CENTEC INC.
COURSE OUTLINE

Revision 26
August 2005

CENTEC INC.
TECHNICAL TRAINING DOCUMENT

CenTec Inc. Technical Training Centre

This document has been produced as a reference guide of available training from the CenTec, Inc. Technical Training Centers.

The guide provides an outline of each course, giving the following information:

- Name
- Short name
- Length in hours
- Prerequisites
- Purpose of this training
- Description
- Topics

For more detailed information concerning the courses you may contact:

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CENTEC INC.

■ MISSION STATEMENT

To provide high-value recruiting, training, and assessment of maintenance technicians for companies in North America and to dominate this field by following high ethical standards and delivering measurable business results to customers.

■ TECHNICAL TRAINING

The technical training is designed for manufacturing companies to train maintenance technicians, managers, engineers, and operators.

■ TRAINING FORMAT

Technical Training is normally divided into 2 parts:

1) Theoretical Training

The technical training provided by CenTec will allow the trainees to gain the theory portion required to successfully do their job.

CenTec will validate the transfer of information through evaluations during the courses.

2) Practical Training

A limited amount of practical training is completed during the course but the largest portion must be accomplished by "on the job" training in the trainees' respective work place. It is therefore important that the trainees be given the opportunity, and accept the responsibility, to apply the knowledge gained within a reasonable timeframe in order to complete the transfer of training. The validation of the practical training is the responsibility of the supervisor and trainee.

The technical training is not finished until both the theoretical and practical has been completed. It is therefore important to have the proper follow-up at all stages of training in order to get the most benefit from the investment.

■ PREREQUISITES

It is important that the trainees are properly prepared before attending the courses. Each course outline identifies prerequisites showing the specific course(s) required to successfully complete the course. Equivalent knowledge and skills are also acceptable. This is in the best interest of the trainee, instructor, and the company. The flow charts found after each index page are used to show the order in which each class should be taken per course selection.

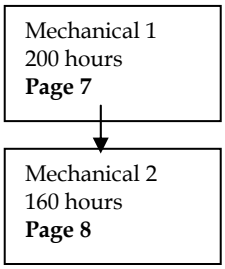
MECHANICAL

Mechanical 1 . . (Mech 1) . . **(200 hr)** 7
Mechanical 2 . . (Mech 2) . . **(160 hr)** 8

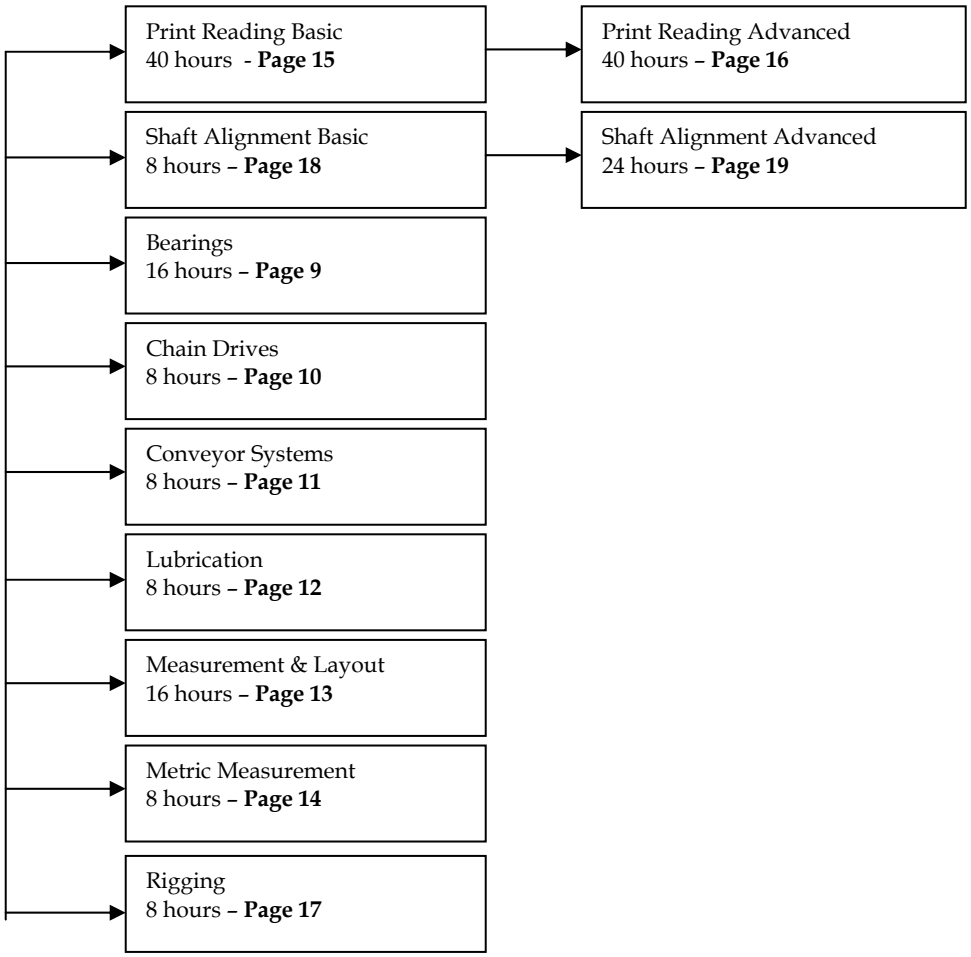
MECHANICAL MODULES

Bearings . . (M108) . . **(16 hr)** 9
Chain Drives. . (M401) . . **(8 hr)** 10
Conveyor Systems . . (M302) . . **(8 hr)** 11
Lubrication . . (M300) . . **(8 hr)** 12
Measurement & Layout . . (M105) . . **(16 hr)** 13
Metric Measurement . . (M100) . . **(8 hr)** 14
Print Reading Basic . . (M102) . . **(40 hr)** 15
Print Reading Advanced . . (M303). . **(40 hr)** 16
Rigging . . (M109) . . **(8 hr)** 17
Shaft Alignment Basic . . (M113) . . **(8 hr)** 18
Shaft Alignment Advanced . . (M408). . **(24 hr)** 19

MECHANICAL



MECHANICAL MODULES



Course name: MECHANICAL 1

Short name: MECH 1

Length: 200 hrs

Prerequisites: Working skills in four-function math including whole numbers, signed numbers, decimals and fractions. The ability to solve simple linear equations is also required. (Remediation is available.)

Purpose

This course provides the knowledge and hand skills needed to form the foundation for ongoing mechanical training. Engineers performing equipment design or modification gain much practical knowledge in this course.

Description

This course provides training in four areas: workshop practice and safety, technology, math, and drawing. This course will provide an understanding of industry standards, work methods, and practices.

Topics include:

- Safety
- Drawing technology
- Drawing rectangular, sloped, & round parts
- Visualization of detail parts
- Basic assembly drawing analysis
- Use of the drawing package
- Foreign language drawings
- Work methods (following & writing)
- Lubrication, seals, & gaskets
- Couplings
- Fasteners and thread designations
- Gear, belt, and chain drives
- Bearings and bushings
- Surface finish
- Tolerances & fits (ISO & geometric)
- Conveyors
- Hand skills plus layout techniques
- Drilling, tapping, reaming, broaching
- Hands-on machine assembly
- Coupling alignments
- Precision measuring
- Basic trade math - through algebra
- Metric measurement

Course Objectives:

Upon the successful completion of this course, the trainee will be competent in:

- General safety procedures as they relate to shop, tools, and equipment.
- Analyzing mechanical drawings in both 1st and 3rd angle view.
- Recognizing, identifying, and explaining function, failures, and proper installation of mechanical components and their usage: belts, pulleys, clutches, fasteners, gears, seals, and bearings.
- Applying tolerances, fits, and bearing theory.
- Using precision measuring devices to verify proper machine setup.
- Performing mathematical functions as they apply to mechanical theory.
- Selecting proper lubrication for specific application.
- Aligning and tensioning or adjusting drive systems.

Course name: MECHANICAL 2

Short name: MECH 2

Length: 160 hrs

Prerequisites: MECH 1
Working skills in four-function math including whole numbers, signed numbers, decimals and fractions. The ability to solve simple linear equations is also required. (Remediation is available.)

Purpose

This course provides a foundation for mechanical skills in the topics listed below.

Description

Assembly print reading and the in-depth analysis of mechanical assemblies.
Assembly skills needed to properly build and adjust mechanisms.
Practical application of tools and metrology needed to obtain proper fits and alignments.

Topics include:

- Gear drives
- Cumulative tolerance
- Bearing technology
- Right angle trigonometry
- Sling calculations (Vectors)
- Levers and torque
- Simultaneous equations
- Metals technologies incl. AISI standards
- Heat treatment
- Hardness testing
- Assembly drawing analysis
- Work method development
- Work method implementation
- Hands-on machine assembly
- Coupling alignment

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- General safety procedures as they relate to shop, tools, and equipment.
- Analyzing mechanical drawings in both 1st and 3rd angle view.
- Recognizing, identifying, and explaining function, failures, and proper installation of mechanical components and their usage: belts, pulleys, clutches, fasteners, gears, seals, and bearings.
- Applying tolerances, fits, and bearing theory.
- Using precision measuring devices to verify proper machine setup.
- Performing mathematical functions as they apply to mechanical theory.
- Accurately assembling a machine using assembly drawings and be able to analyze and repair as needed.
- Identifying different material designations and cross reference between American and European designations.
- Different heat treatment processes performed on metals.
- Recognizing and verifying different hardness designations.

Course name: BEARINGS

Short name: M108

Length: 16 hrs

Prerequisites: None

Purpose

This course provides the knowledge of the more common bearings, their identification, terminology, general care, and handling.

Description

This course is a classroom introduction to bearings identifying types, their function, and application. The practical use of bearing catalogues for reference to load rating, speed, and type of lubrication are also discussed.

Topics include:

- Classification
- Terminology
- Type (friction/anti-friction)
- Speed
- Drawing symbols
- Loads
- Number designation (code)
- Symbols
- X + O configuration
- Bearing recognition

Course Objectives:

Upon successful completion of this course the trainee will be competent in:

- Identifying any standard type of bearing; know its load types, and application.
- Investigating a machine or drawings for a machine and determine how the bearings are properly removed and installed.
- Inspecting bearing seats on shaft and housing and determine if correct sizes for proper fit.
- Proper storage and handling of bearings.
- Using the proper equipment & technique to install and remove bearings.
- Lubricating bearings.
- Inspecting a bearing in hand and analyze a bearing when it is running to determine if the bearing is faulty.
- Setting internal clearance in taper roller bearings and taper bore bearings.

Course name: CHAIN DRIVES

Short name: M401

Length: 8 hrs

Prerequisites: None

Purpose

This course provides the knowledge of chain driven systems, transmission of power, and conveyance of materials.

Description

This course provides the differences between standard roller chain and sprockets in both British and American Standard along with practical exercises in sprocket alignment, chain adjustment, and speed calculations.

