Industrial Wiring Learning Systems
46102-00

LabVolt Series

Datasheet

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en 120 V - 60 Hz
04/2021

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General Description

The Industrial Wiring Training Systems are hands-on systems designed to train students for careers as electricians and electrical maintenance technicians. The systems, which use high-quality UL-listed components, faithfully reproduce an industrial environment where students can develop their skills in the installation and wiring of industrial electrical equipment, in compliance with the National Electrical Code® (NEC®). The systems can also be used to train students in the adjustment and maintenance of industrial electrical equipment, and teach them the safety rules to be followed when working at industrial sites.

The Industrial Wiring Training Systems are divided into two levels, each level being further divided into specific topics that deal with various aspects of industrial electrical equipment installation.

The Mobile Workstation

The above picture shows the 120 V – 60 Hz variant of the Mobile Workstation.
220 V variants include a three-phase transformer to lower the input voltage.

The Mobile Workstation is the basic component of the training system. It is a versatile bench with enough space for the simultaneous installation of up to four equipment packages. This allows up to four students to perform exercises at the same time on a single workstation.

Tools Required

Performing the courseware exercises in the Industrial Wiring Training Systems requires a number of specialized tools not included with the systems. These tools include hand benders of various sizes, a pipe threader, knock-out punches, a fish tape, a phase sequence indicator, etc. Users can either provide their own specialized tools, or use the following optional sets:

- Enclosure and Conduit Tools, Model 46840
- Electrical Wiring Tools, Model 46841

Performing the courseware exercises also requires the following basic tools, that must be provided by the user:

- Safety glasses and leather gloves
- Measuring tape and felt pen
- Calculator
- Hacksaw and file
- Hammer
- Screwdriver set
- Allen key set
- Diagonal cutters
- Adjustable wrenches (0-25 mm or 0-1 in)
- Ratchet wrench and SAE socket set
- Electric drill and drill set
- Level

Courseware

The courseware for each training system consists of a student manual, an instructor guide and, in some cases, an electrical drawing set. A reference book from the National Center for Construction Education and Research (NCCER) is also included when required. Each student manual consists of a series of job sheets or work orders that describe different tasks to be performed by students. The corresponding instructor guide provides the lists of points that should be checked to assess the student work, as well as notes that indicate how to conduct the course. All student manuals, instructor guides, and reference books are fully illustrated and color-printed. All student manuals, instructor guides, and electrical drawing sets are available as pdf files on a CD-ROM, Model 37866-A.

Consumables

Consumable goods such as outlet boxes, conduits, and electrical wires are required to perform the courseware exercises. Different optional consumable packages are available to fill that need. Each consumable package includes the consumables required for a student to complete the job sheets or work orders in the student manual of a particular equipment package.

Modularity

Each equipment package contains all the electrical components and courseware required to cover a certain topic (e.g., enclosure and conduit installation, three-phase motor starters) and is independent of the other training equipment packages. This modular approach allows the system to be configured to meet various training requirements. The table below indicates the required and optional equipment for each equipment package.

Equipment Packages		Required Equipment			Optional Equipment		
Model	Name	Mobile Workstation Model 46801-1	Enclosure and Conduit Tools Model 46840	Electrical Wiring Tools Model 46841	Inertia Load Model 46830	Blower Application Model 46831	Power Quality Analyzer Model 46832
46810	Enclosures and Conduits	X*	X				
46811	Electrical Wiring	X	X	X			
46812	Three-Phase Motor Starters	X	X	X	O		O
46813	AC Motor Drive	X	X	X		O	O
46814	DC Motor Drive	X	X	X			
46815	Electrical Power Distribution	X*	X				

* The Mobile Workstation, Model 46801, can also be used since these equipment packages do not require power.

Features & Benefits

- Supports up to four equipment setups at the same time, allowing multiple student groups to work at a single workstation
- Two or more equipment setups can be grouped together to form complex industrial applications
- Mobile workstation features swivelling casters with a lock mechanism for easy motion and stable operation
- Mobile workstation sized to fit through standard door openings
- Provides hands-on industrial wiring training in compliance with the National Electrical Code® (NEC®)
- Sturdy, yet flexible design integrating components that meet industrial safety standards
- Wide-range of industrial-grade, UL-listed components
- Each of the training equipment packages contains all the electrical components and courseware required to cover a topic
- Modular approach that allows the system to be configured to fit different training needs
- Comprehensive curriculum
- Total estimated program duration (Levels 1 & 2): 180 hours

List of Available Training Systems

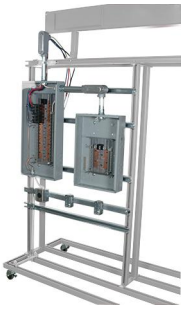
Qty	Description	Model number
1	Basic Industrial Wiring Training System	580143 (46102-10)
1	Industrial Wiring Training System – Level 1	580145 (46102-20)
1	Industrial Wiring Training System - Level 2	580148 (46102-30)

Optional Equipment

Qty	Description	Model number
1	Industrial Wiring Training Systems (Manuals on CD-ROM)	584713 (37866-A0)
1	Three-Phase Power Bus	580041 (46802-00)
1	Inertia Load	580044 (46830-00)
1	Blower Application	580111 (46831-00)
1	Power Quality Clamp Meter	596228 (46832-10)
1	Enclosure Consumables	580114 (46850-00)
1	Conduit Consumables	580115 (46851-00)
1	Electrical Wiring Consumables	580116 (46852-00)
1	Electrical Power Distribution Consumables	580117 (46853-00)
1	Three-Phase Motor Starter Consumables	580118 (46854-00)
1	AC Motor Drive Consumables	580119 (46855-00)
1	DC Motor Drive Consumables	580120 (46856-00)

Available Training Systems

Basic Industrial Wiring Training System 580143 (46102-10)



The Basic Industrial Wiring Training System is a simplified version of the Level 1 system, Model 46102-2. It consists of the Mobile Workstation, Model 46801, and the following two training equipment packages: Enclosures and Conduits, Model 46810, and Electrical Power Distribution, Model 46815.

