FOUNDATIONS OF MANUFACTURING

SAFETY FUNDAMENTALS 77-3202-0000
Introduction to OSHA and Safety Responsibilities/Safety in the Workplace
Personal Protective Equipment (PPE)
Safety Programs
Production Team Training & Responsibilities
Product Development & Customer Service
Customer Service

SAFETY: LOCKOUT / TAGOUT 77-LOT0-0000
Acquiring Lockout/Tagout Basics
Attaching Lockout Devices
Completing and Attaching Tagout Devices
Conduct energy control analysis
Perform lockout/tagout procedure
Perform lockout/tagout release

MATH FOR TECHNICIANS I 77-BA01A-0001
Working with Arithmetic and Algebra
Working with Whole Numbers
Working with Fractions
Working with Decimals
Working with Percentages
Working with Ratios and Proportions
Working with Systems of Measurement
Working with Geometry
Working with Trigonometry

MATH FOR TECHNICIANS II 77-BA01B-0001
Working with Conversion Formulas
Applying Mechanical Principles
Calculating Drive Ratios
Calculating Speed Reducer Service Factor
Using Ohm's Law in Series and Parallel Circuits
Converting Binary, Binary Coded Decimal (BCD), Hexadecimal and Decimal Numbers
Calculating Pressure, Force, Head and Flow
Calculating Shim Requirements
Selecting Pipe Size

EMPLOYABILITY 77-3097-0000
Time-Management Techniques
Personal Qualities Desirable for the Workplace
Interpersonal Communication
Conflict Resolution
Teamwork
Problem-Solving Techniques
Decision-Making Skills
Business and Personal Ethics
Business Etiquette and Ethical Computer Behavior
Employer-Employee Relationships
Proper Communication with Diverse Populations
Career Goals
Resumes and Cover Letters
Job Applications
Potential Employer Interviews
Interviewing Skills

MECHANICAL BLUEPRINT READING 77-BA02-0001
Identify lines and their functions
Single, multiple, and auxiliary views
Reading and locating blue print dimensions
Determine tolerances
Identify thread dimensions
Identify tapers and machined surface symbols
Cutting planes and sections
Geometric dimensions, wear limits and assembly
Identify welding symbols
Reading plot plans
Reading footing, foundation, and floor plans
Read reinforced concrete and structural steel plans

LUBRICATION FOR MAINTENANCE TECHNICIANS 77-BA03-0001
Lubrication Fundamentals
Lubrication Terms
Identifying Lubricating Oils
Identifying General Purpose Greases
Identifying Special Purpose Greases
Applying Lubricating Oils
Applying Lubricating Greases
Bearing Lubrication
Setting Up a Lubrication Schedule
Selecting Synthetic Lubricants
Grease Guns
Bearing Packers
Grease Lubricators
Drop Feed Oilers
Electric Chain Oilers

MECHANICAL FASTENERS 77-BA04-0001
Screws and Bolts
Threaded Fastener Selection
Thread Standards
Creating and Repairing Threads
Nuts
Torque Wrenches
Bolt Extractor
Washers
Rivets
Adhesives
Hook and Loop Fasteners
Cable Ties

HAND TOOLS 77-BA05-0001
Shop Safety
Rulers and Tape Measures
List how hand tools may be misused or abused
Calipers and Feeler gauges
Squares and Levels
Knives
Chisels
Saws
Pliers
Cutters
Files & Deburring Tools
Drivers
Hex Keys
Wrenches
Scribes and Punches
Work Holding Devices
Hammers
Socket and Torque Wrenches

POWER TOOLS 77-BA06-0001
Shop Safety
Power Drills
Drill Presses
Rotary Tools
Jigsaws
Reciprocating Saws
Circular Saws
Table Saws
Bandsaws
Sanders

MECHANICAL MEASUREMENT AND QUALITY CONTROL 77-8014-0001
Introduction
Accuracy, Precision and Measurement Tools
Units of Measurement and Conversion
Fractions, Decimals, and Rounding
Scaled Measurement Tools
Vernier, Dial, and Digital Calipers
Micrometers
Height Gauges and Dial Indicators
Fixed Gauges
Transfer Measurement Tools
Statistical Analysis
Statistical Process Control
Nominal Dimensions and Tolerance
Parts Inspection and Inspection Reports
Conclusion - Quality Control in Industry

INTRODUCTION TO ADVANCED MANUFACTURING 77-3096-0000
Understanding the Definition of Manufacturing
Understanding the History of Manufacturing
Considering Career Choices
Conducting a Job Search
Preparing a Resume
Writing a Cover Letter
Planning and Staffing a Manufacturing Company
Understanding Product and Strategy Selection
Identifying Manufacturing Processes
Understanding CAD, CAE, CAM, CNC
Understanding Statistical Process Control
Understanding Forecasting Software and Computer Simulation Modeling
Understanding the Role of Automation in Manufacturing
Understanding the Role of Flexible Manufacturing Systems
Understanding Computer Integrated Manufacturing
Understanding the Role of Quality Control