Topics include:

- Types of chains
- Chain adjustment
- Types of sprockets
- Chordal action
- Numbers & codes
- Lubrication
- Operating guidelines
- Installation & maintenance
- Chain wrap
- Wear recognition

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Identifying any standard type of chain & characteristics.
- Detach and install a chain.
- Identifying a type of sprocket, aligning and matching the sprocket and chain.
- Identifying connecting links and installing them properly.
- Setting proper chain tension.
- Analyzing chain and sprocket wear and knowing wear limits.
- Chain and sprocket lubrication.
- Identifying chain tensioners and their application.

Course name: CONVEYOR SYSTEMS

Short name: M302

Length: 8 hrs

Prerequisite: None

Purpose

This course provides the knowledge of the different types of conveyor systems and the ability to perform basic maintenance on conveyor systems. The trainee will be able to maintain, track and adjust conveyor belt systems.

Description

This course consists of instruction on conveyor components and their significance, belting types and construction, application of flat or inclined drives, and methods of connecting conveyor belting. Practical applications of belt installation and belt tracking are taught.

Topics include:

- Drive or head pulley
- Misalignment
- Carrier troughing rollers
- Tracking
- Snub pulleys
- Loading
- Self aligning idlers

Course Objectives:

Upon successful completion of this course the trainee will be competent in:

- Identifying the various types of conveyors.
- Identifying the most common types of conveyor belts and there characteristics.
- Identifying the components of a conveyor belt assembly and know the function of each.
- Identifying the types of conveyor belt splices and the characteristics of each.
- Inspecting a conveyor belt for camber and squareness of joint and knowing the limit of each.
- Checking and maintain the alignment of the frame and conveyor components.
- Installing a conveyor belt and adjusting it to the proper tension.
- Reciting the rule for tracking and be able to track a conveyor belt (two directional).

Course name: LUBRICATION

Short name: M300

Length: 8 hrs

Prerequisites: None

Purpose

This course provides the terminology, method of application, types, and uses of lubricants.

Description

This course is an introduction to the basic types of lubricants, their properties, terms used in lubrication, and various methods of applying lubricants with emphasis on cleanliness. (Supported by video.)

Topics include:

- Definitions
- Types of friction
- Function
- Storage
- Types & categories
- Oils & grease
- Application methods

Course Objectives:

Upon successful completion of this course the trainee will be competent in:

- The terms associated with lubrication like adhesion, cohesion, viscosity, viscosity index, flash point consistency etc.
- Using a lubrication manual from a leading lubricant manufacture and select the proper lubricant for a particular machine and the job that it is doing.
- Applying the proper quantity of lubricant to the machine and using the proper lubrication method.

Course name: MEASUREMENT & LAYOUT

Short name: M105

Length: 16 hrs

Prerequisite: None

Purpose

This course provides the knowledge and skill of measurement and layout instruments and their application.

Description

The course begins with a brief history of measurement, then from linear, through comparison, to accurate measurement instruments, concluding with different methods of layout.

Topics include:

- Measurement
- Non-precision measuring tools
- Precision measuring tools
- Direct reading & transfer type instruments
- Gauging instruments
- Layout

Course Objectives:

Upon successful completion of this course the trainee will be competent in:

- Working effectively with the metric system in linear measurement.
- Taking accurate measurements with the following instruments:
  - Rule
  - Feeler gauge
  - Vernier caliper
  - Micrometer caliper
  - Small-hole gauge
  - Telescopic gauge
  - Vernier protractor
  - Inside Micrometer
  - Screw pitch gauge
  - Building up of gauge blocks to specific size
  - Using dial indicators to check measurements
  - Laying out outlines of parts with layout tools such as scribers, squares, dividers, height gauges, angle plates, center heads, “V” blocks, etc.

Course name: METRIC MEASUREMENT

Short name: M100

Length: 8 hrs

Prerequisite: None

Purpose

This course is an introduction to Metric measurement systems.

Description

This course provides the definitions of the various Metric units of measure, the practical applications, calculations and expressions.

Topics include:

- Metric system
- Derived Metric units
- Base units of length, etc.
- Metric, imperial conversion
- Prefixes
- Working with the Metric system

Course Objectives:

Upon successful completion of this course the trainee will be competent in:

- Recognizing a metric base unit of measure and a derived metric unit.
- Recognizing the prefixes associated to metric units.
- Converting from one prefix to another within a base unit.
- Hands-on appreciation for the more common units. Ex: visualize the length of a centimeter, have a feel for the mass of a kilogram or recognize the volume of a liter.
- Expressing measurements of length, mass, time and temperature in the metric system.
- Conversion of some of the common units from imperial to metric and metric to imperial.

Course name: PRINT READING BASIC

Short name: M102

Length: 40 hrs

Prerequisites: None

Purpose

This course provides the knowledge required to read mechanical drawings in various languages and standards.

Description

This course covers drafting techniques, standards and generalities of mechanical drawings, as well as an overview of bill of materials and assembly drawings. Activities include reading and producing basic detail drawings.

Topics include:

- Familiarization with drafting tools and techniques
- Technology of lines
- Quality of lines and identification
- Part visualization and orthogonal viewing
- View projection
- First angle views: International and US standards
- View representation
- Shapes and sizes
- Explanation of pictorial drawings
- Recognition of Isometric, Oblique, and Perspective drawings
- Producing a simple detail drawing with dimensions
- Title block development
- Interpretation of curved surfaces
- Dimensioning generalities
- Dimensioning cylinders
- Dimensioning prisms
- Dates and revision control
- Content of a drawing number
- Modifications
- Bill of materials, assembly and detail drawings
- Foreign language terminology (customer's choice)
- Mechanical print reading assignments

Course Objectives:

Upon successful completion of this course the trainee will be competent in:

- Producing a complete detail drawing of a mechanical component in 1st angle projection.
- Reading nomenclature drawings (parts lists) to obtain a complete list of mechanical components both engineered and purchased.
- Reading a detail drawing to understand exactly a particular part. The material it's made of, its size, shape, tolerance, surface finish, and heat treatment.
- Reading an assembly drawing without the use of section views and determining some of the information available. Including, number of parts, relationship of parts to each other, and to be able to freely move from one view to another and find a common feature.
- Analyzing the information in a title bock and the meaning of each number in a drawing number.

Course name: PRINT READING ADVANCED

Short name: M303

Length: 40 hrs

Prerequisites: M102

Purpose

This class provides the advanced knowledge of print reading skills to cover all aspects of mechanical drawings.

Description

This course will cover the finer points of detailed drawings and the production of "bill of materials". Assembly drawings reading skills will assure the maximum information is obtained from the drawing. CenTec will provide drawings; however, your company's drawings are recommended.

Topics include:

- Symmetry
- Geometric tolerances
- Section views
- Surface finish
- Auxiliary views
- Material specifications
- Partial views
- Fastener designations
- Tolerance of size
- Foreign language and other terminology and standards

Course Objectives:

Upon successful completion of this course the trainee will be competent in:

- Recognizing the types of section views and how they assist in reading a mechanical drawing.
- Recognizing the use of symmetry and what it represents.
- Reading a drawing that uses auxiliary views to describe a part or assembly.
- Recognizing the designations for fasteners, bearings, seals and materials and what they mean.
- Taking an assembly drawing and analyzing how the machine comes apart, how it goes together and how it Functions.

Course name: RIGGING

Short name: M109

Length: 8 hrs

Prerequisites: None

Purpose

This course provides a familiarization with the safety aspect and principles applied to rigging.

Description

This course provides the terminology and methodology in choosing the correct lifting equipment for the application. Safety is stressed in all forms of lifting and lifting devices. The trainees will become familiar with the reference "Handbook for Riggers" as a guide to safe working practice in the work place.

Topics include:

- Lifting devices
- Slings
- Inspection
- Wire rope
- Practical exercises
- Working loads
- Steps in planning a rigging operation
- Rigging hardware

Course Objectives:

Upon successful completion of this course the trainee will be competent in:

- Calculating the weight of load and its center of gravity.
- Safety inspecting and using lifting devices such as lever hoists, chain hoists, drum hoists, electric hoists and pneumatic hoists.
- Safety inspecting, determining load ratings and using lifting devices such as shackles, spreaders, slings, turnbuckles, eyebolts, pulleys and hooks.
- Safely rigging a load and actually making a lift with the equipment covered in this course.

Course name: SHAFT ALIGNMENT BASIC

Short name: M113

Length: 8 hrs

Prerequisites: None

Purpose

This course provides the knowledge of the effects of misalignment and the various methods for correction.

Description

This course provides the methods of shaft alignment using feeler gauge/straight edge and dial indicator. Trainees will align shafts on training modules in the shop using math formulae to within 0.05mm. Installation procedures are discussed as it relates to alignment.

Topics include:

- Alignment methods and accuracies of each
- Equipment installation "tips and pointers"
- Soft foot condition and how to correct it
- Coupling types and alignment requirements of each
- Straight edge / feeler gauge method of alignment
  - Calculation of shim requirements and machine offsets
- Dial indicator method of alignment
  - Tool set up for dial indicator method
  - Bar sag calculations and offsets
  - Calculations for shim requirements and machine offsets
- Proper clamping procedures to maintain alignment

Course Objectives:

Upon successful completion of this course the trainee will be competent in:

- Preparing a machine for alignment.
- Checking for soft-feet conditions.
- Doing a "straight-edge and feeler gauge" alignment to accuracy of 0.1mm.
- Doing a "dial indicator rim and face" alignment to accuracy of 0.05mm.
- Proper machine shimming and torqueing.

Course name: SHAFT ALIGNMENT ADVANCED

Short name: M408

Length: 24 hrs

Prerequisites: M113

Purpose

This course provides advanced knowledge that includes additional methods, conditions, and related problems of alignment.

Description

This course provides additional alignment methods including reverse dial indicator and laser. The trainee will practice proper alignment procedures to within 0.02mm including reverse dial indicator.