The Basic Industrial Wiring Training System allows students to learn via hands-on manipulations how to perform the basic tasks carried out by electricians working at industrial sites. These tasks include: enclosure installation, conduit bending, conductor installation, main distribution panel wiring, equipment grounding, etc. The basic system provides a completely safe training environment since power is not supplied to the equipment, as is the case in real-life electric power distribution installation. The basic system is ideal for students beginning their training as electricians.

List of Equipment

Qty	Description	Model number
1	Mobile Workstation	580029 (46801-00)
1	Enclosures and Conduits	763417 (46810-00)
1	Electrical Power Distribution	580109 (46815-00)

List of Manuals

Description	Manual number
NCCER Electrical Trainee Guide - Level 1 (Reference Book)	584711 (37860-80)
Enclosures and Conduits (Job Sheets - Student)	584715 (37866-20)
Enclosures and Conduits (Job Sheets - Instructor)	584716 (37866-30)
Enclosures and Conduits (Work Orders - Student)	584717 (37866-60)
Enclosures and Conduits (Work Orders - Instructor)	584719 (37866-70)
Electrical Power Distribution (Job Sheets - Student)	584792 (38530-20)
Electrical Power Distribution (Job Sheets - Instructor)	584793 (38530-30)
Electrical Power Distribution (Work Orders - Student)	584794 (38530-60)
Electrical Power Distribution (Work Orders - Instructor)	584796 (38530-70)
NCCER Electrical Trainee Guide - Level 2 (Reference Book)	584810 (38643-80)
Electrical Power Distribution (Drawing Set)	584831 (38963-00)
National Electrical Code (NEC®) (Reference Book)	590179 (93617-00)

Table of Contents of the Manual(s)

Enclosures and Conduits (Job Sheets - Student) (584715 (37866-20))

- 1 Installing Metal Struts on the Mobile Workstation
- 2 Installing Enclosures and Boxes on the Mobile Workstation
- 3 Making Holes for Conduit Connections in Enclosure Walls
- 4 Installing Flexible Metal Conduit
- 5 Installing Liquidtight Flexible Nonmetallic Conduit
- 6 Conduit Bending – 90° Bends
- 7 Conduit Bending – Offsets
- 8 Conduit Bending – Saddle Bends
- 9 Installing Electrical Metallic Tubing
- 10 Cutting, Reaming, and Threading Rigid Metal Conduit
- 11 Installing Rigid Metal Conduit
- 12 Feeding Conductors into Conduit
- 13 Feeding Conductors into Conduit Using a Pulling Point

Enclosures and Conduits (Work Orders - Student) (584717 (37866-60))

- 1 Installing Metal Struts on the Mobile Workstation
- 2 Installing Enclosures and Boxes on the Mobile Workstation
- 3 Making Holes for Conduit Connections in Enclosure Walls
- 4 Installing Flexible Metal Conduit
- 5 Installing Liquidtight Flexible Nonmetallic Conduit
- 6 Conduit Bending – 90° Bends
- 7 Conduit Bending – Offsets
- 8 Conduit Bending – Saddle Bends
- 9 Installing Electrical Metallic Tubing
- 10 Cutting, Reaming, and Threading Rigid Metal Conduit
- 11 Installing Rigid Metal Conduit
- 12 Feeding Conductors into Conduit
- 13 Feeding Conductors into Conduit Using a Pulling Point

Electrical Power Distribution (Job Sheets - Student) (584792 (38530-20))

- 1 Installing a Main Distribution Panelboard

- 2 Conduit Installation
- 3 Conductor Installation
- 4 Wiring of the Main Distribution Panelboard
- 5 Installing a Downstream Distribution Panelboard

Electrical Power Distribution (Work Orders - Student) (584794 (38530-60))

- 1 Installing a Main Distribution Panelboard
- 2 Conduit Installation
- 3 Conductor Installation
- 4 Wiring of the Main Distribution Panelboard
- 5 Installing a Downstream Distribution Panelboard

System Specifications

Parameter	Value
Physical Characteristics	
Intended Location	On the floor (stands on casters)
Dimensions (H x W x D)	2223 x 1988 x 800 mm (87.5 x 78.25 x 31.5 in)
Net Weight	TBE

Industrial Wiring Training System – Level 1 580145 (46102-20)

The Industrial Wiring Training System – Level 1 provides students with complete basic training as electricians. The system consists of the Mobile Workstation, Model 46801-1, and the following three training equipment packages: Enclosures and Conduits, Electrical Wiring, and Electrical Power Distribution (Models 46810, 46811, and 46815, respectively).

List of Equipment

Qty	Description	Model number
1	Mobile Workstation with Three-Phase Power Bus	580030 (46801-10)
1	Enclosures and Conduits	763417 (46810-00)
1	Electrical Wiring	580101 (46811-00)
1	Electrical Power Distribution	580109 (46815-00)

List of Manuals

Description	Manual number
NCCER Electrical Trainee Guide - Level 1 (Reference Book)	584711 (37860-80)
Enclosures and Conduits (Job Sheets - Student)	584715 (37866-20)
Enclosures and Conduits (Job Sheets - Instructor)	584716 (37866-30)
Enclosures and Conduits (Work Orders - Student)	584717 (37866-60)
Enclosures and Conduits (Work Orders - Instructor)	584719 (37866-70)
Electrical Power Distribution (Job Sheets - Student)	584792 (38530-20)
Electrical Power Distribution (Job Sheets - Instructor)	584793 (38530-30)
Electrical Power Distribution (Work Orders - Student)	584794 (38530-60)
Electrical Power Distribution (Work Orders - Instructor)	584796 (38530-70)
NCCER Electrical Trainee Guide - Level 2 (Reference Book)	584810 (38643-80)
NCCER Electrical Trainee Guide - Level 3 (Reference Book)	584811 (38644-80)
Electrical Power Distribution (Drawing Set)	584831 (38963-00)
National Electrical Code (NEC®) (Reference Book)	590179 (93617-00)
Electrical Wiring (Job Sheets - Student)	8116920
Electrical Wiring (Job Sheets - Instructor)	8116922
Electrical Wiring (Drawing Set)	8116925