INTRODUCTION TO LEAN MANUFACTURING 77-3109-0000
Defining Lean Manufacturing
Understanding Waste
Identifying Wastes in a Workplace
Designing the Manufacturing Workplace
Redesigning a Workstation
Mistake Proofing
Fundamental Concepts in Lean
Designing Lean Production Processes
Applying Lean to a Household Task
Task Analysis and Design
Lean Production Scheduling Systems
Problem Solving Tools
Designing a Lean Production Process

ROBOTICS

FUNDAMENTALS OF ROBOTICS 77-3046-0000
Introduction to Robotics
How Robots Work
Using Robotic Control Software
Recording Robot Positions
Programming a Simple Pick and Place Task
Absolute and Relative Positions
Basic Robotic Programming Tools
Block Alignment Project
Feeders and Templates
Peripheral Devices
Linear Slidebase Project
Encoders
Roll and Pitch
Programming the Robot to Execute Linear and Circular Movements
Final Project: Drawing a House

ADVANCED ROBOTICS 77-3048-0000
Review of Robotic Fundamentals
Programming with Subroutines
Digital Inputs
Digital Outputs
Project #1 - Delivering Materials with a Conveyor
Conditional Branching
Project #2 - Programming with Conditional Branching
Analog Inputs and Outputs
Loops and Counters
Contact and Non-Contact Sensors
Programming a Sorting System Project

ROBOTICS & MATERIALS HANDLING 1 77-8082-0000
Introduction to Robotics
Robotic Control Software
Recording Robot Positions
Writing and Running a Robot Program
Cartesian Coordinates
Inputs and Program Jumps
Outputs
Joint and XYZ Coordinate Systems
Relative Positions
Subroutines
Contact and Non-Contact Sensors
Servo Control of the Conveyor
I/O Control of the Conveyor

ROBOTICS & MATERIALS HANDLING 2 77-8083-0000
Basic Robotic Programming Tools
Manipulating Blocks Project
Programming the Robot to Execute Circular Movements
Drawing a House
Roll and Pitch
Block Alignment Project
Feeders and Templates
Peripheral Devices
Linear Slidebase Project
Programming Using Encoder Values
Conditional Branching
Programming with Conditional Branching
Analog Inputs and Outputs
Programming a Sorting System Project

AUTOMATED WELDING 77-3001-0000
Intro to Automated Welding Simulation Software
Recording Robot Positions
Basic Welding Programming Tools
Advanced Robotic Programming Tools
Programming Gravity Feeder Operations
Programming Jig and Gun Operations
Programming Welding Operations
Programming a Fully Automated Welding Cycle
Performing a T-joint Weld and Fine-Tuning
Programming and performing a Butt Joint Weld
Preventing Thermal Deformation
Changing Parameters: Inert Gas Shield
Changing Parameters: Robot Speed and Feed Rate
Project: Welding Your Name

MACHINING

CNC MILLING 77-3140-0001
Introduction to CNC
Safety Fundamentals
CNCMotion Control Software
Mounting the Workpiece
Tooling
Reference Positions
Verifying a Program
Running a Program
Fundamentals of NC Programming
Project #1 - Programming the House
Arc Programming
Project #2 - Programming the Star
Project #3 - Programming Your Initials

CNC TURNING 77-3141-0001
Introduction to CNC
Safety Fundamentals
CNCMotion Control Software
Securing the Workpiece
Tooling
Reference Positions
Verifying a Program
Running a Program
Fundamentals of NC Programming
Programming a Taper Machining
Project #1 - Machining
Arc Programming
Project #2 - Programming
Project #3 - Final Project

COMPUTER-AIDED DESIGN WITH SpectraCAD 77-3004-0001
Using spectraCAD
Managing Files
Creating the LMC Project
Drawing the M
Drawing the C
Speaker Design Project
Creating the Speaker Cone
Completing the Speaker Project
SpectraCAD Engraver
Generating an NC File
NC Files and Coding
Pocketing
Pocket Toolpaths and SpectraCAM

COMPUTER-AIDED MANUFACTURING WITH SpectraCAM - MILLING 77-3005-0001
Using SpectraCAM
Starting the LMC Project
Generating Tool Paths - LMC Project
Contouring and NC File Generation
Speaker Design Project
First Pocket Operation
Second Pocket Operation
Engraving Text and Generating Code
Advanced Operations Setup
Advanced Operations
Ruled Surfaces
Swept Surfaces
Final Steps