Topics include:

- Installation of equipment, tips and pointers
- Straight edge / feeler gauge method review
- Soft foot condition and how to correct it
- Dial indicator method review
- Reverse dial indicator method of alignment
  - Calculation of shims and offsets by graph
  - Calculation of shims and offsets by calculator
  - Computer analysis of misalignment
  - Shims and offsets requirement
- Laser method of alignment
  - Set up of laser
  - Computer analysis of misalignment
  - Shims and offsets requirement
- Reverse dial versus laser, comparing advantages and disadvantages

Course Objectives:

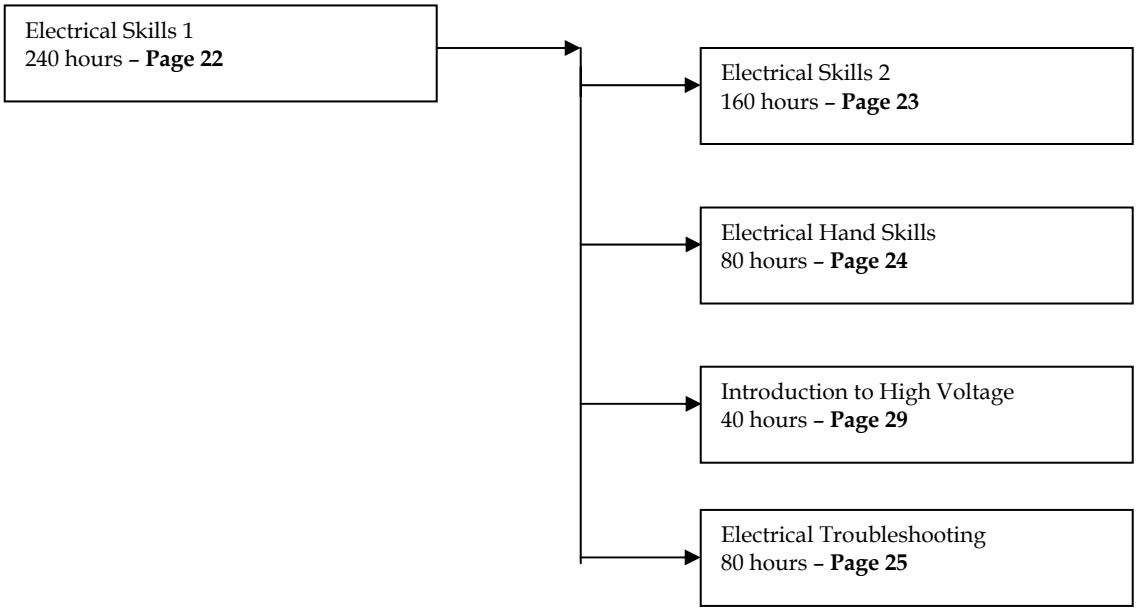
Upon successful completion of this course the trainee will be competent in:

- All aspects of Shaft Alignment Basic (M113).
- Thermal growth calculations and alignment allowances for thermal growth.
- Doing a “reverse dial indicator” alignment to accuracy of 0.02mm.
- Doing a “laser” alignment to accuracy of 0.02mm.

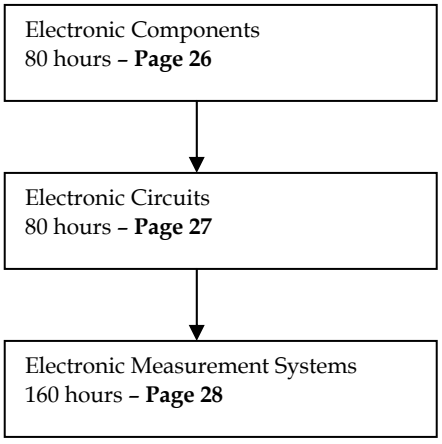
ELECTRICAL/ELECTRONICS

Electrical Skills 1 . . (ES1) . . **(240 hr)** 22
Electrical Skills 2 . . (ES2) . . **(160 hr)** 23
Electrical Hand Skills . . (EHS) . . **(80 hr)** 24
Electrical Troubleshooting . . (ETS) . . **(80 hr)** 25
Electronic Components . . (ECOM. . **(80 hr)** 26
Electronic Circuits . . (ECIRC) . . **(80 hr)** 27
Electronic Measurement Systems . . (EMS) . . **(160 hr)** 28
Introduction to High Voltage . . (IHVM) . . **(40 hr)** 29

ELECTRICAL



ELECTRONICS



Course name: ELECTRICAL SKILLS 1

Short name: ES1

Length: 240 hrs

Prerequisites: Working skills in four-function math including whole numbers, signed numbers, decimals and knowledge of Algebra and right angle Trigonometry. (Remediation is available.)

Purpose

This course provides the knowledge and skills required to form the foundation for electrical training. It has an emphasis on relay control circuits. The trainee will design, install and analyze several electrical installations.

Description

This course is designed to give the skills necessary to effectively analyze and repair intermediate control circuits, power circuits, AC and DC motors.

Topics include:

- Electrical safety
- Conventional motor control
  - Input devices
  - Output devices
- Basic electrical principles
  - DC circuit analysis
  - AC relationships
    - Inductance
    - Capacitance
- Protection devices
  - Fuses
  - Overloads
- Three phase AC
- Wiring practices/projects
- Power supplies
- Basic electrical drawings
- Schematic interpretation
- Analyzing
  - Open circuits
  - Ground fault/short circuit
- Basic test equipment
- Transformers
  - Control circuit grounding

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Applying electrical theory to the practical application of electrical components.
- Analyzing power and control circuits and replacing defective components efficiently.
- Analyzing single and three phase motors.
- Drawing electrical schematics.
- Fabricating electrical panels from schematics.
- Assisting in the installation and start up of electrical equipment.

Course name: ELECTRICAL SKILLS 2

Short name: ES2

Length: 160 hrs

Prerequisites: 10 – 18 months of applying the concepts from ES1

Purpose

This course provides the skills necessary to effectively analyze and comprehend more complex electrical control circuits, power circuits, AC and DC motors.

Description

This course is a study of electrical theory, equipment technology, advanced electrical schematic interrelation and advanced circuit analysis.

Topics include:

- Electrical safety
- Conventional motor control
  - Input devices
  - Output devices
- Basic electrical principles
  - DC circuit analysis
  - AC relationships
  - Network analysis
- Protection devices
  - Fuses/overloads
  - Breakers
- Wiring practices
- Power supplies
- Electrical drawings
- Advanced AC/DC motors
- Circuit analysis and repair
  - Practical applications
- Transformers
  - Single phase
  - Three phase
- Advanced electrical principals
  - Three phase relationships
  - Power factor correction

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- The knowledge of electrical safety.
- Analyzing complex AC and DC circuits.
- AC and DC motor theory and operation.
- Correct application of electrical protection devices.
- Analyzing motor control circuits.
- Interpreting electrical schematics.
- Three phase circuit analysis.

Course name: ELECTRICAL HAND SKILLS

Short name: EHS

Length: 80 hrs

Prerequisite: ES1

Purpose

This course provides electrical hand skills training.

Description

This course is designed to give the skills necessary to effectively wire control systems, modify existing systems, fabricate as necessary, and bend and install electrical conduit.

Topics include:

- Panel layout
  - Back plane
  - Control station
- Drilling
- Tapping
- Wiring
  - Wiring practices
  - Wiring standards
- Conduit
  - Bending and correct installation of EMT
  - Installation of flexible liquid tight conduit
- Electrical Standards
  - Your Company's Electrical Standards
  - NFPA 79 (Electrical Standards for Industrial Machinery)

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Performing typical electrical fabrications (drilling, tapping, etc).
- Installing complex electrical circuits.
- Installing modifications to complex electrical circuits.
- Installing conduit applications using EMT and flexible conduit.
- Solder electrical connections.

Course name: ELECTRICAL TROUBLESHOOTING

Short name: ETS

Length: 80 hrs

Prerequisites: ES1

Purpose

This course is designed to improve electrical troubleshooting methodology and skills.

Description

This course provides practical troubleshooting skills. Approximately 75% of the time is spent in a workshop/lab environment.

Topics include:

- Electrical safety
- Applied system troubleshooting
- Safety equipment
- Troubleshooting methods
- Electrical shock
- US/Canada electrical codes
- Test equipment
- Your company's standards
- Live electrical work methods
- Review of components and symbols
- Drawing and reading electrical schematics

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Working safely while analyzing and repairing both power and control circuits.
- Drawing and reading electrical schematics.
- Able to use VOM, ammeter, and meg-ohm-meter.

Course name: ELECTRONIC COMPONENTS

Short name: ECOM

Length: 80 hrs

Prerequisites: ES2

Purpose

This course is an introductory course to electronic components and their characteristics. It is designed to provide a fundamental working knowledge of the most common industrial electronic components. It is an introduction to electronics for maintenance technicians.

Description

This course develops an understanding of electronic components. The class covers operation, symbols, component testing and operation in simple circuits. Calculations and lab exercises explain the theory of operation.

Topics include:

- Diodes
- Zener diodes
- LED's
- Bipolar transistors
- Transistor biasing
- Operational amplifiers
- SCRs and TRIACs
- Logic gates
- J-FETs and MOSFETs

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Testing the condition of electronic devices.
- Analyzing function of basic electronic circuits using schematics.
- Verifying operation of basic electronic components.
- Determining the correct size of components to use when replacements are needed.

Course name: ELECTRONIC CIRCUITS

Short name: ECIR

Length: 80 hrs

Prerequisites: ECOM

Purpose

This course is a basic electronics course with an emphasis on applications. It will provide a fundamental working knowledge of common electronic circuits. It is an extension of the Electronics Components course (ECOM) for maintenance technicians.

Description

This course combines the simple component circuits discussed in ECOM to form many of the fundamental circuits used in manufacturing operations. Calculations and lab exercises support the theory of operation of the circuits covered. Labs focus on developing basic circuit analysis.

Topics include:

- Filtered DC supplies
- Voltage regulation
- Current limit
- Power supplies with adjustable output and feedback
- Switching power supplies
- Latches
- Shift registers
- Digital counters
- Digital to analog conversion
- Analog to digital conversion

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Analyzing function of common electronic circuits using schematics.
- Verifying operation of electronic circuits.
- Determining the correct size of components to use when modifications or failed components are needed.

Course name: ELECTRONIC MEASUREMENT SYSTEMS

Short name: EMS

Length: 160 hrs

Prerequisites: ES2 and ECIR

Purpose

This course develops comprehension of electronic instrumentation and its application in process measurement and control. It is designed for maintenance technicians.

Description

This course focuses on the electronic circuits used in instrumentation. Analytical skills are developed and enhanced through analysis of circuit operation and circuit parameters. Circuits are observed and verified using oscilloscopes and multi-meters. A better understanding of electronic schematics results in enhanced analytical ability. Trainees are taught to develop references and calibration procedures for circuits.

Topics include:

- Instrumentation amplifier
- Pressure/force measurement (strain gages)
- PID control modes and analog circuitry
- Active integrator and differentiator circuits
- Temperature measurement (thermistors, RTDs, thermocouples)
- Hall effect devices
- Various passive and active filter characteristics and expected outputs
- Position measurement devices and feedback circuitry (LVDT's and resolvers)
- Frequency to voltage conversion

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Verifying the operation of electronic transducers.
- Analyzing function of electronic circuits used in measurement systems.
- Developing technical write ups for calibrations and analysis.

Course name: INTRODUCTION TO HIGH VOLTAGE

Short name: IHVM

Length: 40 hrs

Prerequisites: ES1

Purpose

This course provides an introduction to the theory, technology, and safety associated with power distribution in an industrial environment.

Description

This course instructs how to interact with or assist a trained power distribution technician. This is an introductory course and does not fully qualify an individual to perform all the tasks reviewed.

