

## L1 INSTRUMENTATION



LEVEL 1

### Curriculum Notes

- 187.5 Hours (Includes 72.5 hours of Core Curriculum, which is a prerequisite for Level 1 completion and must be purchased separately. See p. 14 for ordering information.)
- Revised: 2014, Third Edition
- Downloadable instructor resources that include module tests, PowerPoints®, and performance profile sheets are available at [www.nccer.org/irc](http://www.nccer.org/irc).

### PAPERBACK

Trainee Guide: \$67

### ISBN

978-0-13-383080-4

### MODULES

All of the modules listed below are included in the Trainee Guide. The following ISBN and pricing information is for ordering individual modules only.

#### Instrumentation Safety Practices (12.5 Hours)

Trainee \$20 ISBN 978-0-13-378832-7  
Instructor \$20 ISBN 978-0-13-378858-7

(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.

#### Hand and Power Tools for Instrumentation

(12.5 Hours)  
Trainee \$20 ISBN 978-0-13-378834-1  
Instructor \$20 ISBN 978-0-13-378859-4

(Module ID 12114-14) Explains how to identify, inspect, use, and maintain the various hand and power tools used by instrument fitters and technicians.

#### Craft-Related Mathematics (10 Hours)

Trainee \$20 ISBN 978-0-13-378838-9  
Instructor \$20 ISBN 978-0-13-378861-7

(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)

Trainee \$20 ISBN 978-0-13-378839-6  
Instructor \$20 ISBN 978-0-13-378862-4

(Module ID 12107-14) 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)

Trainee \$20 ISBN 978-0-13-378840-2  
Instructor \$20 ISBN 978-0-13-378863-1

(Module ID 12304-14) Covers the methods used in receiving, inspecting, handling, and storing project-related instrumentation equipment.

### Electrical Systems for Instrumentation

(12.5 Hours)

Trainee \$20 ISBN 978-0-13-378841-9  
Instructor \$20 ISBN 978-0-13-378864-8

(Module ID 12116-14) Covers basic electrical concepts and terms, DC circuit calculations, electrical measuring instruments, and electrical wiring.

#### Fasteners (7.5 Hours)

Trainee \$20 ISBN 978-0-13-378842-6  
Instructor \$20 ISBN 978-0-13-378865-5

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

#### Gaskets, O-Rings, and Packing (10 Hours)

Trainee \$20 ISBN 978-0-13-378843-3  
Instructor \$20 ISBN 978-0-13-378866-2

(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)

Trainee \$20 ISBN 978-0-13-378844-0  
Instructor \$20 ISBN 978-0-13-378867-9

(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)

Trainee \$20 ISBN 978-0-13-378853-2  
Instructor \$20 ISBN 978-0-13-378868-6

(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)

Trainee \$20 ISBN 978-0-13-378854-9  
Instructor \$20 ISBN 978-0-13-378869-3

(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)

Trainee \$20 ISBN 978-0-13-378856-3  
Instructor \$20 ISBN 978-0-13-378870-9

(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.

## L2 INSTRUMENTATION

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](http://www.nccer.org/irc).

### PAPERBACK

Trainee Guide: \$97

### ISBN

978-0-13-413101-6

### MODULES

All of the modules listed below are included in the Trainee Guide. The following ISBN and pricing information is for ordering individual modules only.

#### Temperature, Pressure, Level, and Flow

(15 Hours)

Trainee \$20 ISBN 978-0-13-448255-2  
Instructor \$20 ISBN 978-0-13-448273-6

(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)

Trainee \$20 ISBN 978-0-13-448257-6  
Instructor \$20 ISBN 978-0-13-448258-3

(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)

Trainee \$20 ISBN 978-0-13-448260-6  
Instructor \$20 ISBN 978-0-13-448259-0

(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.

#### Test Equipment (10 Hours)

(Module ID 33205-10; from *Electronic Systems Technician Level 2*)  
Trainee \$20 ISBN 978-0-13-266158-4  
Instructor \$20 ISBN 978-0-13-266169-0

#### Panel-Mounted Instruments (10 Hours)

Trainee \$20 ISBN 978-0-13-448261-3  
Instructor \$20 ISBN 978-0-13-448262-0

(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)

Trainee \$20 ISBN 978-0-13-448263-7  
Instructor \$20 ISBN 978-0-13-448265-1

(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.

#### Raceways for Instrumentation (17.5 Hours)

Trainee \$20 ISBN 978-0-13-448267-5  
Instructor \$20 ISBN 978-0-13-448264-4

(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)

Trainee \$20 ISBN 978-0-13-448269-9  
Instructor \$20 ISBN 978-0-13-448266-8

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

## Instrumentation Level 2 (continued)

### Protective Measures for Instrumentation

(20 Hours)

Trainee \$20 ISBN 978-0-13-448270-5  
 Instructor \$20 ISBN 978-0-13-448271-2  
 (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)

Trainee \$20 ISBN 978-0-13-448272-9  
 Instructor \$20 ISBN 978-0-13-448276-7  
 (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.