COMPUTER-AIDED MANUFACTURING WITH SpectraCAM - TURNING 77-3007-0001
Using SpectraCAM
Starting a Project
Creating the CAD Drawing
Geometry Duplication and Rough Tool Path Generation
Finish Tool Path and NC File Generation
Advanced Project Setup
Creating the Part Drawing
Final Geometry and Tool Paths
Tool Paths and NC Code
Creating the Lighter Geometry
Final Geometry and Tool Paths
Final Tool Paths and NC Code

CNC ROUTING 77-8160-0001
Getting Started with Routers
Basic Terminology
Axis of Travel
Securing the Work Piece
Installing a Tool
Spoil board
Dust Collection
Mach3 Layout
Homing the Router
Jogging the Router
Setting Part Zero
G-Code Editing
Cutting a Sample Part
Introduction to Vectric VCarve Pro
Making a Gear Clock Drawing
Importing Pictures
Importing a Drawing DXF/DWG/SVG
3D Dinosaur Project

PNEUMATICS

FUNDAMENTALS OF PNEUMATICS 77-8068-0000
Introduction to Pneumatics
Atmospheric Pressure and Vacuum
Atmospheric Pressure, Vacuum and Mechanical Work
The Double-Acting Cylinder
3/2 Valves
Controlling a Piston with PBs
5/2 Air-Operated, Air-Returned Valve
5/2 Air-Air Valves
Laws of Gases
3/2 Air-Operated, Spring-Returned Valve
Spot Welding System
3/2 Roller Valves
The Punch - A Semi-Automatic System

ADVANCED PNEUMATICS 77-8069-0000
Introduction to Logic
The Logic Function AND
Implementing AND in a Pneumatic Circuit
The Toggle Valve
Using AND to Build a Fully Automatic System
The Logic Function OR
Implementing OR in a Pneumatic Circuit
Circuit with Two Double-Acting Cylinders
Sequential Cycle
A Delay
Sequential Control with a Timed Delay
Opposing Control Signals
Timing Diagrams
Using a Single Pilot Valve to Prevent Opposing Control Signals
Using A Single Pilot Valve in a Pneumatic Circuit

ELECTRO-PNEUMATICS 77-3039-0000
Electric Control vs. Pneumatic Control
Building a Basic Electrical Circuit
The 5/2 Solenoid-Spring Valve
The 3/2 Solenoid-Solenoid Valve
Magnetic Switches
Implementing the Logic Function AND
Implementing the Logic Function OR
Implementing the Logic Function NOT
Sequential Operation
The Relay
Unlatching a Relay
Building a Fully Automatic Circuit
Adding a Delay Using an Electric Timer
Unlatching a Fully Automatic Circuit
Measuring Cylinder Speed

ADV. PNEUMATICS AND ELECTRO-PNEUMATICS 77-3040-0000
The Single-Acting Cylinder
The 5/3 Closed-Center Valve
The Manual 5/2 Valve
Sequential Operation
Vacuum Generator and Pad
Pneumatic Counter
Quick Exhaust Valve
Switches and Relays
5/2 Solenoid Spring-Return Valve
Pressure Sensor
Latching a Relay
Overlapping Control Signals
Timing Diagram
Overlapping Signals Solution
Using a Timer
Using a Counter

HYDRAULICS

FUNDAMENTALS OF HYDRAULICS 77-8008-0000
What is Hydraulics?
Pressure and Force
Pressure Gauges
Hydraulic Power Transmission
Hydraulic Power Source
Determining Component Characteristics
Flow Control Valves
4/3 Closed-Center Valve - Construction and Function
4/3 Closed-Center Valve - Characteristics
Power Transformation Using a Double-Acting Cylinder
Loading a Piston
Controlling the Piston Location
Task: Building a Circuit

ADVANCED HYDRAULICS 77-3025-0000
Mechatronics and Hydraulic Systems
Building a Diesel Insertion System
Controlling a Hydraulic Press
Controlling a Barricade
Sequential Operation
Controlling a Cargo Airplane Door
Increasing System Efficiency
The Relay
Latching a Relay
Semi-Automatic Press System
The Timer
Irrigation System
Improving Control in a Circuit with Sequential Operation

ADVANCED HYDRAULICS AND ELECTRO-HYDRAULICS 77-3026-0000
Hydraulic Systems Usage and Control
Electrical Control Signals
Controlling Piston Speed
Non-Return Pilot Valve
Bi-Directional Motor
Pressure Relief Valve
4/3 Closed-Center Valve vs. 4/3 Tandem-Center Valve
Simultaneous Operation of Two Components
Controlling Two Actuators Using Two Valves
Roller Valves
Limit Switch
Sequence Valve
Sequential Operation
Pressure-Reducing Valve
Latching a Relay
Timers
Automatic Cycle

