



Course Description

ET12315C | Fluid/Pneumatic Instrumentation | 3.00 credits

This course is designed for students specializing in industrial equipment maintenance. Students will learn to apply the basic principles and operation of hydraulic and pneumatic instrumentation and testing equipment to repair equipment. Laboratory experiments are performed with extensive hands-on application.

Course Competencies

Competency 1: The student will demonstrate an understanding of the principles of pneumatic instrument operation by:

1. Explaining the basic concepts of pneumatics
2. Defining common terminology used in pneumatics
3. Describing the principles of operation of a typical pneumatic transmitter
4. Stating the basic laws of physics as they apply to pneumatics, including: Pascal's law, Boyle's law, Charles' law, and the ideal gas law
5. Explaining the applications of pneumatic instrumentation in industrial systems, its benefits, and limitations
6. Describing the purpose and operations of each component in a pneumatic air supply system, including compressors, dryers, filters, and regulators, and discussing factors that affect their operation
7. Preparing a filter for disassembly, disassembling, cleaning, and reassembling a filter
8. Describing the basic operations and uses of the three types of dryers used in pneumatic control systems

Competency 2: The student will demonstrate a basic understanding of hydraulic/fluid systems by:

1. Describing the characteristics of a typical hydraulic system
2. Explaining how a hydraulic system operates
3. Identifying the component parts of a hydraulic system and their functions within the system
4. Identifying types of flow measuring devices and their applications

Competency 3: The student will demonstrate an understanding of pneumatic and hydraulic test devices, including manometers, test gages, portable pneumatic and hydraulic calibrators, and pneumatic and hydraulic deadweight testers by:

1. Identifying the facility's primary and secondary standard pneumatic test equipment
2. Explaining the operating principles and procedures for using manometers, test gages, calibrators, and deadweight testers
3. Distinguishing between different types of testing devices and selecting the appropriate test device for a particular instrument calibration
4. Taking test readings and interpreting the meaning of those readings
5. Connecting test equipment
6. Recognizing and identifying the factors that affect the accuracy of test instruments
7. Calibrating test equipment to prepare for testing and adjusting devices to assure accurate readings
8. Identifying the major components of pneumatic indicators and explaining their operation

Competency 4: The student will demonstrate an understanding of the principles and usages of pneumatic sensors and transmitters by:

1. Explaining the operation of a basic pneumatic instrument
2. Listing the most common types of sensing devices used to measure, detect, or record system pressure, and explaining the application, purpose, and operation of each type of device, including: diaphragm capsule, Bourdon tube, filled bulb sensor, bellows, force-balance pneumatic transmitter, and pneumatic relay
3. Interpreting a manufacturer's schematic drawing of a pneumatic transmitter to describe its principle of

operation and location of parts

4. Describing the operation of force and motion-balance pneumatic transmitters and associating each type of transmitter with its application
5. Identifying pneumatic transmitter components and stating their purpose
6. Explaining the principles of operation of a typical pneumatic transmitter
7. Identifying pneumatic transmitter components and stating their purposes
8. Discussing the role of sensors in pneumatic instrumentation controls
9. Identifying the nozzle/flapper, relay, feedback element, and restrictor in a pneumatic instrument and describing the function and operation of each component

Competency 5: The student will demonstrate an understanding of the operation and use of controllers and recorders by:

1. Explaining the fundamental principles of control theory
2. Explaining the purpose of pneumatic controllers and the fundamental principles of how they operate.
3. Identifying common components found in a controller and stating the function of each
4. Defining common terms and concepts, including: damping in pneumatic systems, proportional, integral, and derivative control modes, and proportional band and gain
5. Describing the operating principle of the four bellows arrangement
6. Reviewing offset and the difference between repeats per minute and minutes per repeat
7. Describing an appropriate application for each of the control modes
8. Defining direct action and reverse action and giving an example of where each would be used

Competency 6: The student will demonstrate an understanding of how to recognize, identify, and understand actuators and positioners as they relate to control valve trim by:

1. Describing the principles of control valve operation
2. Stating the purpose of a valve actuator in a control valve system, identifying the major components, and explaining its operation
3. Stating the purpose of a pneumatic positioner in a control valve system, identifying the major components, and explaining its operation
4. Discussing the advantages and limitations of pneumatic actuators
5. Listing types of actuators, describing how each works, and citing appropriate applications for each type
6. Explaining the principles of pneumatic positioner operation and how they are applied to control valve performance
7. Listing types of positioners, describing how each works, and citing appropriate applications for each type
8. Describing the selection factors that indicate the appropriate actuator or positioner for system applications
9. Matching failsafe requirements with the appropriate actuator response
10. Identifying external fail-safe devices used with piston actuators

Competency 7: The student will demonstrate an understanding of how to calibrate, maintain, and repair pneumatic testing devices by:

1. Defining calibration and describing the general procedure for calibrating an instrument
2. Discussing calibration standards and how they are derived
3. Identifying the causes for inaccurate readings and discussing factors that may damage or impede the performance of specific instruments and contribute to instrument inaccuracy
4. Selecting the appropriate devices to calibrate, maintain, and repair specific equipment
5. Troubleshooting and diagnosing equipment problems
6. Performing basic maintenance and repair functions, including: disconnecting, disassembling, reassembling, and reconnecting a Bourdon instrument; cleaning pneumatic transmitter flapper/nozzles and restrictors; disassembling, repairing, and cleaning a pneumatic transmitter relay; replacing a pneumatic transmitter air supply filter screen and the diaphragm capsule; checking the operation of

pneumatic components to determine that they are functioning correctly; diagnosing operational problems, making system adjustments, replacing parts, and correcting identified problems; calibrating controllers and recorders; checking the operation of a controller, diagnosing possible malfunctions, and identifying probable causes; removing a controller from service and returning a controller to service; cleaning and replacing relays and restrictors; aligning and calibrating a proportional-plus-reset controller; identifying the components of a pneumatic recorder; disassembling and cleaning a pneumatic recorder; removing, cleaning, and replacing a chart drive motor; calibrating a pneumatic recorder; configuring the bellows, relays, links, and levers within a controller to provide proportional, integral, and derivative control modes, both in direct and reverse action; explaining the methodology involved in a pneumatic loop calibration including typical test equipment and record keeping

Learning Outcomes

- Communicate effectively using listening, speaking, reading, and writing skills
- Use quantitative analytical skills to evaluate and process numerical data
- Formulate strategies to locate, evaluate, and apply information