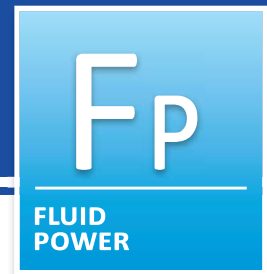


Basic Fluid Power Learning System – Double Sided A-Frame Bench with One Hydraulic Manifold

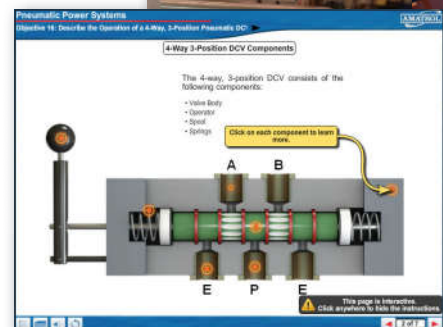
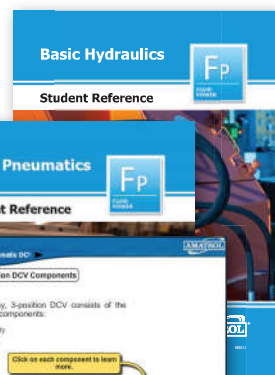
850-CD2



850-CD2 Shown with Optional 85-EF



850-CD2 (Back) w/ Optional Panels



Interactive Multimedia and Student Reference Guides

Learning Topics:

- Hydraulic Power Systems
- Basic Hydraulic Circuits
- Principles of Hydraulic Pressure and Flow
- Hydraulic Speed Control
- Pressure Control Circuits
- Pneumatic Power Systems
- Basic Pneumatic Circuits
- Principles of Pneumatic Pressure and Flow
- Pneumatic Speed Control Circuits
- Flow Control Valves

Amatrol's Basic Fluid Power Learning System – Double Sided A-Frame Bench with One Hydraulic Manifold (850-CD2) maximizes training space for teaching industrial pneumatic and hydraulic skills. The 850-CD2 allows customers to combine up to three additional single panel learning systems with the included set of Basic Hydraulic Learning System (85-BH) panels and Basic Pneumatics Learning System (85-BP) panels.

With this system, you can expand the base hydraulics system to include the intermediate, advanced, or electro-fluid power system. Optionally, you could expand the basic pneumatics system to include the intermediate or advanced pneumatics system or add an additional basic pneumatic system to create a three station training system. The 850-CD2 demonstrates fundamental fluid power principles like pressure and flow by introducing industry-relevant hydraulic and pneumatic skills.

In addition to the 85-BH and 85-BP, the 850-CD2 includes a controls technology workbench, a 2.5 GPM/500 psi hydraulic power unit, student curriculum, a student reference guide, and much more! This learning system features standard industrial-grade components and provides learners with real-world experience they would normally only attain on the job.



Technical Data

Complete technical specifications available upon request.

A-Frame Double Sided Controls Technology Bench
Hydraulic Power Supply (85-HPS)
Basic Hydraulic Actuator
Basic Hydraulic Valves
Basic Hydraulic Instrumentation Panel
Hydraulic Hose and Fittings Package (85-HHF)
Basic Pneumatics Actuator/Valve Panel
Basic Pneumatics Instrumentation Panel
Pneumatic Hose and Fittings Package (85-PHF)
Bench Manifold Kit (16141)
Student Curricula (BB831 & BB834)
Teacher's Assessment Guide (CB831 & CB834)
Installation Guide (DB831 & DB834)
Student Reference Guide (HB831 & HB834)

Additional Requirements:

Hydraulic oil (16391) or equivalent
Hand Tool Package (41220) or equivalent

Optional Learning Systems:

Up to (3) three single panel pneumatic or hydraulic learning systems

Utilities

Pneumatic power supply or conditioned (dry and filtered) shop air (2 CFM @ 100 PSIG/0.06cm³ @ 690 kPa)
Electric (110V/60Hz/1Ph)

Maximize Your Available Training Area!

The 850-CD2 optimizes both limited training space and the ability for customers to configure the system with the hydraulic and pneumatic panels that fit their needs. Panels can be easily removed and repositioned as necessary to facilitate the completion of the learner's tasks. The 850-CD2 is equipped with a hose storage rack on one side that contains all the hoses needed to perform the required hydraulic skills. Also for hydraulic applications, the included hydraulic power unit provides hydraulic fluid flow where learners practice skills such as connecting and actuating basic hydraulic circuits.



Double-Sided for Maximum Use of Training Area

Curriculum with a Strong Offering of Hydraulic and Pneumatic Skills and Concepts

The 850-CD2 features both basic hydraulic and pneumatic curriculum. Within hydraulics, learners will study about the physical principles of hydraulics and how hydraulic mechanisms are used in real world applications. From this building block, learners begin constructing hydraulic circuits, which gradually increase in difficulty and number of industry-standard components as the curriculum goes along. Basic pneumatics follows this same approach, beginning with an explanation of pneumatic power and basic cylinder circuits before advancing to topics like pressure and flow, pneumatic leverage, pneumatic speed control circuits, and air flow control and measurement. In addition to the printed curriculum, Amatrol offers an optional version presented in an interactive multimedia format. This format includes all of the text from the printed material with the addition of audio narrative, colorful 3D animations, video, and interactive quizzes and exercises.