PLCs

FUNDAMENTALS OF LADDER LOGIC 77-3032-0000
Examining Input/Output Relationships
PLC Monitoring Tools
Writing and Simulating a Basic Ladder Diagram
Project: Controlling a Sorting System
NOT Logic
AND Logic
OR Logic
Project: Animate Filling Station
Latching and Unlatching Outputs
Improving Elevator Control
One Shot Rising
Timer On Delay
Timer Off Delay

ADVANCED LADDER LOGIC 77-3033-0000
Bits and Words
Counter Up and Reset
Counter Down
Project: Implementing CTU and CTD
The Equal (EQU) Instruction
The Not Equal (NEQ) Instruction
Project: Applying Equal and Not Equal
The Less Than (LES) Instruction
The Greater Than (GRT) Instruction

Project: Implementing GRT and LES
The Move (MOV) Instruction
The Add (ADD) Instruction
The Subtract (SUB) Instruction

PLC-CONTROLLED PNEUMATIC SYSTEMS 77-3034-0000
The Pneumatic HMI
Manual Control of a Pneumatic Piston
Semi-Automatic Control Systems
Semi-Automatic Action Using a 5/2
Spring-Return Valve
Fully Automatic Operation
Fully Automatic Operation with Spring
Timers
Counters
Sequential Operation with Two Double-Acting Cylinders
Sequential Operation with Three Double-Acting Cylinders
Sequential Operation with Three Double-Acting Cylinders and a Delay
Solving Opposing Control Signals
Solving Opposing Control Signals in a Three Cylinder System
Controlling a System with a Variable Timer

PLC CONTROLLED HYDRAULIC SYSTEMS 77-3035-0000
Using a 4/2 Sol-Sol Valve to Control a Double-Acting Cylinder
Using a 4/2 Sol-Spring Valve to Control a Double-Acting Cylinder
Using a 4/3 Sol-Sol Valve to Control a Double-Acting Cylinder
Using a Fully Automatic Hydraulic Circuit
Using a Fully Automatic Hydraulic Circuit with a Timer
Using a 4/3 Sol-Sol Valve with a Counter
Using a Fully Automatic Hydraulic Circuit with an OSR Instruction
Sequential Operation with Two Double-Acting Cylinders
Sequential Operation with Three Double-Acting Cylinders
Sequential Operation with Three Double-Acting Cylinders and a Delay
Sequential Operation with Three Double-Acting Cylinders and a Delay
Variable Timers
Variable Counters
Project: Port Soil Removal System

MACHINE VISION

MACHINE VISION AND IMAGE PROCESSING 77-3027-0000
Machine Vision and Quality Control
Binary and Hexadecimal, Bits and Bytes
Camera
Image Digitization
Grayscale, Binary Images
Color – RGB, CMYK and HSL
Introduction to Blobs & Blob Analysis
Image Quality and Interference Problems
Noise
Neighborhood and Point-to-Point Operations
Morphological and Geometric Operation
Arithmetic Operations
Quality Control

EXPLORING MACHINE VISION AND QUALITY CONTROL 77-3028-0000
Image Calibration
Pattern Matching and Searches
Finding and Measuring Edges and Stripes
Digital Images: File Types, Compression, Graphic Cards and Scanners
Introduction to Remote Sensing
Machine Vision in the Medical Sector
Analog and Digital Camcorders
Machine Vision and Robot Guidance
Introduction to Using Programming Languages

MACHINE VISION AND QUALITY CONTROL 77-8084-0001
Camera and Lighting
Image Digitization
Working with Images - Image Enhancement
Using Filters
Object Analysis
Pattern Matching
Blob Analysis
Quality Control - Flaw Detection / Part Counting / Measurement and Gauging / Position Verification
Executing a Machine Vision Operation

BASIC POWER ELECTRICITY

ELECTRICAL CIRCUITS JM-BASE-EA01A
Performing Lockout/Tagout
Constructing a Basic Circuit
Identifying Switches
Connecting a Momentary Switch
Connecting a Toggle Switch
Identifying Sources of Electricity
Measuring DC Voltage
Constructing a Series Circuit
Constructing a Parallel Circuit
Testing an Electrolytic Cell
Testing a Battery
Testing a Thermocouple
Testing a Solar Cell

RESISTORS & CONDUCTORS JM-BASE-EA01B
Measuring Resistance in Series and Parallel Circuits
Drawing and Reading Resistor Symbols
Testing an Adjustable Resistor
Measuring Wire Size
Applying Resistance And Wire Size
Calculating Wire Size
Determining Losses in a Conductor