Table of Contents of the Manual(s)

Enclosures and Conduits (Job Sheets - Student) (584715 (37866-20))

- 1 Installing Metal Struts on the Mobile Workstation
- 2 Installing Enclosures and Boxes on the Mobile Workstation
- 3 Making Holes for Conduit Connections in Enclosure Walls
- 4 Installing Flexible Metal Conduit
- 5 Installing Liquidtight Flexible Nonmetallic Conduit
- 6 Conduit Bending – 90° Bends
- 7 Conduit Bending – Offsets
- 8 Conduit Bending – Saddle Bends
- 9 Installing Electrical Metallic Tubing
- 10 Cutting, Reaming, and Threading Rigid Metal Conduit
- 11 Installing Rigid Metal Conduit
- 12 Feeding Conductors into Conduit
- 13 Feeding Conductors into Conduit Using a Pulling Point

Enclosures and Conduits (Work Orders - Student) (584717 (37866-60))

- 1 Installing Metal Struts on the Mobile Workstation
- 2 Installing Enclosures and Boxes on the Mobile Workstation
- 3 Making Holes for Conduit Connections in Enclosure Walls
- 4 Installing Flexible Metal Conduit
- 5 Installing Liquidtight Flexible Nonmetallic Conduit
- 6 Conduit Bending – 90° Bends
- 7 Conduit Bending – Offsets
- 8 Conduit Bending – Saddle Bends
- 9 Installing Electrical Metallic Tubing
- 10 Cutting, Reaming, and Threading Rigid Metal Conduit
- 11 Installing Rigid Metal Conduit

- 12 Feeding Conductors into Conduit
- 13 Feeding Conductors into Conduit Using a Pulling Point

Electrical Power Distribution (Job Sheets - Student) (584792 (38530-20))

- 1 Installing a Main Distribution Panelboard
- 2 Conduit Installation
- 3 Conductor Installation
- 4 Wiring of the Main Distribution Panelboard
- 5 Installing a Downstream Distribution Panelboard

Electrical Power Distribution (Work Orders - Student) (584794 (38530-60))

- 1 Installing a Main Distribution Panelboard
- 2 Conduit Installation
- 3 Conductor Installation
- 4 Wiring of the Main Distribution Panelboard
- 5 Installing a Downstream Distribution Panelboard

Electrical Wiring (Job Sheets - Student) (8116920)

- 1 Overhead Door Installation – Part I
- 2 Overhead Door Installation – Part II
- 3 Enclosure and Box Installation
- 4 Reading Electrical Drawings
- 5 Wiring of the Motor Control Circuit
- 6 Conduit Installation
- 7 Conductor Installation
- 8 Installation of the Safety Switch Handle on the Motor Control Enclosure
- 9 Installation of the Motor Overload Reset Button on the Motor Control Enclosure
- 10 Wiring of the Overhead Door Simulator
- 11 Connection of the Overhead Door Simulator to the Power Lines
- 12 Testing the Overhead Door Simulator

System Specifications

Parameter	Value
System Requirements	
AC Power Network Installation	3 phases (120/208 V – 60 Hz), star (wye) configuration including neutral and ground wires, protected by a 20 A circuit breaker
AC Power Network Connector	NEMA L21-20
Physical Characteristics	
Intended Location	On the floor (stands on casters)
Dimensions (H x W x D)	2223 x 2200 x 800 mm (87.5 x 86.6 x 31.5 in)
Net Weight	TBE

Industrial Wiring Training System - Level 2 580148 (46102-30)

The Industrial Wiring Training System - Level 2 adds on to Level 1 to provide training in motor control equipment installation as well as a solid introduction to the maintenance of industrial electrical equipment. It consists of the following three training equipment packages: Three-Phase Motor Starters, AC Motor Drive, and DC Motor Drive.

Two optional industrial application packages, the Inertia Load and the Blower Application can be added to the Level 2 system to make it even more representative of the industrial environment. An optional Power Quality Clamp Meter can also be added to analyze the performance of the implemented ac motor controllers.

List of Equipment

Qty	Description	Model number
1	Three-Phase Motor Starters	580103 (46812-00)
1	AC Motor Drive	580105 (46813-00)
1	DC Motor Drive	593729 (46814-00)

List of Manuals

Description	Manual number
Three-Phase Motor Starters (Work Orders - Student)	584780 (38527-60)
Three-Phase Motor Starters (Work Orders - Instructor)	584782 (38527-70)
AC Motor Drive (Work Orders - Student)	584784 (38528-60)
AC Motor Drive (Work Orders - Instructor)	584786 (38528-70)
DC Motor Drive (Work Orders - Student)	584788 (38529-60)
DC Motor Drive (Work Orders - Instructor)	584790 (38529-70)
DC Motor Drive (Drawing Set)	584808 (38641-00)
Three-Phase Motor Starters (Drawing Set)	584812 (38696-00)
AC Motor Drive (Drawing Set)	584817 (38778-00)
NCCER Electrical Trainee Guide - Level 4 (Reference Book)	584829 (38927-80)

Table of Contents of the Manual(s)

Three-Phase Motor Starters (Work Orders - Student) (584780 (38527-60))

- 1 Building a Magnetic Starter for a Three-Phase Induction Motor
- 2 Adding Maintenance Control to the Magnetic Starter
- 3 Adding Remote Control to the Magnetic Starter with Maintenance Control
- 4 Installing a Soft Starter for a Three-Phase Induction Motor

AC Motor Drive (Work Orders - Student) (584784 (38528-60))

- 1 Installing a Manual Starter for a Three-Phase Induction Motor
- 2 Replacing the Manual Starter with an AC Motor Drive

DC Motor Drive (Work Orders - Student) (584788 (38529-60))

