textbook: pgs. 306–307, 713 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: pgs. 292–293, 307–308 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: pgs. 293–296 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: pgs. 293 Lab Workbook: Activity 15-3, Sampling and Servicing Hydraulic Fluid
Inspect fluid for water and visible contaminants.	Textbook: pgs. 291–295 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: pgs. 293–295, 313 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: pgs. 293 Lab Workbook: Activity 15-3, Sampling and Servicing Hydraulic Fluid

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Standards	G-W Content
Use manufacturer's documentation to determine the correct oil to use in a hydraulic system.	Textbook: pgs. 291–296 Lab Workbook: Activity 15-3, Sampling and Servicing Hydraulic Fluid
Take a fluid sample and prepare for submittal to a testing lab.	Textbook: pgs. 308–309 Lab Workbook: Activity 15-3, Sampling and Servicing Hydraulic Fluid
Duty Title: 3.07. Install hydraulic conductors.	
Interpret pipe, hose, and tubing specifications.	Textbook: pgs. 297–298 Lab Workbook: Activity 15-4, Hydraulic Tubing and Fittings
Identify type and size of hose, tubing, and hydraulic fittings given a sample.	Textbook: pgs. 297–298 Lab Workbook: Activity 15-4, Hydraulic Tubing and Fittings
Use safety procedures to make sure pressure is removed before disconnecting conductors.	Textbook: pgs. 285, 309 Lab Workbook: Activity 15-4, Hydraulic Tubing and Fittings
Describe proper fitting tightening and describe the consequences of over-tightening.	Textbook: pgs. 297–298 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: pgs. 297–298
Describe the operation of an O-ring.	Textbook: pgs. 343, 782, 807 Lab Workbook: Activity 16-2, Hydraulic Component Replacement

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Standards	G-W Content
Install an O-ring.	Textbook: pgs. 343 Lab Workbook: Activity 16-2, Hydraulic Component Replacement
Describe how O-rings are specified.	Textbook: pgs. 343
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: pgs. 284, 325–326 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
Replace subplate-mounted directional, flow and pressure control valves in a hydraulic system.	Textbook: pgs. 357, 359–365 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: pgs. 320–325
Describe types of cylinder and motor mounting methods and their applications.	Textbook: pgs. 320–325
Operate a hydraulic system to determine that it is performing correctly.	Textbook: pgs. 284–285, 327–328 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: pgs. 323 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: pgs. 285, 309–325 Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components

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Standards	G-W Content
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: pgs. 289, 337–338, 342–343 Lab Workbook: Activity 15-2, Hydraulic Filter Servicing
Use systematic methodologies to troubleshoot basic hydraulic circuits with linear and rotary actuators with these symptoms: Actuator will not move Actuator moves at incorrect speed Actuator moves erratically No or low system pressure	Textbook: pgs. 327–328, 351–352, 363–365, 370 Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components
Describe types of failures of basic hydraulic component.	Textbook: pgs.292–293, 305–306, 361–362 Lab Workbook: Activity 16-1, Assembling and Testing a Basic Hydraulic Circuit Lab Workbook: Activity 18-1, Troubleshooting Hydraulic Components

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