LCR CIRCUITS JM-BASE-EA01C
Discharging a Capacitor & Testing a Capacitor
Determining Capacitance
Applying Capacitance Principles
Applying Magnetic Principles
Inducing a Magnetic Field
Assembling an Electromagnet
Applying Electromagnetic Principles
Inducing Voltage
Inducing DC Voltage
Assembling & Operating Transformers
Applying Inductance Principles
Operating Electromagnets
Drawing Inductance Symbols

MOTORS & GENERATORS JM-BASE-EA01D
Operating a PMDC Motor
Operating a DC Generator
Operating an AC Generator
Operating a Series Motor
Demoing Principles of Reactance and Impedance
Applying Phase Relationship Principles
Illustrating Three-Phase Power
Measuring AC Voltage

ELECTRICAL CONTROL SYSTEMS

OVERLOAD/OVERCURRENT PROTECTION AND MONITORING JM-CTRL-EA02
Drawing and Reading Circuit Protection Symbols
Sizing and Installing Fuses
Testing and Replacing Fuses
Performing Maintenance and Troubleshooting Fuse Blocks
Sizing Circuit Breakers
Testing and Resetting a Circuit Breaker
Sizing and Installing an Overload Heater
Adjusting and Testing the Overload Relay
Installing and Setting Up a Three-Phase Motor

TRANSFORMERS JM-CTRL-EA03
Apply Transformer Principles
Draw and Read Transformer Symbols
Install a Control Transformer
Install a Station Transformer
Troubleshoot Transformer
Connect Transformer as an Auto Transformer for Buck and Boost Operation
Connect Transformers in Delta and Wye
Inspect and Service a Transformer
Size a Transformer

ELECTRIC MOTORS JM-CTRL-EA04
Connecting and Operating a Split-Phase Motor
Connecting and Operating a Capacitor-Start Motor
Connecting and Operating a Shaded-Pole Motor
Connecting and Operating a DC Motor
Connecting and Operating a Three-Phase Motor
Performing Visual Inspections
Lubricating a Motor
Performing DMM and Motor Megger Tests
Troubleshooting a Split-Phase Motor
Troubleshooting a Capacitor-Start Motor
Troubleshooting a Shaded-Pole Motor
Troubleshooting a DC Motor
Troubleshooting a Three-Phase Motor
Testing Motors with Adjustable Loads

ELECTRO-MAGNETIC MOTOR STARTERS JM-CTRL-EA07
Connecting a Control Relay Seal-In Circuit
Connecting, Adjusting and Operating a Single Magnetic Starter
Testing and Resetting Overload Protection
Connect, Adjust, and Operate a Three-phase Reversing Starter
Connect and Operate a Magnetic Starter for Jogging
Troubleshoot a Three-phase Motor Control Circuit
Troubleshoot a Reversing Three-phase Motor Control Circuit
Performing Preventive Maintenance on Magnetic Starters

RELAYS, TIMERS AND THE DELAY RELAYS JM-CTRL-EA08
Connecting, Programming, and Operating Analog On-Delay and Off-Delay Relays
Using Analog Relays and Motors
Connecting, Programming, and Operating Digital Interval, Repeat Cycle, and One Shot Relays
Using Digital Relays and Motors
Connecting and Operating Electric Timers
Using Electric Timers and Motors
Troubleshooting Relays
Performing Preventative Maintenance on Relays

PILOT DEVICES JM-CTRL-EA09
Connecting and Operating a Photoelectric Detector
Connecting and Operating a Photoelectric Sensor with Fiber Optics
Connecting and Operating a Capacitive Proximity Switch
Connecting and Operating an Inductive Proximity Switch
Connecting and Operating a Limit Switch
Connecting and Operating a Pressure Switch
Connecting and Operating Liquid Level Switches
Connecting and Operating a Magnetic Reed Switch

SOLID-STATE REDUCED VOLTAGE STARTERS JM-CTRL-EA11
Apply Solid State Starter Principles
Connect and Operate a Solid State Starter
Adjust a Solid State Starter
Test Solid State Starters
Troubleshoot Solid State Starter

VARIABLE FREQUENCY DRIVES - VFD JM-CTRL-EA12
Applying VFD Principles
Connecting and Operating a Variable Frequency Drive
Adjusting VFD Operating Parameters
Testing VFD Resistance
Reading Voltage and Current on the VFD
Troubleshooting the VFD

DC MOTOR CONTROL JM-CTRL-EA16
Demonstrate DC Drive Principles
Connect, Set Up, and Operate DC Drive
Connect and Operate Braking Controls
Test DC Drive
Troubleshoot DC Drive
Perform Preventive Maintenance
Connect and Operate SCR Speed Control
Connect and Operate TRIAC Speed Control

