## Instrumentation

### Level 1

**Curriculum Notes**
- 187.5 Hours
- Includes 72.5 hours of Core, which is a prerequisite for Level 1 completion and must be purchased separately.
- Downloadable instructor resources that include module tests, PowerPoints®, and performance profile sheets are available at www.nccer.org/irc.

### Modules

#### Instrumentation Safety Practices (12.5 Hours)
(Module ID 12115-14) Covers precautions for electrical hazards found on the job and teaches the OSHA-mandated lockout/tagout procedure. Identifies safety practices related to potentially hazardous tools and materials.

#### Craft-Related Mathematics (10 Hours)
(Module ID 12119-14) Covers basic concepts of the metric system and the conversion of English units to metric units. Also reviews basic algebra, geometric figures, and calculations associated with triangles.

#### Instrument Drawings and Documents Part One (7.5 Hours)
(Module ID 12017-14) Identifies and describes the types of drawings used in instrumentation work and familiarizes trainees with basic instrument symbols, lines, and abbreviations used on drawings.

#### Inspect, Handle, and Store Instrumentation Materials (2.5 Hours)
(Module ID 12304-14) Covers the methods used in receiving, inspecting, handling, and storing project-related instrumentation equipment.

#### Fasteners (7.5 Hours)
(Module ID 12106-14) Explains how to properly identify, select, and install threaded and non-threaded fasteners and anchors used in instrumentation work.

### PAPERBACK

- Trainee Guide: $69.99
- Individual Modules: $24.99

- see module list

### Level 2

**Curriculum Notes**
- 182.5 Hours
- Revised: 2016, Third Edition
- Downloadable instructor resources that include module tests, PowerPoints®, and performance profile sheets are available at www.nccer.org/irc.

### Modules

#### Temperature, Pressure, Level, and Flow (15 Hours)
(Module ID 12110-15) Examines the characteristics of temperature, pressure, level, and flow, and describes the units of measure for each variable. Introduces common devices used to measure these process variables and the basic principles of operation for each device.

#### Instrument Fitter’s Math (15 Hours)
(Module ID 12301-15) Discusses the application of right triangles in bending and installing tubing and conduit as it applies to instrumentation. Shows how to use a scientific calculator in applying instrumentation piping and fitting math.

#### Instrument Drawings and Documents, Part Two (17.5 Hours)
(Module ID 12202-15) Covers reading and interpreting piping and instrumentation drawings, loop sheets, flow diagrams, isometrics, and orthographics to enable the identification of types of instrumentation and the specifications for installation.

### Gaskets, O-Rings, and Packing (10 Hours)
(Module ID 12108-14) Teaches how to recognize, select, and properly install gaskets, packing, and O-rings. Covers the various materials used in gaskets and O-rings, along with their applications and limitations.

#### Lubricants, Sealants, and Cleaners (7.5 Hours)
ISBN 978-0-13-378844-0
(Module ID 12109-14) Covers the proper use, storage, handling, and safety practices associated with various lubricants, cutting fluids, sealants, and cleaners. Includes coverage of the tools and materials used in applying lubricants and cleaning products.

#### Tubing (15 Hours)
(Module ID 12111-14) Introduces types of tubing, tubing materials, fittings, and tools. Covers proper storage and handling, cutting, deburring, reaming, bending, and joining of tubing.

#### Steel Piping Practices (10 Hours)
(Module ID 12117-14) Covers both carbon steel and stainless steel piping measuring 2” as it applies to instrumentation work. Includes instructions for calculating pipe cut length, cutting, deburring, reaming, and threading pipe.

#### Hoses (7.5 Hours)
(Module ID 12113-14) Describes different types of hoses and related fittings, along with proper storage and handling. Includes instructions for cutting hoses and installing standard reusable fittings.

#### Test Equipment (10 Hours)
(Module ID 33205-10; from Electronic Systems Technician Level Two) Covers the selection, inspection, use, and maintenance of basic test equipment used in low-voltage work. Also covers specialized test equipment such as signal generators, wattmeters, cable testers, and RF analyzers.

#### Panel-Mounted Instruments (10 Hours)
(Module ID 12212-15) Explains the selection of instruments to be panel-mounted, locating the instruments using drawings, and procedures for installing the instruments in the panels.

#### Installing Field-Mounted Instruments (25 Hours)
(Module ID 12213-15) Covers selection and mounting of instruments at locations other than panels, including stand mounting, in-line mounting, structure mounting, strap mounting, and insertion mounting.