### Instrument Air Filters, Regulators, and Dryers

(7.5 Hours)

Trainee \$20 ISBN 978-0-13-448274-3  
 Instructor \$20 ISBN 978-0-13-448256-9  
 (Module ID 12210-15) Presents the construction, operation, and uses of filters, regulators, and dryers. Covers identification and selection of the correct component for installation using applicable specifications and schematics.

## L3 INSTRUMENTATION

LEVEL 3

### Curriculum Notes

- 150 Hours
- Revised: 2016, Third Edition
- Downloadable instructor resources that include module tests, PowerPoints®, and performance profile sheets are available at [www.nccer.org/irc](http://www.nccer.org/irc).

### PAPERBACK

ISBN

Trainee Guide: \$97

978-0-13-413095-8

### MODULES

All of the modules listed below are included in the Trainee Guide. The following ISBN and pricing information is for ordering individual modules only.

#### Control Valves, Actuators, and Positioners

(15 Hours)

Trainee \$20 ISBN 978-0-13-448277-4  
 Instructor \$20 ISBN 978-0-13-448280-4  
 (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)

Trainee \$20 ISBN 978-0-13-448278-1  
 Instructor \$20 ISBN 978-0-13-448279-8  
 (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)

Trainee \$20 ISBN 978-0-13-448281-1  
 Instructor \$20 ISBN 978-0-13-448282-8  
 (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)

Trainee \$20 ISBN 978-0-13-448283-5  
 Instructor \$20 ISBN 978-0-13-448285-9  
 (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)

Trainee \$20 ISBN 978-0-13-448286-6  
 Instructor \$20 ISBN 978-0-13-448287-3  
 (Module ID 12209-16) Covers the principles of operation and applications of switches and photoelectric devices in the instrumentation environment.

### Terminating Conductors

(20 Hours)

Trainee \$20 ISBN 978-0-13-448288-0  
 Instructor \$20 ISBN 978-0-13-448290-3  
 (Module ID 12307-16) Explains the methods, procedures, and standards used to terminate and test common types of conductors utilized in electrical and electronic wiring applications.

### Grounding and Shielding of Instrumentation Wiring

(10 Hours)

Trainee \$20 ISBN 978-0-13-448291-0  
 Instructor \$20 ISBN 978-0-13-448293-4  
 (Module ID 12306-16) Teaches the basic concepts of grounding and shielding, including wire and cable identification. Defines various types of noise that can be induced into instrumentation wiring and describes the methods used to reduce or eliminate it.

### Process Control Theory

(25 Hours)

Trainee \$20 ISBN 978-0-13-448294-1  
 Instructor \$20 ISBN 978-0-13-448295-8  
 (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)

Trainee \$20 ISBN 978-0-13-448296-5  
 Instructor \$20 ISBN 978-0-13-448297-2  
 (Module ID 12206-16) Covers the theory of operation and the application of common process controllers, including both pneumatic and electronic devices.

## L4 INSTRUMENTATION

LEVEL 4

### Curriculum Notes

- 165 Hours
- Revised: 2016, Third Edition
- Downloadable instructor resources that include module tests, PowerPoints®, and performance profile sheets are available at [www.nccer.org/irc](http://www.nccer.org/irc).

### PAPERBACK

ISBN

Trainee Guide: \$97

978-0-13-449532-3

Instructor's Guide: \$97

978-0-13-454302-4

### MODULES

All of the modules listed below are included in the Trainee Guide. The following ISBN and pricing information is for ordering individual modules only.

#### Instrument Calibration and Configuration

(60 Hours)

Trainee \$20 ISBN 978-0-13-448298-9  
 Instructor \$20 ISBN 978-0-13-448299-6  
 (Module ID 12402-16) Introduces the basic concepts of calibration, including the three- and five-point methods. Addresses pneumatic, analog, and smart instrumentation calibration methods. Also covers other process control devices that require calibration.

#### Proving, Commissioning, and Troubleshooting a Loop

(17.5 Hours)

Trainee \$20 ISBN 978-0-13-448300-9  
 Instructor \$20 ISBN 978-0-13-448301-6  
 (Module ID 12410-16) 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)

Trainee \$20 ISBN 978-0-13-448303-0  
 Instructor \$20 ISBN 978-0-13-448302-3  
 (Module ID 12405-16) Introduces the techniques used in tuning loops employing PID control. Includes basic tuning theory and formulas. Examines open, closed, and visual loop tuning methods.

#### Digital Logic Circuits

(15 Hours)

Trainee \$20 ISBN 978-0-13-448305-4  
 Instructor \$20 ISBN 978-0-13-448304-7  
 (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)

Trainee \$20 ISBN 978-0-13-448306-1  
 Instructor \$20 ISBN 978-0-13-448307-8  
 (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)

Trainee \$20 ISBN 978-0-13-448308-5  
 Instructor \$20 ISBN 978-0-13-448310-8  
 (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)

Trainee \$20 ISBN 978-0-13-448311-5  
 Instructor \$20 ISBN 978-0-13-448312-2  
 (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.