PROCESS CONTROL

FUNDAMENTALS OF PROCESS CONTROL
Basics of Control Theory and Process Control Terms
Controller and Tuning
Process Control Loop
Intro to Measurement of Level, Flow, Temperature, & Pressure

PROCESS MEASUREMENT
Properties of Matter (Liquid/Air)
Principle of Instrumentation
Level Measurement
Flow Measurement
Temperature Measurement
Pressure Measurement
Final Control Elements

PLANT COMMISSIONING AND OPTIMIZATION
Plant Optimization
 Process Control Loop
 Process Behavior
 Effect of Disturbance in Process
 Characteristic of Proportional, Integral, and Derivative
PID Tuning using Different Methods
 Ziegler-Nichols & Cohen Coon

ACTIVITY
Plant start up and commissioning
Process Control Loop
Understand the process behavior
Proportional, Integral & Derivative
Control Loop tuning - Ziegler-Nichols and Cohen Coon

CIM/FMS

FLEXIBLE MANUFACTURING SYSTEM 77-3022-0000
CNC Machining
RoboCell Simulation and Control Software
Designing an FMS Workcell
Expanding the Workcell
Writing a Program
Programming MII Operations
Conditional Programming
Storing Finished Parts
Multiple Part Programming
Lathe Operations
Multiple Part Lathe Operations
Program Integration
Designing and Running the Final Project

COMPUTER INTEGRATED MANUFACTURING 1 77-3015-0000
Introduction to CIM
Introducing OpenCIM Software
Parts and Production Flow
Storage Setup
Production Planning
Processes and Machine Definition
Part Definition
Defining a Product Part
Producing a New Part
Time and Optimization
View Production Details in the Device View and Storage View
Defining Part Production in the Lathe
Integrated Production
Tracking Integrated Production

COMPUTER INTEGRATED MANUFACTURING 2 77-3016-0000
Mass Production and CIM
Robotic Systems
Location Planning
QC Devices
Feeders
Adding an Assembly Station
Assembled Part Production
Assembled Product Characteristics
Expanding Assembly Capabilities
Sub-assemblies and Multi-Level Assembly
Purchase Orders and MRP
Multi-Level Assembly Production
CIM Databases

INDUSTRIAL POWER ELECTRONICS

OSCILLOSCOPE JM-POWR-EB01A
Oscilloscope Screen
Oscilloscope Controls
Setting Up and Operating the Oscilloscope
Adjusting Probe Compensation
Performing AC Voltage Calculations
Measuring AC Voltage and Frequency
Performing DC Voltage Calculations
Measuring DC Voltage

DIGITAL MULTIMETER JM-POWR-EB01B
Digital Multimeter Safety
DMM Controls and Features
Locating and Reading DMM Icons and Symbols
Reading the Liquid Crystal Display
Setting Up the DMM for Reading AC Voltage
Measuring AC Voltage
Calculating & Converting AC Voltage
Measuring DC Voltage
Measuring Resistance
Discharging a Capacitor
Measuring Capacitance
Testing Capacitors
Measuring Current
Measuring DC Millivolts
Performing Continuity Tests
Testing Grounds and Bonds
Measuring Frequency

HAND HELD DIGITAL OSCILLOSCOPE JM-POWR-EB01C
Reading the Oscilloscope Screen
Setting Up and Using Oscilloscope Controls
Setting Up and Operating the Oscilloscope
Performing AC Voltage Calculations
Measuring AC Voltage and Frequency
Performing DC Voltage Calculations
Measuring DC Voltage
Storing and Recalling Screen Displays

DC POWER SUPPLIES JM-POWR-EB02A
Power Supply Block Diagram
Schematic Symbols
Testing a Transformer
Locating Diodes and Symbols
Testing a Diode
Drawing a Half-Wave Rectifier
Connecting and Operating a Half-Wave DC PS
Confirming Full-Wave DC Power Supply Operation
Connecting and Operating a Full-Wave DC PS
Confirming Single-Phase Bridge Rectifier Operation
Connecting and Operating Single-Phase Bridge Rectifier

SINGLE-PHASE AND THREE-PHASE POWER SUPPLIES JM-POWR-EB02B
Drawing Filter Schematic Diagrams
Connecting and Operating a Power Supply
Drawing Zener Schematic Diagrams
Connecting and Operating a Zener Diode Voltage Regulator
Locating an IC Voltage Regulator
Connecting and Operating a DC Power Supply with an IC Voltage Regulator

Connecting and Operating a Bleeder Resistor
Connecting and Operating a Voltage Divider
Troubleshooting a DC Power Supply
Confirming Three-Phase Bridge Rectifier Operation
Connecting and Operating a Three-Phase Bridge Rectifier
Performing a Three-Phase Bridge Rectifier