- 1 Installing a DC Motor Drive

Optional Equipment

Qty	Description	Model number
1	Inertia Load	580044 (46830-00)
1	Blower Application	580111 (46831-00)
1	Power Quality Clamp Meter	596228 (46832-10)

System Specifications

Parameter	Value
System Requirements	
AC Power Network Installation	3 phases (120/208 V – 60 Hz), star (wye) configuration including neutral and ground wires, protected by a 20 A circuit breaker
AC Power Network Connector	NEMA L21-20
Physical Characteristics	
Intended Location	Installed on the workstation of the Industrial Wiring Training System - Level 1, Model 46102-20
Net Weight	TBE

Equipment Description

Mobile Workstation
580029 (46801-00)

The Mobile Workstation is a versatile bench with enough space for the simultaneous installation of up to four equipment packages. This allows up to four students to perform exercises at the same time on a single workstation. It is constructed from heavy-duty metal struts and painted using powder-coated paint for durability. The unit is mounted on four swivelling casters with a lock mechanism to ensure easy motion and stable operation, and is sized to pass through standard door openings. The Mobile Workstation includes enough galvanized metal struts to allow the installation of the electrical equipment (enclosures, conduits, outlet boxes, etc.) from four training packages.

Specifications

Parameter	Value
Physical Characteristics	
Intended Location	On the floor (stands on casters)
Dimensions (H x W x D)	2223 x 1988 x 800 mm (87.5 x 78.25 x 31.5 in)
Net Weight	TBE

Mobile Workstation with Three-Phase Power Bus
580030 (46801-10)

The Mobile Workstation with Three-Phase Power Bus is a variant of the Mobile Workstation, Model 46801-0, that includes a three-phase power bus to power energize the equipment installed in the workstation. Electrical power is accessible through a wiring trough, while a lockable disconnect switch ensures students' safety during setup. Variants of the Mobile Workstation designed for local ac power networks with a voltage higher than 120 V include a three-phase transformer to lower the input voltage.

The Mobile Workstation with Three-Phase Power Bus is a versatile bench with enough space for the simultaneous installation of up to four equipment packages. This allows up to four students to perform exercises at the same time on a single workstation. It is constructed from heavy-duty metal struts and painted using powder-coated paint for durability. The unit is mounted on four swiveling casters with a lock mechanism to ensure easy motion and stable operation, and is sized to pass through standard door openings. The Mobile Workstation includes enough galvanized metal struts to allow the installation of the electrical equipment (enclosures, conduits, outlet boxes, etc.) from four training packages.

Specifications

Parameter	Value
Module Requirements	
AC Power Network Installation	3 phases (120/208 V – 60 Hz), star (wye) configuration including neutral and ground wires, protected by a 20 A circuit breaker
AC Power Network Connector	NEMA L21-20
Three-Phase Power Bus	
Output Voltage	120/208 V
Output Frequency	60 Hz
Maximum Output Current	17.5 A
Fuses (3)	17.5 A, 250 V, Time Delay / Class RK5
Included Accessories	
	NEMA L21-20 wall connector with wall plate (1)
	Danger tag (5)
	Spare fuses (6)
	Lockout/Tagout device (1)
	Padlocks (5)
	2 m (80 in) galvanized metal struts (8)
Physical Characteristics	
Intended Location	On the floor (stands on casters)
Dimensions (H x W x D)	2223 x 2200 x 800 mm (87.5 x 86.6 x 31.5 in)
Net Weight	TBE

Enclosures and Conduits
763417 (46810-00)

The Enclosures and Conduits is a training equipment package that enables students to learn via hands-on manipulations how to perform basic tasks carried out by electricians working at industrial sites, such as enclosure installation, conduit bending, conductor installation, etc.

The Enclosures and Conduits package includes dummy enclosures, dummy boxes of two different sizes, electrical wires, and lengths of the following four types of conduit in two different sizes: flexible metal conduit (FMC), liquidtight flexible nonmetallic conduit (LFNC), electrical metallic tubing (EMT), and rigid metal conduit (RMC). The package also includes all the fittings and hardware required for the installation of these enclosures, boxes, and conduits.

The courseware for the Enclosures and Conduits package consists of a student manual, an instructor guide, the Electrical Level One – Trainee Guide (reference book) from the National Center for Construction Education and Research (NCCER), and a copy of the National Electrical Code® (NEC®).

List of Manuals

Description	Manual number
NCCER Electrical Trainee Guide - Level 1 (Reference Book)	584711 (37860-80)
Enclosures and Conduits (Job Sheets - Student)	584715 (37866-20)
Enclosures and Conduits (Job Sheets - Instructor)	584716 (37866-30)
Enclosures and Conduits (Work Orders - Student)	584717 (37866-60)
Enclosures and Conduits (Work Orders - Instructor)	584719 (37866-70)
National Electrical Code (NEC®) (Reference Book)	590179 (93617-00)

Table of Contents of the Manual(s)

Enclosures and Conduits (Job Sheets - Student) (584715 (37866-20))

- 1 Installing Metal Struts on the Mobile Workstation
- 2 Installing Enclosures and Boxes on the Mobile Workstation
- 3 Making Holes for Conduit Connections in Enclosure Walls
- 4 Installing Flexible Metal Conduit
- 5 Installing Liquidtight Flexible Nonmetallic Conduit
- 6 Conduit Bending – 90° Bends
- 7 Conduit Bending – Offsets
- 8 Conduit Bending – Saddle Bends
- 9 Installing Electrical Metallic Tubing
- 10 Cutting, Reaming, and Threading Rigid Metal Conduit
- 11 Installing Rigid Metal Conduit
- 12 Feeding Conductors into Conduit
- 13 Feeding Conductors into Conduit Using a Pulling Point

Enclosures and Conduits (Work Orders - Student) (584717 (37866-60))