Topics include:

- Safety
  - Equipment lockout procedures
  - Power distribution equipment
- One-line diagrams
- Basic test equipment
- Low voltage
  - Circuit breakers
  - Switchgear
- Medium voltage
  - Circuit breakers
  - Switchgear
- Transformer maintenance
- Short circuit analysis
- System coordination
- Battery maintenance
- NFPA 70B code book

Course Objectives:

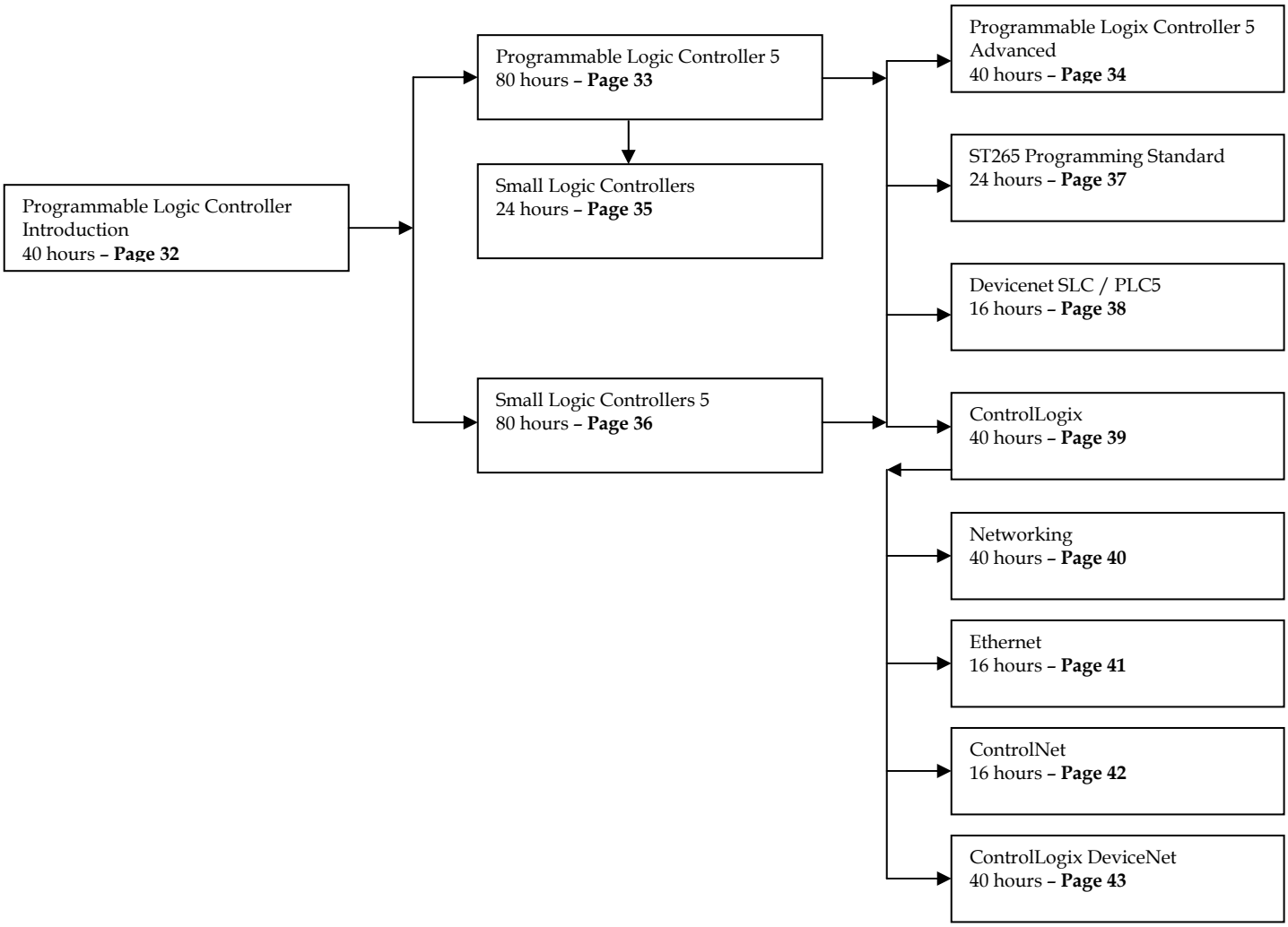
Upon successful completion of this course, the trainee will be competent in:

- Recognizing potential hazards and safety precautions.
- Working safely around power distribution.
- Assisting a trained power distribution technician.

PROGRAMMABLE LOGIC CONTROL

Programmable Logix Controller Introduction . . (PLCI) . . **(40 hr)** 32
Programmable Logix Controller 5 (using Allen-Bradley Family) . . (PLC5) . . **(80 hr)** 33
Programmable Logix Controller 5 Advanced (using Allen-Bradley) . . (PLCADV) . . **(40 hr)** 34
Small Logix Controllers (using Allen-Bradley) Conversion. . (SLC) . . **(24 hr)** 35
Small Logix Controllers 5 (using Allen-Bradley) . . (SLC500) . . **(80 hr)** 36
ST265 Programming Standard . . (ST265) . . **(24 hr)** 37
Devicenet SLC / PLC5. . (DNET) . . **(16 hr)** 38
ControlLogix . . (CTRLGX) . . **(40 hr)** 39
Programmable Logix Controller Networking . . (NET). . **(40 hr)** 40
Ethernet . . (ENET) . . **(16 hr)** 41
ControlNet . . (CNET). . **(16 hr)** 42
ControlLogix DeviceNet…(CDNET)…**(16hr)** 43

PROGRAMMABLE LOGIC CONTROLLER



Course name: PROGRAMMABLE LOGIC CONTROLLER INTRODUCTION

Short name: PLCI

Length: 40 hrs

Prerequisites: ES1

Purpose

This course provides an introduction to the Allen-Bradley SLC/PLC families of processors. It is designed for trainees who have very little or no experience with PLCs.

Description

This course provides the technical knowledge and hands-on skills needed to understand the hardware, computer software and fundamental instructions.

Topics include:

- Numbering systems and conversions
- Supply voltages
- Input and output wiring
- Input, output and program data addressing
- Basic instructions (bit level to counters)
- Memory organization for program and data files
- Processor scan and program considerations
- Dip switch setting on hardware
- Using RSLogix for program entry, monitoring and documentation
- Saving, Restoring and Printing a program

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Assisting in the installation and start up of PLC controller equipment.
- Performing basic diagnostics.
- Replace defective hardware.
- Uploading and downloading program files and data files.
- Modifying programs.

Course name: PROGRAMMABLE LOGIC CONTROLLER 5
(using Allen–Bradley Family)

Short name: PLC5

Length: 80 hrs

Prerequisites: ES1
PLCI

Purpose

This course provides the necessary foundation to analyze machines and processes controlled by Allen-Bradley PLC5 Controllers.

Description

This course includes instruction on Allen-Bradley PLC5 hardware configurations (the 1771 and 1794 I/O families), memory organizations, I/O addressing, the processor scan, the processor instruction set, and Grafcet fundamentals. The trainees apply this knowledge to analyzing functioning PLC controlled machines in the workshop. Instruction is given on programming software as well as a current engineering standard of PLC program design.

Topics include:

- PLC fundamentals
- Hardware configuration
- Memory organization
- I/O addressing
- Programming software
- Processor scan
- Processor instruction set
- GRAFCET fundamentals
- Introduction to programming standards and methods
- Data highway plus fundamentals
- Remote I/O communications
- Analyzing PLC controlled machines

Course Objective:

Upon successful completion of this course, the trainee will be competent in:

- Installing and starting up of PLC controlled equipment.
- Using PLC programming software for configuring, programming, analyzing and diagnosis of PLC systems.
- Locating and replacing defective hardware.
- Uploading and downloading program files and data files.
- Writing and modifying structured programs.

Course name: PROGRAMMABLE LOGIC CONTROLLER 5 ADVANCED

Short name: PLCADV (Allen-Bradley)

Length: 40 hrs

Prerequisites: PLC5

Purpose

This course provides advanced knowledge and analytical abilities of trainees whose job responsibilities include maintenance of Allen-Bradley PLC5 equipment utilizing Allen-Bradley intelligent modules and DH+ communications.

Description

This course provides a solid foundation in processor control of Intelligent I/O modules and communication over Data Highway + and the Remote I/O. Treatment of basic network terminology, topologies and access methods is also included. Exercises are implemented on a shop floor machine and simulators.

Topics include:

- BTR, BTW instructions and programming considerations
- Thermocouple/Millivolt input module (1771-IXE)
- Analog input module (1771-IFE)
- Analog output module (1771-OFE)
- Remote I/O scanner to adapter communication
- Remote I/O link to external devices (i.e. Allen-Bradley drives)
- Data highway plus (DH+) message instruction

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Installing and configuring intelligent I/O modules in a PLC control system.
- Analyzing ladder logic programs that control intelligent I/O.
- Installing and configuring a Data Highway Plus or Remote I/O network systems.
- Installing and configuring PLC processors to communicate in Scanner-Adapter mode.
- Programming communication over Data Highway and/or Remote I/O.

Course name: SMALL LOGIC CONTROLLERS (Allen-Bradley) CONVERSION COURSE

Short name: SLC

Length: 24 hrs

Prerequisites: PLC5

Purpose

This course is designed to provide instruction unique to the Allen-Bradley SLC500 family of small programmable controllers.

Description

This course is an accelerated PLC training course. Instruction is provided on the SLC500 family of processors and I/O configurations, as well as ladder programming. Exercises are designed to reinforce classroom discussions and provide practical experience using the SLC500.

Topics include:

- SLC500 family hardware characteristics
- SLC500 processor memory organization
- Input output, (I/O) addressing
- Processor instruction set
- Fault finding, using the status file
- Ladder logic programming software

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Installing and starting up SLC processor controlled equipment.
- Using the SLC programming software for configuring, programming, analyzing and diagnosis of SLC systems.

Course name: SMALL LOGIC CONTROLLERS 5

Short name: SLC500 (Allen-Bradley)

Length: 80 hrs

Prerequisites: ES1
PLCI

Purpose

This course provides the foundation to analyze machines and processes controlled by Allen-Bradley SLC500 Controllers. This course differs from PLC5 only in the equipment emphasized.

Description

This course includes instruction on Allen-Bradley SLC500 hardware configurations (the 1747 and 1746 I/O families). Trainees apply this knowledge to analyze PLC controlled machines in the workshop. Instruction is given on programming software as well as engineering standards of PLC program design.

Topics include:

- PLC fundamentals
- Hardware configuration
- Memory organization
- I/O addressing
- Programming software
- Processor scan
- Processor instruction set
- GRAFCET fundamentals
- Introduction to programming standards and methods
- Data highway plus fundamentals
- Remote I/O communications
- Analyzing

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Installing and starting up of SLC controlled equipment.
- Using the SLC programming software for configuring, programming, analyzing and diagnosis of the SLC500 System.
- Locating and replacing defective hardware.
- Uploading and downloading program files and data files.
- Writing and modifying structured programs.

Course name: ST265 PROGRAMMING STANDARD

Short name: ST265

Length: 24 hrs

Prerequisites: PLC5 and/or SLC500

Purpose

This course is designed to instruct the current version of PLC machine animation using a specific programming standard called ST-265 (rev. date: 06/01/97). This standard is similar to the Allen-Bradley Sequential Function Chart "SFC" method. The "ST-265" specification document was developed for use with the Allen-Bradley PLC5 and SLC5/0x families of processors.