THYRISTOR ELECTRIC MOTOR DRIVES JM-POWR-EB03
Locating an SCR and Drawing the Schematic Symbol
Testing an SCR
Connecting and Operating an SCR
Confirming Full-Wave SCR Control
Connecting and Operating a Full-Wave SCR DC Motor Drive
Setting Up the DMM for Reading AC Voltage
Measuring AC Voltage
Calculating & Converting AC Voltage
Measuring DC Voltage
Measuring Resistance
Demonstrating TRIAC Control Principles
Locating a DIAC and Drawing the Schematic Symbol
Connecting and Operating a DIAC-Controlled TRIAC AC Motor Drive
Connecting and Operating a Schmitt Trigger-Controlled TRIAC AC Motor Drive
Troubleshooting a TRIAC Motor Drive
Demonstrating PWM Principles
Troubleshooting a PWM DC Motor Drive

ELECTRONIC TIMERS JM-POWR-EB04
Locating Timer Pins
Verifying a Monostable Timer Circuit
Connecting and Operating a 555 Timer in Monostable Mode
Verifying an Astable Timer Circuit
Connecting and Operating a 555 Timer in Astable Mode
Verifying a Pulse Train Circuit
Connecting and Operating an Electronic Pulse Train

STEPPER MOTOR DRIVES JM-POWR-EB05
Identifying Detent Torque
Confirming Stepper Motor Step Angle
Demonstrating Stepper Motor Step Angle
Locating Diodes and Symbols
Confirming Stator Winding Connections
Demonstrating Unipolar Stepper Motor Drive
Installing, Connecting and Monitoring a Stepper Motor Drive
Testing and Troubleshooting a Basic Stepper Motor Drive

SERVO MOTOR DRIVES JM-POWR-EB06
Demonstrate Closed-Loop Servo Motor Control Principles
Connecting and Operating a Servo Motor Drive
Install, Connect and Monitor a Basic Servo Motor Drive
Testing and Troubleshooting a Basic Servo Motor Drive

MECHANICAL WORKBENCH

BASIC MACHINES JM-MBLM-ME01
Introduction to Basic Machines
Measurement
Torque
Work
Power
Horsepower
Friction
Velocity
Acceleration
Mass and Inertia
Energy
Mechanical Advantage
Inclined Planes
Wedges
Screws
Levers
Wheels and Axes
Pulleys

MACHINE STATICS AND DYNAMICS JM-MBLM-ME02
Identify Stress, Strain & Combined Stresses
Identify Material Fatigue & Fatigue Stress Points
Identify Fatigue Failure & Failure Modes
Machine Shafts and Keys — JM-MBLM-ME03
Measuring & Verifying Shafts
Demonstrating Shaft Expansion Principles
Measuring Eccentricity & Shaft Runout
Demonstrating Shaft Key Principles
Preparing a Key from Keystock
Shaft Troubleshooting & Failure Analysis

BEARINGS JM-MBLM-ME04
Identifying Bearing Types
Reading Bearing Dimensions
Mounting Bearing Housings
Reading a Tolerance Chart
Bearing Troubleshooting & Failure Analysis

BELT DRIVES JM-MBLM-ME05
Demonstrating Belt Drive Ratio Principles
Installing Belt Drives
Aligning a Belt Drive
Belt Tensioning
Installing Adjustable Speed Sheaves
Installing Positive Drive Systems
Belt Troubleshooting & Maintenance

CHAIN DRIVES JM-MBLM-ME06
Demonstrating Roller Chain & Sprocket Principles
Sizing Chain
Installing & Aligning Sprockets
Installing Chain Drives
Adjusting Slack
Chain Troubleshooting & Maintenance

MACHINE SHAFT COUPLINGS JM-MBLM-ME07
Identifying Shaft Couplings
Correcting Soft Foot
Aligning Shafts
Aligning Rims & Faces
Connecting Chain Couplings
Connecting Universal Joints

GEAR DRIVES JM-MBLM-ME08
Demonstrating Gear Measurement Principles
Installing a Worm Gear Drive
Installing a Spur Gear Drive
Measuring Backlash
Installing a Helical Gear Drive
Installing a Bevel Gear Drive
Maintaining & Troubleshooting Gear Drives

MACHINE SPEED REDUCERS JM-MBLM-ME09
Demonstrating Basic Speed Reducer Principles
Selecting a Speed Reducer
Maintaining & Troubleshooting Speed Reducers

ELECTRIC BRAKES JM-MBLM-ME10
Operating Electric Brakes
Installing Electric Brakes
Maintaining & Troubleshooting Electric Brakes

LASER ALIGNMENT JM-MBLM-ME11
Aligning a Belt Drive
Aligning a Coupling
Correcting for Soft Foot
Filling Out an Alignment Report