- 1 Installing Metal Struts on the Mobile Workstation
- 2 Installing Enclosures and Boxes on the Mobile Workstation
- 3 Making Holes for Conduit Connections in Enclosure Walls
- 4 Installing Flexible Metal Conduit
- 5 Installing Liquidtight Flexible Nonmetallic Conduit
- 6 Conduit Bending – 90° Bends
- 7 Conduit Bending – Offsets
- 8 Conduit Bending – Saddle Bends
- 9 Installing Electrical Metallic Tubing
- 10 Cutting, Reaming, and Threading Rigid Metal Conduit
- 11 Installing Rigid Metal Conduit
- 12 Feeding Conductors into Conduit

- 13 Feeding Conductors into Conduit Using a Pulling Point

Electrical Wiring
580101 (46811-00)

The Electrical Wiring is a training equipment package that consists of a project requiring students to install, wire, and test a completely functional overhead door simulator. This allows students to greatly improve their skills as electricians and learn to correctly execute the lockout/tagout procedures required by the Occupational Safety and Health Administration (OSHA). The simulator provides a realistic simulation of a typical overhead door system by means of a miniature wooden panel that slides up and down in a metal chassis mounted in an upright position on the workstation.

The Electrical Wiring package includes the following main elements: a wooden door panel, a metal chassis, a door motor, all the electrical components required to build the door motor control circuit (industrial-type contactors, relays, terminal blocks, etc.), a motor control enclosure, upper and lower limit switches, a safety limit switch, a push-button control station, and a local junction box. The package also includes all the conduits, electric wire, fittings, and hardware required to build the overhead door simulator.

List of Manuals

Description	Manual number
NCCER Electrical Trainee Guide - Level 3 (Reference Book)	584811 (38644-80)
Electrical Wiring (Job Sheets - Student)	8116920
Electrical Wiring (Job Sheets - Instructor)	8116922
Electrical Wiring (Drawing Set)	8116925

Table of Contents of the Manual(s)

Electrical Wiring (Job Sheets - Student) (8116920)

- 1 Overhead Door Installation – Part I
- 2 Overhead Door Installation – Part II
- 3 Enclosure and Box Installation
- 4 Reading Electrical Drawings
- 5 Wiring of the Motor Control Circuit
- 6 Conduit Installation
- 7 Conductor Installation
- 8 Installation of the Safety Switch Handle on the Motor Control Enclosure
- 9 Installation of the Motor Overload Reset Button on the Motor Control Enclosure
- 10 Wiring of the Overhead Door Simulator
- 11 Connection of the Overhead Door Simulator to the Power Lines
- 12 Testing the Overhead Door Simulator

Three-Phase Motor Starters
580103 (46812-00)

The Three-Phase Motor Starters is a training equipment package that provides students with a basic knowledge of ac motor starters and a solid introduction to electrical equipment maintenance. The courseware of the package requires students to install, wire, and test a completely functional magnetic starter for a three-phase induction motor, and then modify this starter to successively add maintenance control and remote control. Students are also instructed to install, wire, program, and test a soft starter for a three-phase induction motor.

The Three-Phase Motor Starters package includes a three-phase induction motor, all the electrical components required to build and modify the magnetic starter (industrial-type contactors, relays, terminal blocks, etc.), a soft starter, a motor control enclosure, two different push-button control stations, and an emergency-stop push-button. The package also includes all the conduits, electrical wires, fittings, and hardware required to build the magnetic starter and install the soft starter.

List of Manuals

Description	Manual number
Three-Phase Motor Starters (Work Orders - Student)	584780 (38527-60)
Three-Phase Motor Starters (Work Orders - Instructor)	584782 (38527-70)
Three-Phase Motor Starters (Drawing Set)	584812 (38696-00)
NCCER Electrical Trainee Guide - Level 4 (Reference Book)	584829 (38927-80)

Table of Contents of the Manual(s)

Three-Phase Motor Starters (Work Orders - Student) (584780 (38527-60))

- 1 Building a Magnetic Starter for a Three-Phase Induction Motor
- 2 Adding Maintenance Control to the Magnetic Starter
- 3 Adding Remote Control to the Magnetic Starter with Maintenance Control
- 4 Installing a Soft Starter for a Three-Phase Induction Motor

Optional Equipment

Qty	Description	Model number
1	Inertia Load	580044 (46830-00)
1	Power Quality Clamp Meter	596228 (46832-10)

AC Motor Drive 580105 (46813-00)

The AC Motor Drive is a training equipment package that provides students with a basic knowledge of ac motor drives and a solid introduction to electrical equipment maintenance. The courseware of the package requires students to install, wire, and test a manual starter for a three-phase induction motor. Students must then replace the manual starter with an ac motor drive (a typical equipment maintenance case), program the ac drive, and test the system for correct operation.

The AC Motor Drive package includes a three-phase induction motor, a manual ac motor starter, an ac motor drive, a three-pole safety switch, a motor overload relay, two motor control enclosures, and various push-button switches. The package also includes all the conduits, electrical wires, fittings, and hardware required to install the manual starter and the ac motor drive.

List of Manuals

Description	Manual number
AC Motor Drive (Work Orders - Student)	584784 (38528-60)
AC Motor Drive (Work Orders - Instructor)	584786 (38528-70)
AC Motor Drive (Drawing Set)	584817 (38778-00)
NCCER Electrical Trainee Guide - Level 4 (Reference Book)	584829 (38927-80)

Table of Contents of the Manual(s)

AC Motor Drive (Work Orders - Student) (584784 (38528-60))

- 1 Installing a Manual Starter for a Three-Phase Induction Motor
- 2 Replacing the Manual Starter with an AC Motor Drive

Optional Equipment

Qty	Description	Model number
1	Blower Application	580111 (46831-00)
1	Power Quality Clamp Meter	596228 (46832-10)

DC Motor Drive
593729 (46814-00)

The DC Motor Drive is a training equipment package that provides students with a basic knowledge of dc motor drives. The courseware of the package requires students to install and test a dc motor drive.

The DC Motor Drive package includes a permanent-magnet dc motor, a pulse-width modulated (PWM) dc motor drive, various electrical components (single-pole safety switch, fuse holder, start/stop switch, potentiometer, terminal blocks, etc.), and a motor control enclosure. The package also includes all the conduits, electric wire, fittings, and hardware required to install the dc motor drive.