Continued on following page
### Raceways for Instrumentation (17.5 Hours)

(Module ID 12214-15) Introduces raceways. Also covers identification and selection of conduit, raceways, wireways, cable trays, fittings, and NEC® requirements for installation.

### Clean, Purge, and Test Tubing and Piping Systems (10 Hours)

(Module ID 12303-15) Presents safe methods for cleaning, purging, blowing down, pressure testing, and leak testing tubing, piping, and hoses used in instrumentation.

### Protective Measures for Instrumentation (20 Hours)

(Module ID 12308-15) Covers protective measures applied in instrumentation installations, including heat tracing, chemical treatment, and insulation.

### Layout and Installation of Tubing and Piping Systems (35 Hours)

(Module ID 12302-15) Introduces piping and tubing layout procedures. Explains the steps in creating a hand-drawn isometric drawing that can be applied in the piping and tubing installation. Introduces methods and procedures used to measure, cut, and bend and support piping and tubing.

### L3 INSTRUMENTATION

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<th>Curriculum Notes</th>
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<td>• 150 Hours</td>
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<td>The modules listed below are included in the Trainee Guide. The following ISBNs are for ordering individual modules only.</td>
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### Control Valves, Actuators, and Positioners (15 Hours)

(Module ID 12207-16) Covers the construction and operation of various piping-system valves and actuators. Discusses the application and operation of valve positioners. Presents valve selection criteria and explains how to interpret valve and actuator markings and nameplate information.

### Detectors, Secondary Elements, Transducers, and Transmitters (25 Hours)

(Module ID 12205-16) Introduces instrumentation devices that detect different process variables, devices that change the variable into a transmittable form, and devices that transmit the information to another device for control or informational purposes. Covers devices that sense flow, level, temperature, and pressure, along with various types of transducers and transmitters.

### Instrumentation Electrical Circuitry (25 Hours)

(Module ID 12305-16) Describes various types of series and parallel circuits; resistance, inductance, and capacitance in AC circuits; DC power supplies; analog and digital signals; and common applications of electrical and electronic circuitry.

### Relays and Timers (10 Hours)

(Module ID 12208-16) Presents the principles of operation and applications of various relays and timers. Also reviews the selection process for these devices.

### Switches and Photoelectric Devices (10 Hours)

(Module ID 12209-16) Covers the principles of operation and applications of switches and photoelectric devices in the instrumentation environment.

### Terminating Conductors (20 Hours)

(Module ID 12309-16) Explains the methods, procedures, and standards used to terminate and test common types of conductors utilized in electrical and electronic wiring applications.

### Process Control Theory (25 Hours)

(Module ID 12204-16) Describes the principles of process control and how various types of control loops are applied. Discusses ON-OFF and modulating control schemes. Explains how process control principles are applied to flow, level, temperature, and pressure control loops.

### Controllers (10 Hours)

(Module ID 12206-16) Covers the theory of operation and the application of common process controllers, including both pneumatic and electronic devices.

### Proving, Commissioning, and Troubleshooting a Loop (15 Hours)

(Module ID 12401-16) Explains the three stages in readying a loop for operation: checking, proving, and commissioning. Examines the key ideas behind each step and stresses the differences. Explores troubleshooting techniques and methodologies, with an emphasis on their use during the three stages of readying a loop.

### Tuning Loops (15 hours)

ISBN 978-0-13-448303-0  
(Module ID 12406-16) Introduces the techniques used in tuning loops employing PID control. Includes basic tuning theory and formulas. Examines open, closed, and visual loop tuning methods.

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Instrumentation Level 4 (continued)

**Digital Logic Circuits (15 Hours)**
ISBN 978-0-13-448305-4
(Module ID 12401-16) Introduces the basic ideas of digital electronics. Presents gates, combination logic, and truth tables. Addresses memory devices, counters, and arithmetic circuits as well as the numbering systems commonly used in digital systems.

**Programmable Logic Controllers (12.5 Hours)**
(Module ID 12406-16) Introduces PLCs and their uses in industrial control. Includes hardware components, applications, communications, number systems, and programming methods.

**Distributed Control Systems (15 Hours)**
(Module ID 12407-16) Surveys DCS technologies, including an overview of their development. Discusses key components, fieldbuses, servers, and human-machine interfaces. Also introduces maintenance and the increasingly important aspect of DCS security.

**Analyzers and Monitors (30 Hours)**
(Module ID 12409-16) Introduces the key concepts of chemistry, with an emphasis on their application in instrumentation. Explains crucial physical and chemical properties of matter. Discusses the different analytical methods used in industry to assess processes. Includes pH, conductivity, ORP, gas analysis, and particulate counts. Explores specific instruments and techniques.