Description

This course is a customized course for PLC programming standards. This course provides the basic technical knowledge needed to understand the ST-265 method of user software structuring for the purpose of programming, interpreting and analyzing applications.

Topics include:

- GRAFCET
- Modular structure
- Program structure
- Data structure
- Application structure
- Graph structure, master
- Coding and synchronization of graphs
- Diagnostics

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Understanding program structure and data structure of the standard model.
- The interaction of the Stop graph, Operating graph and Cycle graphs.
- The use of grafcets and diagnostics for analyzing machines programmed to the standard.
- Implementing programming structure which enhances program efficiency.

Course name: DEVICENET

Short name: DNET

Length: 16 hrs

Prerequisites: PLC and/or
RSLogix 5 or 500.

Purpose

This course provides the necessary foundation to analyze Devicenet networks using Rockwell Software "RSNetWorx for Devicenet".

Description

This course provides the technical knowledge and hands-on skills needed to understand Devicenet hardware and the software "RSNetWorx for Devicenet" using PLC5 and SLC scanners. Exercises are implemented on classroom simulators.

Topics include:

- Devicenet hardware and configuration
- Power supplies
- EDS files
- Data and I/O configuration
- Status information

Course Objectives:

Upon the successful completion of this course, the trainee will be competent in:

- Installation and removal of hardware from the network.
- Testing power supplies for operation and condition.
- Installation of new EDS files.
- Analyze bidirectional data flow from device and PLC.
- Analyze status of devices using software.

Course name: CONTROLLOGIX

Short name: CTRLGX

Length: 40 hrs

Prerequisites: PLC5 and/or
RSLogix 5 or 500.

Purpose

This course provides the knowledge and practice to analyze machines and processes controlled by Allen- Bradley ControlLogix 5000 processors.

Description

This course provides the technical knowledge and hands-on skills needed to understand the ControlLogix hardware and the programming and documentation software (RSLogix 5000). Exercises on classroom simulators are included.

Topics include:

- ControlLogix family hardware and configuration
- Organizing a project and its tasks
- Data and I/O configuration
- Status instructions
- Editing processor instructions and ladder logix
- Introduction to communications networks

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Installing and starting up ControlLogix components.
- Configuring and analyzing ControlLogix hardware.
- Identifying I/O tags in memory and their relationship to field devices.
- Working with controller and program scoped tags.
- Using the programming software for configuration of tasks, programs and routines.

Course name: PLC Networking

Short name: Net

Length: 40 hrs

Prerequisites: ControlLogix RSLogix 5000

Purpose

This course provides the necessary foundation to analyze Ethernet Devicenet and ControlNet as it relates to the ControlLogix platform

Description

This course is designed to give the technical knowledge and hands-on skills required to understand hardware and the software for all three networks. When combined into one course the common properties of each network make it possible to complete in 40 hours.

Topics include:

- Ethernet hardware and configuration
- Configuring RSLinks© for Ethernet
- IP addressing
- ControlNet hardware and configuration
- Messages
- DeviceNet hardware and configuration
- Power supplies
- EDS files
- Node commissioning
- Troubleshooting
- Status information

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Installation and removal of hardware from the network
- Determine and follow bidirectional data flow
- Determine status of devices using software and indicators
- Trouble shooting Ethernet and ControlNet
- Test power supplies for operation and condition
- Installation of new EDS files
- Determine and follow bidirectional data flow from device and PLC

Course name: ETHERNET

Short name: ENET

Length: 16 hrs

Prerequisites: RSLogix 5000

Purpose

This course provides the necessary foundation to analyze Ethernet networks for the ControlLogix© platform.

Description

This course is designed to give the technical knowledge and hands-on skills required to understand Ethernet hardware using the ControlLogix platform. Exercises are implemented on classroom simulators.

Topics include:

- Ethernet hardware and configuration
- Configuring RSLinks© for Ethernet
- IP addressing
- Troubleshooting
- Status information

Course Objectives:

Upon the successful completion of this course, the student will be competent in:

- Installation and removal of hardware from the network
- Troubleshooting Ethernet
- Determine and follow bidirectional data flow.
- Determine status of devices using software and indicators.

Course name: CONTROLNET

Short name: CNET

Length: 16 hrs

Prerequisites: RSLogix 5000

Purpose

This course provides the necessary foundation to analyze ControlNet networks using Rockwell Software "RSNetWorx© for ControlNet" software.

Description

This course is designed to give the technical knowledge and hands-on skills required to understand ControlNet hardware and the software "RSNetWorx© for ControlNet" using the ControlLogix platform. Exercises are implemented on classroom simulators.

Topics include:

- ControlNet hardware and configuration
- Messages
- Scheduling Data
- Troubleshooting
- Status Information

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Installation and removal of hardware from the network
- Troubleshooting ControlNet
- Determine and follow bidirectional data flow
- Determine status of devices using software and indicators

Course name: CONTROLLOGIX DEVICENET

Short name: CDNET

Length: 16 hrs

Prerequisites: ControlLogix RSLogics 5000

Purpose

This course provides the necessary foundation to analyze Devicenet networks using Rockwell Software "RSNetWorx© for Devicenet".

Description

This course is designed to give the technical knowledge and hands-on skills needed to understand Devicenet hardware and the software "RSNetWorx© for Devicenet" using ControlLogix scanners. Exercises are implemented on classroom simulators.

Topics include:

- Devicenet hardware and configuration
- Power supplies
- EDS files
- Data and I/O configuration
- Status information
- Node Commissioning

Course Objectives:

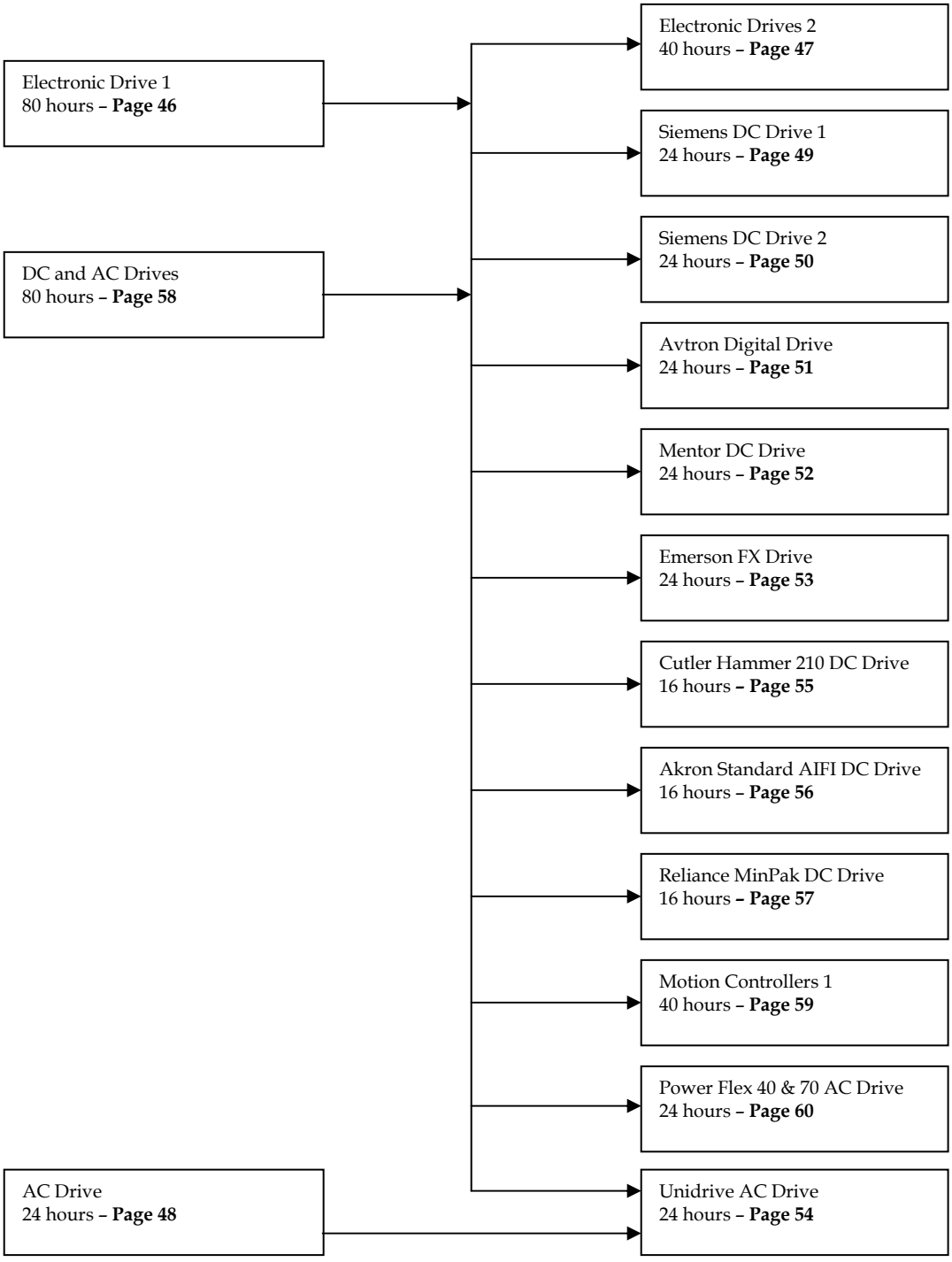
Upon successful completion of this course, the trainee will be competent in:

- Installation and removal of hardware from the network
- Test power supplies for operation and condition
- Installation of new EDS files
- Determine and follow bidirectional data flow from device and PLC
- Determine status of devices using software

DRIVES

Electronic Drives 1 . . (ED1) . . **(80 hr)** 46
Electronic Drives 2 . . (ED2) . . **(40 hr)** 47
AC Drives . . (ACD) . . **(24 hr)** 48
Siemens DC Drive 1 . . (SDCD1) . . **(24 hr)** 49
Siemens DC Drive 2 . . (SDCD2) . . **(24 hr)** 50
Avtron Digital Drive . . (AVDC) . . **(24 hr)** 51
Mentor DC Drive . . (MENT) . . **(24 hr)** 52
Emerson FX Drive . . (EMFX) . . **(24 hr)** 53
Unidrive AC Drive . . (UNIDR) . . **(24 hr)** 54
Cutler Hammer 210 DC Drive . . (CHDCD) . . **(16 hr)** 55
Akron Standard AIFI DC Drive . . (AKDCD) . . **(16 hr)** 56
Reliance MinPak DC Drive . . (REMDCD) . . **(16 hr)** 57
DC and AC Drives . . (DC&ACD) . . **(80 hr)** 58
Motion Controllers 1 . . (MC1) . . **(40 hr)** 59
PowerFlex 40 & 70 ACDrive…(PFX)…**(24 hr**)…… 60

DRIVES


Electronic Drive 1
80 hours – Page 46
DC and AC Drives
80 hours – Page 58
AC Drive
24 hours – Page 48
Electronic Drives 2
40 hours – Page 47
Siemens DC Drive 1
24 hours – Page 49
Siemens DC Drive 2
24 hours – Page 50
Avtron Digital Drive
24 hours – Page 51
Mentor DC Drive
24 hours – Page 52
Emerson FX Drive
24 hours – Page 53
Cutler Hammer 210 DC Drive
16 hours – Page 55
Akron Standard AIFI DC Drive
16 hours – Page 56
Reliance MinPak DC Drive
16 hours – Page 57
Motion Controllers 1
40 hours – Page 59
Power Flex 40 & 70 AC Drive
24 hours – Page 60
Unidrive AC Drive
24 hours – Page 54

Course name: ELECTRONIC DRIVES 1

Short name: ED1

Length: 80 hrs

Prerequisites: ES1

Purpose

This course provides knowledge of industrial electronics and its application to motor controls. Setup and programming skills are included.