List of Manuals

Description	Manual number
DC Motor Drive (Work Orders - Student)	584788 (38529-60)
DC Motor Drive (Work Orders - Instructor)	584790 (38529-70)
DC Motor Drive (Drawing Set)	584808 (38641-00)

Table of Contents of the Manual(s)

DC Motor Drive (Work Orders - Student) (584788 (38529-60))

- 1 Installing a DC Motor Drive

Electrical Power Distribution
580109 (46815-00)

The Electrical Power Distribution is a training equipment package that allows students to learn via hands-on manipulations how to perform various tasks carried out by electricians during the installation of electric power distribution equipment (e.g., main distribution panel installation, conduit and conductor installation, main distribution panel wiring, equipment grounding, ac power outlet installation, subpanel installation, etc.).

The package includes a main distribution panelboard, a downstream distribution panelboard (subpanel), conventional single-pole and three-pole circuit breakers, a ground-fault circuit interrupter (GFCI) single-pole circuit breaker, outlet boxes, single-phase and three-phase receptacles, conduits, and electric wire of different types and sizes. The package also includes all the fittings and hardware required for the installation of this equipment on the workstation.

List of Manuals

Description	Manual number
Electrical Power Distribution (Job Sheets - Student)	584792 (38530-20)
Electrical Power Distribution (Job Sheets - Instructor)	584793 (38530-30)
Electrical Power Distribution (Work Orders - Student)	584794 (38530-60)
Electrical Power Distribution (Work Orders - Instructor)	584796 (38530-70)
NCCER Electrical Trainee Guide - Level 2 (Reference Book)	584810 (38643-80)
Electrical Power Distribution (Drawing Set)	584831 (38963-00)

Table of Contents of the Manual(s)

Electrical Power Distribution (Job Sheets - Student) (584792 (38530-20))

- 1 Installing a Main Distribution Panelboard
- 2 Conduit Installation
- 3 Conductor Installation
- 4 Wiring of the Main Distribution Panelboard
- 5 Installing a Downstream Distribution Panelboard

Electrical Power Distribution (Work Orders - Student) (584794 (38530-60))

- 1 Installing a Main Distribution Panelboard
- 2 Conduit Installation
- 3 Conductor Installation
- 4 Wiring of the Main Distribution Panelboard
- 5 Installing a Downstream Distribution Panelboard

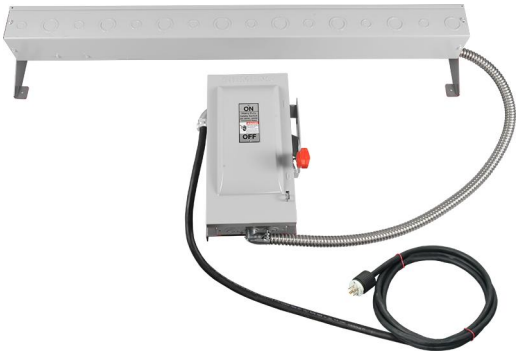
Optional Equipment Description

Industrial Wiring Training Systems (Manuals on CD-ROM) (Optional) 584713 (37866-A0)

List of Manuals

Description	Manual number
Enclosures and Conduits (Job Sheets - Student)	591166 (37866-20)
Enclosures and Conduits (Job Sheets - Instructor)	591168 (37866-30)
Enclosures and Conduits (Work Orders - Student)	591170 (37866-60)
Enclosure and Conduits (Work Orders - Instructor)	591172 (37866-70)
Electrical Wiring (Job Sheets - Student)	591174 (37867-20)
Electrical Wiring (Job Sheets - Instructor)	591176 (37867-30)
Electrical Wiring (Work Orders - Student)	591178 (37867-60)
Electrical Wiring (Work Orders - Instructor)	591180 (37867-70)
Three-Phase Motor Starters (Work Orders - Student)	591261 (38527-60)
Three-Phase Motor Starters (Work Orders - Instructor)	591263 (38527-70)
AC Motor Drive (Work Orders - Student)	591265 (38528-60)
AC Motor Drive (Work Orders - Instructor)	591267 (38528-70)
DC Motor Drive (Work Orders - Student)	591269 (38529-60)
DC Motor Drive (Work Orders - Instructor)	591271 (38529-70)
Electrical Power Distribution (Job Sheets - Student)	591273 (38530-20)
Electrical Power Distribution (Job Sheets - Instructor)	591275 (38530-30)
Electrical Power Distribution (Work Orders - Student)	591277 (38530-60)
Electrical Power Distribution (Work Orders - Instructor)	591279 (38530-70)
Electrical Wiring (Drawing Set)	591281 (38531-00)
DC Motor Drive (Drawing Set)	591312 (38641-00)
Three-Phase Motor Starters (Drawing Set)	591314 (38696-00)
AC Motor Drive (Drawing Set)	591320 (38778-00)
Electrical Power Distribution (Drawing Set)	591331 (38963-00)
Electrical Wiring (Job Sheets - Student)	8116921
Electrical Wiring (Job Sheets - Instructor)	8116923
Electrical Wiring (Drawing Set)	8116926

Three-Phase Power Bus (Optional) 580041 (46802-00)



The Three-Phase Power Bus is designed to be installed on the Mobile Workstation. It allows students to power the electrical equipment that they have set up with three-phase power accessible through a wiring trough and a lockable disconnect switch ensures their safety while making connections.

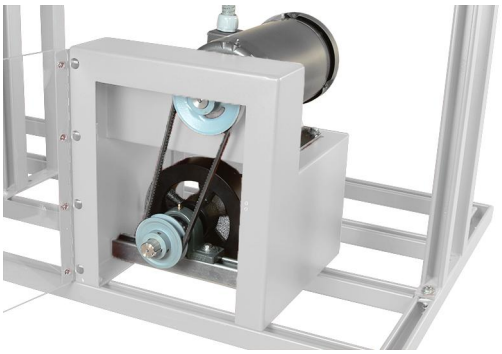
Note: the above picture shows the 120 V 60 Hz variant of the Three-Phase Power Bus. 220 V variants include a safety switch, a three-phase transformer, and a wiring trough.