VIBRATION ANALYSIS JM-MBLM-ME12
Reading a Vibration Severity Chart
Filling Out a Maintenance Log
Measuring the Vibration of a Motor
Measuring Shaft Misalignment
Troubleshooting Misaligned Shaft Vibration
Measuring Coupling Vibration
Troubleshooting Bent Shaft Vibration
Troubleshooting Defective Shaft Component Vibration
Troubleshooting Resonant Vibration
Demonstrating Vibration Source Principles

VARIABLE FREQUENCY DRIVE JM-MBLM-ME13
Install Drive
Rough-in Drive Wiring
Megger Test VFD Wires
Program and Test Drive

BEARING MAINTENANCE JM-MBLM-ME13
Identifying Anti-Friction Bearings
Identifying Plain Bearings
Using an Arbor Press
Using a Bearing Puller
Installing and Removing Bushings
Using a Grease Gun
Loading a Grease Gun
Greasing a Pillow Block
Hand Packing a Bearing
Using a Bearing Packer
Demonstrating Bearing Seal Principles
Performing Bearing Failure Analysis

ELECTRO MECHANICAL MAINTENANCE CELL

BASIC MAINTENANCE CELL JM-EMMC-ZA01
CELL
Assemble the Base
Assemble & Install the Conveyor Mount Support
Assembly
Install Pull Box, End and Feeder Tube Supports
Install Crossbars and Top Members
Assembly & Align Completed Frame
ENCLOSURES
Install Load Center
Install Cable Trays
Install Wireway
Install Pull Boxes
Install Equipment Enclosures
Install Safety Disconnects
Install Fuse Box and Station Transformer
CONDUIT & FITTINGS
Cut and Ream Conduit
Install Flexible Metal Conduit
Install EMT Conduit
LOW VOLTAGE & CIRCUIT PROTECTION
Wire & Connect Main Power Cord
Install & Connect Circuit Breakers
Install Equipment Grounds
Wire Fuse Box
Wire Station Transformer
Perform Megohmmeter Tests

CONVEYOR, DRIVE AND CONTROL JM-EMMC-ZA02
CONVEYOR
Install Conveyor Drive
Install Conveyor Drive Components
Install and Align Conveyor Drive Chain
Conveyor Drive Safety Guard

CONVEYOR CONTROLS
Install and Connect Conveyor Drive Controls
Install Emergency Stop Circuits
Perform Circuit Continuity Tests
Megger Test Conveyor Drive
Test and Troubleshoot Conveyor Drive
PREDICTIVE/PREVENTIVE MAINTENANCE
Lubricate Conveyor Drive
Verify Conveyor Alignment
Verify Drive Chain Alignment
Obtain Vibration Profiles

PART MANIPULATOR JM-EMMC-ZA03
PART MANIPULATION
Install Part Stacker and Feeder Tray
Install Part Kicker
Install Stacker Part Sensor
PAINT, BAKE AND COOL TUNNEL
Install Paint Bake Heaters
Install Paint Sensor
Install Cool Down Blower
Install Part Count Sensor
Install Paint Tunnel Status Indicators
PROGRAMMABLE LOGIC CONTROLLER (PLC)
Install PLC
Rough-in PLC power
Program PLC
Connect PLC input Sensor Circuits
Connect PLC Output Device Circuits
Troubleshoot Paint, Bake & Cool System

INDUSTRIAL LIGHTING JM-EMMC-ZA04
INDUSTRIAL LIGHTING CIRCUITS
Install Fluorescent Task Lighting
Install Low Bay Lighting
Install High Bay Lighting
Install Flood Lighting
Install Hazardous Location Lighting
Install Emergency Lighting
Rough-in Wiring Lighting Circuits
Megger Test Lighting Circuits
INDUSTRIAL POWER CIRCUITS
Install Wiring Devices
Rough-in Wiring Device Circuits
Megger Test Power Circuits
Install & Wire Lighting Control
Install and Test GFCI Circuit
Troubleshoot Lighting and Power System

VARIABLE FREQUENCY DRIVE JM-EMMC-ZA05
Install Drive
Rough-in Drive Wiring
Megger Test VFD Wires
Program and Test Drive

DC MOTOR AND DRIVE JM-EMMC-ZA06
Measure and Remove AC Motor
Install DC motor
Install DC Drive
Rough-in DC Drive Wiring
Set Up and Test DC Drive (Manual - jumpers)
Program DC Drive
Troubleshoot DC Drive System

FAULT INSERTION SYSTEM JM-EMMC-ZA07
Install fault insertion sub panel
Rough-in power circuit
Rough-in fault insertion wiring
Install and configure triggered faults
Install triggered fault system
Test triggered fault system
Troubleshoot gas furnace