Description

This course provides an introduction to electronic components and their application in common drive technologies. This drive technology is then applied to the drives that are selected for this course.

Topics include:

- Introduction to electronic components – capacitors, diodes, zener diodes, transistors, op-amps, SCRs
- AC motor theory
- Operation/application symbols, testing, and ratings of electronic components
- AC drive theory and system block
- Feedback devices
- Drive applications
- Power Supplies (halfwave, fullwave, zener and series pass power supplies)
- DC motor theory
- DC drive theory and system block diagrams
- Drive set-up
- Drive analysis

Drive Equipment:
Drives selected will be from the accompanying list. Generally 4-6 drives will be selected for the course. The customer may select alternative drives based on available equipment.

- Cutler Hammer 210
- Reliance Flex Pack 104
- Allen-Bradley 1333
- Akron Standard
- Control Techniques Unidrive
- Allen-Bradley 160
- Control Techniques Mentor Digital Drive
- Avtron Digital Drive
- Fincor
- Altivar Digital Drive
- Allen-Bradley 1334
- Allen-Bradley 1305
- Control Techniques Mentor II Digital Drive
- Allen-Bradley 1336
- Control Techniques Quantum III Digital Drive
- Siemens 6AR24 Digital Drive
- Siemens 6AR70 Digital Drive
- Reliance MinPack

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Identifying electronic components, and analyzing their functions in electronic circuit and drives.
- Identifying and analyzing AC & DC drive interface circuits.
- Setting-up and configuring their basic parameters.
- Finding basic AC & DC Drive faults.

Course name: ELECTRONIC DRIVES 2

Short name: ED2

Length: 40 hrs

Prerequisites: ES1
ED1

Purpose

This course is an AC/DC drives course with 16 – 20 hours of hands-on training with specific drives.

Description

This course provides instruction on various AC/DC drives using software and manual configuration and set-up. The course will also provide the opportunity for extensive hands-on drive analysis exercises.

Topics include:

- Basic AC/DC drive theory
- Drive set-up
- Feedback devices
- Parameters
- Drive configuration
- Drive analysis

Drive Equipment:
Drives selected will be from the following list. Generally 4-6 drives will be selected for the course. The customer may select alternative drives based on available equipment.

- AB 1336
- Altivar 16
- AB 1305
- Reliance MinPak
- AB 160SS
- Toshiba G2+
- Mentor
- Vicker
- Mentor II
- Avtron
- Quantum III
- Akron Standard AIFI
- Siemens Simoreg 6RA24
- Cutler Hammer 210 DC Drive

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Identifying the interface components of both AC and DC drives and their functions.
- Performing basic and in-depth drive set-ups for both AC and DC drive systems.
- Interpreting faults associated with AC and DC drive systems.

Course name: AC DRIVES

Short name: ACD (Allen-Bradley)

Length: 24 hrs

Prerequisites: ES1

Purpose

This course provides knowledge of control systems that incorporate Allen Bradley AC drives.

Description

This course provides generic AC Motor/Drive theory reinforced by application to common drive units used in manufacturing. Hands-on experience is gained through the analysis and set-up of the drives used in the course.

Topics include:

- AC motor theory
- AC drive theory
- Parameter details
- Drive set-up
- Drive programming
- Drive analysis

Drive Equipment:
Drives selected will be from the accompanying list. The customer may select alternative drives based on available equipment.

- Allen-Bradley 160
- Allen-Bradley 1305
- Allen-Bradley 1333
- Allen-Bradley 1334
- Allen-Bradley 1336

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- The theory of AC Drive operation.
- Identifying and analyzing AC Drive interface circuitry.
- Configuring, setting-up, and programming an AC Drive using the manufacture's documentation.
- Finding basic faults associated with AC drive systems.

Course name: SIEMENS DC DRIVE 1

Short name: SDCD1 (Siemens 6RA24)

Length: 24 hrs

Prerequisites: ED1

Purpose

This course provides knowledge of control systems that incorporate the Siemens 6RA24 DC Drive.

Description

This course is designed to use a Siemens Drive in open and closed loop modes. Configuration exercises are used in both manual and program mode using the Simovis 6RA24 software.

Topics include:

- Drive description
- Drive set-up
- Drive configuration
- Drive programming
- Parameter details
- Drive analysis

Drive Equipment:

- Siemens 6RA24 DC drive
- Simovis 6RA24 software

Course Objective:

Upon successful completion this course, the trainee will be competent in:

- Identifying and analyzing drive's interface circuits. (input power, permissives, speed reference, feedback, motor, etc.)
- Configuring and setting-up the drive using the manufacture's documentation.
- Interpreting the drive's faults.
- Interpreting the drive's function block diagrams.
- Using Simovis software for downloading, uploading, and changing parameters, analyzing the drive.

Course name: SIEMENS DC DRIVE 2

Short name: SDCD2 (Siemens 6RA70)

Length: 24 hrs

Prerequisites: ED1

Purpose

This course provides knowledge of control systems that incorporate the Siemens 6RA70 DC Drive.

Description

This course is designed to use a Siemens Drive in open and closed loop modes. Configuration exercises are used in both manual and program mode using the Simovis 6RA70 software.

Topics include:

- Drive description
- Drive set-up
- Drive configuration
- Drive programming
- Parameter details
- Drive analysis

Drive Equipment:

- Siemens 6RA70 DC drive
- Simovis 6RA70 software

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Identifying and analyzing drive's interface circuits. (input power, permissives, speed reference, feedback, motor, etc.)
- Configuring and setting-up the drive using the manufacture's documentation.
- Interpreting the drive's faults.
- Interpreting the drive's function block diagrams.
- Using Simovis software for downloading, uploading, and changing parameters, analyzing the drive.

Course name: AVTRON DIGITAL DRIVE

Short name: AVDC

Length: 24 hrs

Prerequisites: ED1

Purpose

This course provides knowledge of control systems that incorporate the Avtron Digital Drive.

Description

This course is designed to use an Avtron drive in open and closed loop modes. Configuration exercises are used both in manual mode and program mode using Avtron software.

Topics include:

- Drive description
- Drive set-up
- Drive configuration
- Real time screens
- Parameter details
- Screen designer
- Drive analysis

Drive Equipment:

- Avtron drive
- Avtron software (ADDAPT)

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Identifying and analyzing drive's interface circuits. (in put power, permissives, speed reference, feedback, motor, etc.)
- Configuring and setting-up the drive using the manufacture's documentation.
- Interpreting the drive's faults.
- Interpreting the drive's function block diagrams.
- Using ADDAPT software for downloading, uploading, and changing parameters, analyzing the drive.

Course name: MENTOR DC DRIVE

Short name: MENT

Length: 24 hrs

Prerequisites: ED1

Purpose

This course provides knowledge of control systems that incorporate the Mentor DC Drives by Control Techniques.

Description

This course is designed to use a Mentor in open and closed loop modes. Configuration exercises are used both in manual and in program mode (MentorSoft).

Topics include:

- Drive description
- Drive set-up
- Drive configuration
- Drive programming
- Parameter details
- Drive analysis

Drive Equipment:

The customer may select alternative drives from the list below based on available equipment.

- Mentor
- Mentor II
- Quantum III
- MentorSoft Windows software

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Identifying the Mentor's interface components and their functions.
- Configuring, modifying and analyzing the drive's parameters using Mentorsoft.
- Interpreting faults associated with the Mentor drive.

Course name: EMERSON FX DRIVE

Short name: EMFX

Length: 24 hrs

Prerequisites: ED1

Purpose

This course provides knowledge of control systems that incorporate the Emerson FX Servo Drive.

Description

This course is designed to use a FX Drive using the PCX software.

Topics include:

- Basic servo theory
- PCX programming
- Servo motors
- Drive tuning
- Drive description
- Axis programming
- Drive configuration
- Drive analysis

Drive Equipment:

- Emerson FX Servo drive
- PCM 15 option Module
- PCX software

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Identifying the drive's interface components and their functions.
- Configuring the Servo drive and Motion control parameters with PCX software.
- Programming motion control sequences.
- Interpreting faults associated with the Emerson FX Servo system.

Course name: UNIDRIVE AC DRIVE

Short name: UNIDR

Length: 24 hrs

Prerequisites: ED1

Purpose

This course provides knowledge of control systems that incorporate the Unidrive AC Drive by Control Techniques.

Description

This course is designed to use a Unidrive in open and closed loop modes. Configuration exercises are extensively used in manual and in program mode (Unisoft).

Topics include:

- Drive description
- Drive set-up
- Drive configuration
- Drive programming
- Parameter details
- Drive analysis

Drive Equipment:

- Unidrive 1401 drive
- Unisoft Windows software

Course Objective:

Upon successful completion of this course, the trainee will be competent in:

- Identifying the Unidrive's interface components and their functions.
- Configuring, modifying and analyzing the drive's parameters using Unisoft or CTsoft.
- Identifying and replacing the option modules.
- Interpreting faults associated with the Unidrive drive.

Course name: CUTLER HAMMER 210 DC DRIVE

Short name: CHDCD

Length: 16 hrs

Prerequisites: ED1

Purpose

This course provides knowledge of control systems that incorporate the Cutler Hammer DC Drive.

Description

This course uses the block diagram method of analysis. The trainee will exercise component level circuit analysis within each functional block. Although this course is based on the CH-210 drive, the block diagram method allows the concepts learned to be applied to other analog drive systems. Practical exercises are developed to reinforce the setting up of the drives and practical analysis to the component level.

SCR systems will be discussed including the full wave bridge and the six SCR three phase bridge. The need for protective devices will be explained and all such devices examined.

Topics include:

- Drive description
- Drive set-up
- Drive configuration
- Drive analysis
- Feedback set-up
- Repair

Drive Equipment:

- Cutler Hammer 210 DC drive

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Identifying and analyzing the drive's interface circuits.
- Interpreting faults associated with the drive.
- Configuring and setting-up the drive using the manufacture's documentation.
- Analyzing the drive to component level.

Course name: AKRON STANDARD AIFI DC DRIVE

Short name: AKDCD

Length: 16 hrs

Prerequisites: ED1

Purpose

This course provides knowledge of control systems that incorporate the Akron Standard AIFI DC Drive.