Specifications

Parameter	Value
Module Requirements	
AC Power Network Installation	3 phases (120/208 V – 60 Hz), star (wye) configuration including neutral and ground wires, protected by a 20 A circuit breaker

Parameter	Value
AC Power Network Connector	NEMA L21-20
Three-Phase Power Bus	
Output Voltage	120/208 V
Output Frequency	60 Hz
Maximum Output Current	17.5 A
Fuses (3)	17.5 A, 250 V, Time Delay / Class RK5
Included Accessories	
	NEMA L21-20 wall connector with wall plate (1)
	Danger tag (5)
	Spare fuses (6)
	Lockout/Tagout device (1)
	Padlocks (5)
	All the hardware required for the installation on the workstation
Physical Characteristics	
Intended Location	Installed on the Mobile Workstation, Model 46801.
Net Weight	TBE

Inertia Load (Optional) 580044 (46830-00)



The Inertia Load is an optional equipment that consists of an inertia wheel which can be coupled to a drive motor using a rubber belt. For safety purposes, the inertia wheel is enclosed in a metal case with a transparent front door that can be locked. The metal case also serves as a support for the drive motor. The Inertia Load includes a set of 3D drawings that shows how to assemble the unit.

When used with the Three-Phase Motor Starters training equipment package and the optional Power Quality Clamp Meter, the Inertia Load allows students to measure the transient (starting) and steady-state motor's parameters and observe the behavior of an induction motor driving a high-inertia load. Optional manipulations in the student manual supplied with the Three-Phase Motor Starters package indicate how to mechanically couple the Inertia Load to the three-phase induction motor. Optional manipulations using the Inertia Load and the Power Quality Clamp Meter are also suggested in the instructor guide supplied with the Three-Phase Motor Starters package.

Manual

Description	Manual number
Inertia Load (Drawing Set)	584819 (38840-00)

Optional Equipment

Qty	Description	Model number
1	Power Quality Clamp Meter	596228 (46832-10)

Specifications

Parameter	Value
Inertia Wheel	
Diameter	215 mm (8.5 in)
Thickness	57 mm (2.25 in)
Shaft Diameter	29 mm (1.125 in)

Parameter	Value
Moment of Inertia	0.066 kg·m² (1.57 lb·ft²)
Physical Characteristics	
Dimensions (H x W x D)	430 x 380 x 380 mm (17 x 15 x 15 in)
Net Weight	TBE

Blower Application (Optional) 580111 (46831-00)

The Blower Application is an optional equipment that consists of a high flow-rate blower like those used in ventilation systems of commercial and industrial buildings. The blower wheel is designed for direct coupling to the drive motor. For safety purposes, the inlet and outlet ducts of the blower are fitted with metallic screens. The outlet duct is also provided with a restriction plate that allows manual control of the air flow rate. The Blower Application includes a set of 3D drawings that shows how to assemble the unit.

When used with the AC Motor Drive training equipment package and the optional Power Quality Analyzer the Blower Application allows students to learn about the behavior of an induction motor driving a variable torque load, such as a blower, by measuring the transient (starting) and steady-state motor's parameters. Optional manipulations in the student manual supplied with the AC Motor Drive package indicate how to mechanically couple the blower to the three-phase induction motor. Optional manipulations using the Blower Application and the Power Quality Analyzer are also suggested in the instructor guide supplied with the AC Motor Drive package.

Manual

Description	Manual number
Blower Application (Drawing Set)	584821 (38846-00)

Optional Equipment

Qty	Description	Model number
1	Power Quality Clamp Meter	596228 (46832-10)

Power Quality Clamp Meter (Optional) 596228 (46832-10)

The Power Quality Clamp Meter is a sophisticated, easy-to-use, portable instrument for measuring current, voltage, and power quality. It can be used to measure various motor parameters, such as the RMS voltage, peak starting current, power factor, current inrush duration, etc., as well as to perform time and frequency domain analysis.

When used with the Three-Phase Motor Starters and Inertia Load or with the AC Motor Drive and Blower Application, the Power Quality Clamp Meter allows students to learn about the behavior of an induction motor driving a mechanical load by measuring the transient (starting) and steady-state motor parameters.