Description

DC drive concepts are presented utilizing the block diagram approach, however component level circuit analysis is exercised within each block. Practical exercises are dedicated to motor exercises, observing proper drive operations, and practical analyzing to the component level.

SCR systems will be discussed including the full wave bridge and the six SCR three phase bridge. The need for protective devices will be explained and all such devices examined.

Topics include:

- Drive description
- Drive set-up
- Drive configuration
- Repair
- Feedback set-up
- Drive analysis

Drive Equipment:

- Akron Standard AIFI DC drive

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Identifying and troubleshooting the drive's interface circuits.
- Configuring and setting-up the drive using the manufacture's documentation.
- Interpreting faults associated with the drive.
- Analyzing the drive to a component level.

Course name: RELIANCE MINPAK DC DRIVE

Short name: REMDCD

Length: 16 hrs

Prerequisites: ED1

Purpose

This course provides knowledge of control systems that incorporate the Reliance Minpak DC Drive.

Description

DC drive concepts are presented utilizing the block diagram approach, however component level circuit analysis is exercised within each block. Although specific drives are used throughout the course, the block diagram approach allows the concepts taught to be extended to other DC drive systems. Practical exercises are dedicated to motor exercises, observing proper drive operations, and practical analyzing to the component level.

SCR systems will be discussed including the power cube bridge and the six SCR three phase bridge. The need for protective devices will be explained and all such devices will be examined.

Topics include:

- Drive description
- Drive set-up
- Drive configuration
- Repair
- Drive analysis

Drive Equipment:

- Reliance MinPak DC drive

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Identifying the Minpak drive's interface components and their functions.
- Configuring the drive using the Manufacturer's documentation.
- Interpreting faults associated with the Minpak drive.

Course name: DC and AC Drives

Short name: DC&ACD

Length: 80 hrs

Prerequisites: ECOM

Purpose

This course provides the knowledge and skills necessary to isolate and repair problems occurring within AC and DC Drive systems.

Description

This course provides the common drive technologies used in industry including AC and DC Drives. This is accomplished through extensive hands-on exercises and system level analyzing using necessary test equipment.

Topics include:

- DC motor theory
- DC drive theory and system block diagrams
- Component level circuit analysis of analog drives
- AC motor theory
- AC drive theory and system block diagrams
- Feedback devices
- Drive applications
- Drive set-up
- Drive analysis

Drive Equipment:

Drives selected will be from the following list. Generally 4-6 drives will be selected for the course. The customer may select alternative drives based on available equipment.

- Cutler Hammer 210
- Akron Reliance
- Mentor Digital Drive
- Mentor II Digital Drive
- Altivar
- Simoreg Digital Drive
- 6RA22
- 6RA24
- 6RA70
- Flex Pack 104
- Unidrive
- Avtron Digital Drive
- Toshiba
- AB 1334
- AB 1336
- AB 1333
- AB 160
- Fincor
- AB 1305
- Quantum III

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Identifying and analyzing AC & DC Drive interface circuits.
- Analyzing analog drives to component level.
- Setting-up, programming, and configuring basic, and in-depth parameters of AC & DC drives.
- Finding faults associated with AC and DC drives.

Course name: MOTION CONTROLLERS 1

Short name: MC1

Length: 40 hrs

Prerequisites: ED1
PLC Advanced

Purpose

This course provides the knowledge and skills necessary to configure, program, and analyze the Allen-Bradley 1394 servo drive system or IMCS Class Motion Controller.

Description

This course provides a working knowledge of motion control systems and their components including servo drive operation, Brushless Motor theory, Feedback Devices and Programming of Motion Controllers. The course is based on the Allen-Bradley 1394 Servo Controller and the GML Commander Programming Language. This course can also be applied to the IMCS Class Motion Controller.

Topics include:

- Brushless motor theory
- Brushless drive theory
- Feedback devices
- System set-up
- GML programming (using GML Commander)
- Drive configuration
- Drive tuning
- Axis programming
- Remote I/O communications with PLCs
- Discrete and block transfers via remote I/O
- Axis link (transfer of data between motion controllers)
- Drive analysis

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Analyzing the components associated with the 1394 Motion controller system.
- Configuring the Motion Controller system using GML Commander software.
- Programming motion control sequences.
- Interpreting faults associated with the Motion Controller System.

Course name: POWER FLEX 40 & 70 AC DRIVE

Short name: PFX

Length: 24 hrs

Prerequisites: ED1

Purpose

This course provides knowledge of control systems that incorporate the Power Flex 40 & 70 AC Drives by Allen-Bradley

Description

This course is designed to use a Power Flex 40 in open loop, and Power Flex 70 in open and closed loop modes. Students configure and program the drives using the keypad (HIM) and the Drive Tools software.

Topics include:

- Drive description
- Drive set-up
- Drive configuration
- Drive programming
- Parameter details
- Drive analysis

Drive Equipment:

- Power Flex 40 & 70 AC drives
- Drive Tools software

Course Objective:

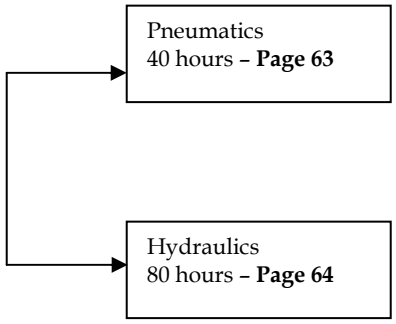
Upon successful completion of this course, the trainee will be competent in:

- Identifying the Power Flex 40 & 70's interface components and their functions.
- Install/Replace and start-up drive system.
- Configuring, modifying and analyzing the drive's parameters using Drive Tools.
- Interpreting faults associated with the Power Flex 40 & 70 drive.

FLUID POWER

Pneumatics . . (PNE) . . **(40 hr)** 63
Hydraulics . . (HYD) . . **(80 hr)** 64

FLUID POWER



Course name: PNEUMATICS

Short name: PNE

Length: 40 hrs

Prerequisites: Working skills in four-function math including whole numbers, decimals and fractions. The ability to manipulate and solve basic algebraic equations and calculate areas and volumes is also required.

Purpose

This course provides a basic foundation in pneumatic components, circuits, controls, their application, and drawing standards.

Description

The course simulators are used by trainees to build circuits and to analyze systems. This is a very hands-on course targeted at those who want the hands-on skill exposure.

Topics include:

- Fluid physics
- Filtration techniques
- Actuators
- Accessories
- Cylinders
- Memories
- Valves
- Air distribution
- Limit/pressure switches
- Step flow chart
- Basic pneumatic circuit design
- Pneumatics safety
- Timers
- Pneumatic circuit analyzing
- Practical piping skills

Course Objectives:

Upon successful completion of this course, the trainee will be competent in:

- Applying appropriate safety procedures as they relate to the energy contained in a pneumatic circuit.
- Recognizing the internal operation of pneumatic components.
- Reading, interpreting and sketching pneumatic schematics.
- Pneumatic circuit operation and fluid flow characteristics.
- Distinguishing the effect of flow versus pressure with respect to speed and force.
- Performing the mathematical calculations for pressure, force and area as they apply to pneumatic circuits.
- Analyzing, identifying and repairing faulty components in a pneumatic circuit.

Course name: HYDRAULICS

Short name: HYD

Length: 80 hrs

Prerequisites: Working skills in four-function math including whole numbers, decimals and fractions. The ability to manipulate and solve basic algebraic equations and calculate areas and volumes is also required.

Purpose

This course provides a basic foundation in hydraulic components, circuits, their application, and drawing standards.

Description

The course simulators are used by trainees to build circuits and to analyze systems. This is a very hands-on course targeted at those who want the hands-on skill exposure.

Topics include:

- Fluid physics
- Flow control devices
- Fluid safety
- Accumulators
- Pressure switches
- Pumps
- Heat exchangers
- Cylinders
- Filters/strainers
- Valves
- Motors
- Pressure control devices
- Basic hydraulic circuit design
- Practical piping skills
- Hydraulic circuit analyzing
- Reservoirs

Course Objectives:

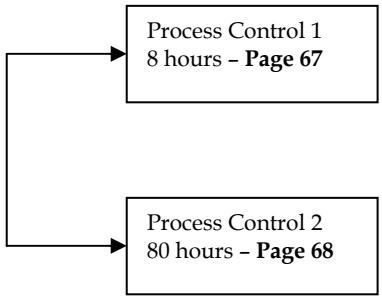
Upon successful completion of this course, the trainee will be competent in:

- Applying appropriate safety procedures as they relate to the energy contained in a hydraulic circuit.
- Recognizing the internal operation of hydraulic components.
- Reading, interpreting and sketching hydraulic schematics.
- Hydraulic circuit operation and fluid flow characteristics.
- Distinguishing the effect of flow versus pressure with respect to speed and force.
- Performing the mathematical calculations for pressure, force and area as they apply to hydraulic circuits.
- Analyzing, identifying and repairing faulty components in a hydraulic circuit.

PROCESS CONTROL

Process Control 1. . (PC1) . . **(8 hr)** 67
Process Control 2. . (PC2) . . **(80 hr)** 68

PROCESS CONTROL



Course name: PROCESS CONTROL 1

Short name: PC1

Length: 8 hrs

Prerequisite: None

Purpose

This course is an entry-level course designed to teach methods and procedures to safely work around process systems. The course is intended for those who have little prior experience with process control.

Description

This course covers systems of pressure, level, flow and temperature. Exercises are performed on simulators to gain practical experience with systems prior to performing fieldwork.

Topics include:

- Identification of fluid systems
- Start-up/shut down of systems
- Components of a system
- Safety rules for pressure vessels and systems
- Energy transfer/conservation in a system
- Fundamental system troubleshooting systems

Course Objectives:

Upon successful completion of this course, the trainee will leave with an appreciation in the above topics.

Course name: PROCESS CONTROL 2

Short name: PC2

Length: 80 hrs

Prerequisite: Experience as process technicians, maintainers or engineers

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Purpose

This course develops skills on Process Control instruments. The course is intended for those who have little prior experience with process control or that need updating on new technologies and practices.

Description

This course covers operating principles of various instruments that are used to measure and control pressure, level, flow and temperature. Exercises are performed on process simulators to gain practical experience prior to performing fieldwork.