Specifications

Parameter	Value
Functions	

Parameter	Value
	Voltmeter / Ammeter / Oscilloscope / Harmonic Analyzer / Power Meter / 3-Phase Power Meter / Inrush-Current Recorder
Voltmeter	
Measurements	RMS Voltage / DC Voltage / AC Voltage / Average Voltage / Peak Voltage / Voltage/Frequency Ratio / Voltage Ripple / Voltage Crest Factor / Frequency
Measuring Range	0-825 Vdc or ac rms
Autorange Facility	4 V / 40 V / 400 V / 750 V
Resolution	1 mV in 4 V Range / 10 mV in 40 V Range / 100 mV in 400 V Range / 1 V in 750 V Range
Frequency Range	DC / 15-1000 Hz
Maximum Overload	1000 Vrms
Ammeter	
Measurements	RMS Current / DC Current / AC Current / Average Current / Peak Current / Current/Frequency Ratio / Current Ripple / Current Crest Factor
Measuring Range	0-2000 Adc or 1400 Aac rms
Autorange Facility	40 A / 400 A / 2000 A
Resolution	10 mA in 40 A Range / 100 mA in 400 A Range / 1 A in 2000 A Range
Frequency Range	DC / 15-1000 Hz
Maximum Overload	10 kA or Arms x Frequency ‹ 400000
Oscilloscope	
Measurements	Current / Voltage
Current Ranges	10 A / 20 A / 40 A / 100 A / 200 A / 400 A / 1000 A / 2000 A
Current Resolution	1 A in 40 A Range / 10 A in 400 A Range / 50 A in 2000 A Range
Current Maximum Overload	10 kA
Voltage Ranges	4 V / 10 V / 20 V / 40 V / 100 V /200 V / 400 V / 1000 V
Voltage Resolution	100 mV in 4 V Range / 1 V in 40 V Range / 10 V in 400 V Range / 31.25 V in 1000 V Range
Voltage Maximum Overload	1000 Vrms
Frequency Range	DC / 15-600 Hz
Time Base	2.5 ms/div / 5 ms/div / 10 ms/div / 25 ms/div / 50 ms/div
Refresh Rate	0.5 seconds
Maximum Sampling Rate	15.625 kHz
Harmonic Analyzer	
Modes	Current / Voltage
Measurements	THD (Total Harmonic Distortion) / DF (Distortion Factor)
Ranges	Up to 30th Harmonic (40th Harmonic for 15-22 Hz)
Resolution	0.1 % (THD and DF)
Frequency Range (Fundamental)	15-22 Hz / 45-65 Hz
Power Meter	
Measurements	Active Power / Apparent Power / Reactive Power / Power Factor (PF) / Displacement Power Factor (DPF)
Active and Apparent Power Measuring Range	DC = 0-1650 k / AC = 0-1200 k
Active and Apparent Power Autoranging Facility	4 k / 40 k / 400 k / 1650 k
Active and Apparent Power Resolution	1 in 4 k Range / 10 in 40 k Range / 100 in 400 k Range / 1 k in 1650 k Range
Reactive Power Measuring Range	0-1250 kVAR
Reactive Power Autorange Facility	4 kVAR / 40 kVAR / 400 kVAR / 1200 kVAR
Reactive Power Resolution	1 VAR in 4 kVAR Range / 10 VAR in 40 kVAR Range / 100 VAR in 400 kVAR Range / 1 kVAR in 1200 kVAR Range
Reactive Power - Power Factor Range	0.3 ‹ PF ‹ 0.99
PF and DPF Measuring Range	0.3 Capacitive - 1.0 - 0.3 Inductive
PF and DPF Resolution	0.001
PF Frequency Range	15-1000 Hz
DPF Frequency Range	15-22 Hz / 45-65 Hz
3-Phase Power Meter	
Measurements	Active Power / Apparent Power / Reactive Power / Power Factor (PF) / Displacement Power Factor (DPF)
Measuring Range	0-1200 k
Autorange Facility	4 k / 40 k / 400 k / 1200 k
Resolution	1 in 4 k Range / 10 in 40 k Range / 100 in 400 k Range / 1 k in 1200 k Range
Reactive Power - Power Factor Range	0.3 ‹ PF ‹ 0.99
PF and DPF Measuring Range	0.3 Capacitive - 1.0 - 0.3 Inductive
PF and DPF Resolution	0.001
PF Frequency Range	15-1000 Hz
DPF Frequency Range	15-22 Hz / 45-65 Hz
Remark	The connected load must be well balanced, and connected in either Wye or Delta.

Parameter	Value
Inrush-Current Recorder	
Ranges	40 A / 400 A / 2000 A
Resolution	10 mA in 40 A Range / 100 mA in 400 A Range / 1 A in 2000 A Range
Frequency Range	DC / 15-1000 Hz
Maximum Overload	10 kA or Arms x frequency ‹ 400000
Capture Time	1 s / 3 s / 10 s / 30 s / 100 s / 300 s
Maximum Sampling Rate	15.625 kHz
Included accessories	
	Soft Carrying Case
	Power Log Software
	Test Leads
	Alligator Clips
	Test Probes
	USB Cable
	International AC Adapter / Battery Eliminator
	Printed English Language User Manual
	Multi-Language Manual CD
Physical Characteristics	
Dimensions (H x W x D)	300 x 98 x 52 mm (12 x 3.75 x 2 in)
Jaw Opening	60 mm
Jaw Capacity	58 mm (Diameter)
Weight (Batteries Included)	820 g / 1.8 lb

Enclosure Consumables (Optional)
580114 (46850-00)

The Enclosure Consumables package contains the dummy enclosures and boxes required for a single student to perform the work orders in the student manual provided with the training equipment package Enclosures and Conduits.

Conduit Consumables (Optional)
580115 (46851-00)

The Conduit Consumables package contains sufficient lengths of the various types of conduits (FMC, LFNC, EMT, and RMC) required for a single student to perform the work orders in the student manual provided with the training equipment package Enclosures and Conduits.

Electrical Wiring Consumables (Optional)
580116 (46852-00)

The Electrical Wiring Consumables package contains the various consumable goods required for a single student to build the overhead door simulator described in the work orders of the student manual provided with the training equipment package Electrical Wiring.

Electrical Power Distribution Consumables (Optional)
580117 (46853-00)

The Electrical Power Distribution Consumables package provides the various consumable goods required for a single student to perform the work orders in the student manual provided with the training equipment package Electrical Power Distribution.

Three-Phase Motor Starter Consumables (Optional)
580118 (46854-00)

The Three-Phase Motor Starter Consumables package provides the various consumable goods required for a single student to perform the work orders in the student manual provided with the training equipment package Three-Phase Motor Starters.

AC Motor Drive Consumables (Optional)
580119 (46855-00)

The AC Motor Drive Consumables package provides the various consumable goods required for a single student to perform the work orders in the student manual provided with the training equipment package AC Motor Drive.

DC Motor Drive Consumables (Optional)
580120 (46856-00)

The DC Motor Drive Consumables package provides the various consumable goods required for a single student to perform the work order in the student manual provided with the training equipment package DC Motor Drive. It includes sufficient lengths of conduit, copper wire, and four-wire shielded cable, crimped lugs, insulating sleeve, cable ties, cable tie mounts, a wire marking tape set, spiral wrap, a label sheet, an MCE mounting plate, a DIN rail, and terminal block element identifiers.

Reflecting the commitment of Festo Didactic to high quality standards in product, design, development, production, installation, and service, our manufacturing and distribution facility has received the ISO 9001 certification.

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