Topics include:

- Symbols (ISA)
- Hardware
  - PID controllers
  - LVDT (position devices)
  - Load cell/Strain gauge
  - Test instruments
  - Current to pressure
  - Pressure to current
  - Control valves
- Schematic reading
- Control loops
  - Designs
  - Troubleshooting
  - Calibrators
  - Tuning
- Process characteristics
  - Energy of systems
  - Steam
  - Safety
- Measurement devices
  - Pressure
  - Differential pressure
  - Temperature
  - Flow
  - PH
  - Vessel fluid level
- Metrology systems fundamentals
  - Calibration
  - Traceability

Course Objectives:

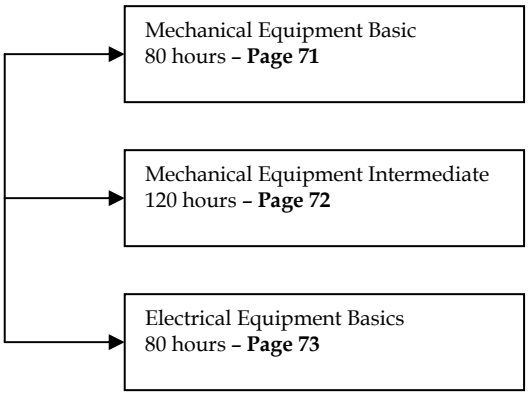
Upon successful completion of this course, the trainee will be competent in:

- The reading of process control drawings.
- Performing diagnostics and troubleshooting.
- Locating and replacing defective hardware.
- Calibrating discreet, analog, and smart transmitters.
- Tuning simple PID loops.

OPERATOR

Mechanical Equipment Basics . . (MEB) . . **(80 hr)** 71
Mechanical Equipment Intermediate . . (MEI) . . **(120 hr)** 72
Electrical Equipment Basics . . (EEB) . . **(80 hr)** 73

OPERATOR


Mechanical Equipment Basic
80 hours – Page 71
Mechanical Equipment Intermediate
120 hours – Page 72
Electrical Equipment Basics
80 hours – Page 73

Course name: MECHANICAL EQUIPMENT BASICS

Short name: MEB

Length: 80 hrs

Prerequisites: None

Purpose

This course has been designed to introduce basic mechanical training for machine operators. It is for those who are required to perform duties of a mechanical nature. It is also an excellent course for supervisors and engineers who need only basic mechanical skills or knowledge.

Description

The course includes basic print reading, Metric system, hand tools, precision measuring, mechanical technologies, and European and international standards. Classroom emphasis is on the knowledge and skills necessary to reference blueprints to understand parts location and machine function. The workshop portion builds basic mechanical skills supporting the classroom subject area.

Topics include:

- Assembly drawings
- Bearings/bushings
- Detail drawings
- Basic hand tools
- Visualization of detail parts
- Layout techniques
- Section views
- Precision measuring
- Dimensioning
- Drilling/tapping/reaming
- The Metric system
- Writing simple work methods
- ISO tolerances
- Assemble simple machines
- Threads and fasteners
- Workshop safety
- Transmission devices

Course Objectives:

Upon successful completion of this course, the trainee will leave with an introduction in/for:

- General shop safety procedures as they apply to power and hand tools and equipment
- Mechanical drawing package including Nomenclature (Bill of Materials), detail and assembly drawings and different drawing techniques
- Mechanical transmission devices such as belts/pulleys, chains/sprockets, and gears
- Mechanical components such as bearings/bushings and different type fasteners
- Hand skills such as layout techniques, drilling, tapping, reaming of holes
- The Metric system and the ISO tolerance system

Course name: MECHANICAL EQUIPMENT INTERMEDIATE

Short name: MEI

Length: 120 hrs

Prerequisite: None

Purpose

This course has been designed to introduce basic mechanical technology for machine operators. Classroom emphasis is on the knowledge and skills necessary to reference blueprints to understand parts location and machine function. The workshop portion builds basic mechanical skills supporting the classroom subject area. It is also an excellent course for supervisors and engineers who need only basic mechanical skills or knowledge.

Description

The course includes basic print reading, basic adult math, Metric system, hand tools, precision measuring devices, basic pneumatic components, mechanical technologies, and European and international standards. Classroom emphasis is on the knowledge and skills necessary to use blueprints to understand parts location and machine function. The workshop portion builds basic mechanical skills supporting the classroom subject area.

Topics include:

- Workshop safety
- Threads and fasteners
- Assembly drawings
- Transmission devices
- Detail drawings
- Bearings/bushings
- Visualization of detail parts
- Basic hand tools
- Section views
- Layout techniques
- Dimensioning
- Precision measuring
- Auxiliary views
- Drilling/tapping/reaming
- The Metric system
- Key fitting
- Basic adult math
- Writing simple work methods
- ISO tolerances
- Assemble simple machines
- Lubrication

Course Objectives:

Upon successful completion of this course, the trainee will leave with an introduction in/for:

- General shop safety procedures as they apply to power and hand tools and equipment
- Mechanical drawing package including Nomenclature (Bill of Materials), detail and assembly drawings and different drawing techniques
- Mechanical transmission devices such as belts/pulleys, chains/sprockets, and gears
- Mechanical components such as bearings/bushings and different type fasteners
- Hand skills such as layout techniques, drilling, tapping, reaming of holes
- The Metric system and the ISO tolerance system
- Writing simple work methods
- Machine assembly
- Proper key fitting techniques and tolerances
- Basic adult math
- Lubrication

Course name: ELECTRICAL EQUIPMENT BASICS

Short name: EEB

Length: 80 hrs

Prerequisites: None

Purpose

This course is designed to provide the machine operator with a basic understanding of the theory and technology of an electrical nature. The trainee will develop a working schematic and wire a functional control panel as part of the training. The course provides hands-on training knowledge of theory, technology, and troubleshooting techniques.

Description

This course introduces the trainee to electrical equipment technology, schematic drawing and wiring methods. Several practical wiring exercises are constructed on simulators. The analytical techniques developed in the classroom are utilized in locating actual faults on the wiring simulators.

Topics include:

- Electrical safety
- Basic DC circuits
- Basic AC circuits
- Push button and limit switch technology
- Photocell and proximity switch technology
- Relay and contactor technology
- Fuse technology and other circuit protection devices
- Single phase transformer technology
- Conductors and insulators
- Wiring methods
- Electrical symbols and drawings
- Basic motor operation
- Control circuit wiring (lab exercises)
- Troubleshooting techniques and application

Course Objectives:

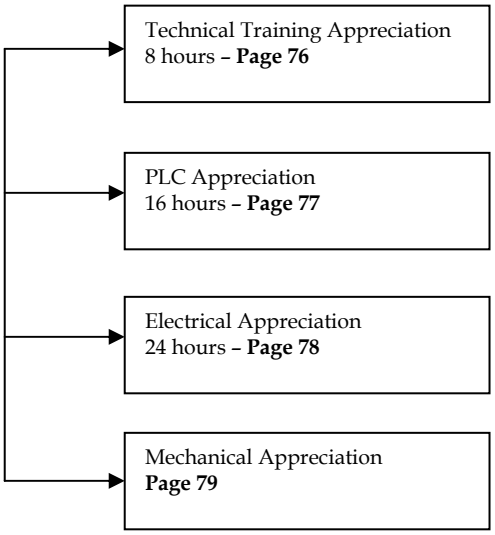
Upon successful completion of this course, the trainee will be competent in:

- The hazards associated with electrical circuits.
- AC and DC circuit theory and analysis.
- Proper application concerning electrical protection devices.
- Electrical symbols and schematic design.
- Wiring methods and practical application.
- Practical and efficient troubleshooting methods.

APPRECIATION

Technical Training Appreciation . . (TTA) . . **(8 hr)** 76
PLC Appreciation . . (PLC App) . . **(16 hr)** 77
Electrical Appreciation . . (EA) . . **(24 hr)** 78
Mechanical Appreciation . . (MA) 79

APPRECIATION



Course: TECHNICAL TRAINING APPRECIATION

Short name: TTA

Length: 8 hrs

Prerequisites: None

Purpose

This course is designed to provide an appreciation of the base courses taught at the Technical Training Center. It will demonstrate the importance of setting new job expectations and the need for on-the-job training utilizing the newly acquired skills. Supervisors, trainers and managers who are responsible for technical employees will benefit greatly from this course.

Description

This course is an overview of the knowledge and skills taught on the Electrical, Electronic, PLC, Mechanical, Pneumatic and Hydraulic courses. This overview will show the rigor of the training and the importance of implementing on-the-job training.

Topics include:

- ES1
- ES2
- Mech 1
- Mech 2
- PLC-I
- PLC 5
- ED1
- Pneu
- Hyd
- Training reports
- CenTec course catalog

Course Objectives:

This course is designed to provide knowledge of all the basic core courses taught at CenTec.

Course name: PLC APPRECIATION

Short name: PLC App

Length: 16 hrs

Prerequisites: None

Purpose

This course is designed to provide trainees with an appreciation of PLC technologies.

Description

This course provides an introduction to PLC ladder logic, basic instructions and demonstrations of concepts.

Topics include:

- PLC basics & concepts

Course Objectives:

Upon the successful completion of this course, the trainee will have an appreciation for:

- PLC basics & concepts to allow discussion with technical employees.
- Recognizing hardware components when seen in the field.
- The function and application of PLC's.

Course name: ELECTRICAL APPRECIATION

Short name: EA

Length: 24 hrs

Prerequisites: None

Purpose

This course will provide an appreciation of the electrical technologies.

Description

This course is an introduction to electrical theory and equipment, electrical safety, schematic reading, troubleshooting exercises. A variety of technologies will be covered.

Topics include:

- The nature of electricity
- 3-Phase systems
- Electrical language and symbols
- Drawings
- Electrical components & protection devices
- Basic circuit design
- DC fundamentals
- DC motors
- Ohm's Law
- AC motors
- Kirchoff's Law
- Electrical safety & lockout
- AC fundamentals
- Electrical troubleshooting
- Transformers

Course Objective:

This course is designed to provide trainees with an appreciation of the following basic electrical concepts:

- The hazards associated with electrical circuits.
- AC and DC circuit concepts.
- Proper application concerning electrical protection devices.
- Electrical symbols.
- Wiring methods and practical application.
- Practical AC and DC motor theory.

Course name: MECHANICAL APPRECIATION

Short name: MA

Length: 40 – 80 hrs. (Dependent on topics chosen)

Prerequisites: None

Purpose

This course is:

a) Designed to provide employees (electrical designers, technicians and supervisors) who do not have a mechanical background, with an overview of the mechanical technologies.

b) Designed to provide operators with a basic introduction to mechanical technologies and to enable them to perform designated tasks.

Description

This course provides basic instructions with some practical demonstration of mechanical theory, hand tools, practical skills, mechanical drawings, safety, machining, and measurement.

This course can be tailored to suit a) or b) using the topics listed below. An advanced notice is required in order to tailor to suit the need. The timeframe for the course will vary according to the request.

Topics include:

- Mechanical print reading
- Drive systems
- Hand tool technique and safety
- Seals
- Fasteners
- Assembly and disassembly practices
- Measurement & layout
- Couplings, clutches and brakes
- Hand skills
- Lubrication
- Drilling technique and quality
- Conveyor systems
- Bearing technology
- Machine tool function and use
- Rigging requirements and safety
- Coupling alignment
- Oxygen and acetylene safety
- Materials and heat treatment

Course Objectives:

Upon the successful completion of courses selected, the trainee will have an appreciation for:

- The basics of these topics and appreciating what skills are required to perform these topics.
- Communicating with maintenance, personnel, and assisting with minor aspects of these topics.