Optional Interactive Multimedia

Optional Hydraulic & Pneumatic Systems Available

The 850-CD2 is also flexible to the needs of a customer that wants to create their own combination of systems, such as intermediate (85-IH) and advanced (85-AH) level hydraulics and intermediate (85-IP) and advanced (85-AP) level pneumatics. The 850-CD2 storage areas allow learners to move panels under the system so that they can focus only on pneumatics or hydraulics or a combination of both.



85-IP



Student Reference Guide

Sample copies of the Basic Hydraulic and Basic Pneumatics Student Reference Guides are included with the learning system. Sourced from the multimedia curricula, these Student Reference Guides take the entire series' technical content contained in the learning objectives and combines them into perfect-bound books.



BASIC FLUID POWER LEARNING SYSTEM – DOUBLE SIDED A-FRAME BENCH WITH ONE HYDRAULIC MANIFOLD

This system provides for both hydraulics and pneumatics training. This system is equipped with one set of Basic Hydraulic Learning System (85-BH) panels and a Basic Pneumatics Learning System (85-BP). This system is comprised of standard industrial-grade components to provide real-world experience. Components include:

- **A-Frame Double Sided Controls Technology Bench**
 - Welded-steel frame construction for durability
 - Heavy duty lockable casters for mobility
 - Slide-in storage racks for both circuit panel and instrumentation modules to allow easy storage
 - Mounting slots for three instrumentation modules

- **Hydraulic Power Supply**
 - This unit shall be completely assembled, plumbed, wired and tested to provide a minimum of 2.3 GPM / 8.7 LPM flow at 0 PSI / kPa. Maximum continuous system operating pressure shall be 500 PSI / 3450 kPa. The minimum features shall include:
 - Pump, fixed gear type
 - Electric motor, 1725 rpm, 1 hp, 115 VAC, 60 Hz/ 230 VAC/ 50 Hz, 1 phase
 - Reservoir, 5 gal./19 Liters
 - Suction filter, strainer type
 - Relief valve, pilot-operated type
 - Filler-Breather cap
 - Pressure Gauge, 2 in. size, 0-1000 PSI, liquid filled, with safety relief
 - Electric motor starter, with start and stop pushbuttons
 - Power cord
 - Oil level gauge with temperature gauge

- **Basic Hydraulic Valves**
 - Each panel shall include:
 - Directional Control Valve, 3-position, lever-operated, closed center
 - Needle Valve
 - Pilot-Operated Relief/Sequence Valve
 - Pressure Reducing Valve
 - Check Valves, one with fitting tees
 - 13-Hoses with quick-connect fittings
 - Open end male quick-connect fittings
 - Quick connect tees
 - Return Manifold, 4 port with hose
 - Supply Manifold, 4 port with hose
 - Shutoff valve

- **Basic Hydraulic Actuators**

- Each panel shall include:
 - Double Acting Cylinder, 1 1/8" bore x 6" stroke, with cam
 - Double Acting Cylinder, 1 1/2" bore x 4" stroke, with cam
 - Hydraulic Motor, with flywheel
 - Flow controls, needle-valve type with integral reverse free-flow check valve
 - Linear Load Device, providing friction, compression and tension, with high impact resistance transparent guard
 - Limit Switch Mounting Tracks positioned for cylinder cam operation
- **Basic Hydraulic Instrumentation Panel**
 - Pressure gauges, 0-1000 PSI range, liquid-filled, with blow-out relief (3)
 - Flow meter, 0-5 gpm range
- **Pneumatic Instrumentation Module**
 - Pressure Gauges, 0-160 PSIG range, 2 1/2" (3)
 - Manometer, inclined, 7" H 0
 - Colored fluid concentrate
 - Rotameter, 20-200 SCFH range
 - Air Filter
 - Pressure Regulator and Gauge, 0-160 PSIG range
 - Supply Manifold, 4-port with quick connects
 - Quick connect supply connection, Industrial Interchange
 - Supply Shutoff Valve
- **Basic Pneumatic Module**
 - Directional Control Valve, 3-position, 5-ported/4-way, spring centered, closed center, transparent
 - Cylinder, double-acting, 1 1/8" bore, 6" stroke, with cam
 - Cylinder, double-acting, 1 1/2" bore, 4" stroke, with cam
 - Cylinder, single-acting, 3/4" Bore, 1" Stroke, spring return, transparent
 - Air Motor, vane-type
 - Motor load device
 - Flow Controls, with integral reverse free-flow check valve (2)
 - Flexible hoses, 1/8" I.D., polyurethane, transparent (13)
 - Limit Switch Mounting Tracks positioned for cylinder cam operation (2)
 - Fitting tees (2)
 - Fitting Cross
- **Hose Rack**
- **Hydraulic Hose and Fittings Packages**
- **Bench Manifold Kit**

- **Pneumatic Hose and Fittings Package**

Student Curriculum

The student curriculum shall consist of (1) set of 9 Learning Activity Packets with 68 skills in basic pneumatic and hydraulic systems. The topics shall include: pneumatic power systems; basic pneumatic circuits; principles of pneumatic pressure and flow; and pneumatic speed control circuits; basic hydraulic principles, Pascal's law, reading flow and pressure gages, pump operation, power unit start-up and adjustment, connection of basic hydraulic circuits, interpretation of schematic diagrams, sizing of cylinders, control of speed, sequence circuits, pressure reducing circuits, calculation of hydraulic and pneumatic cylinder speed, meter-in circuits, meter-out circuits, and independent speed control circuits.

The student curriculum shall be designed in a skill-based format that focuses on teaching industry- relevant tasks. The objectives shall be accomplished by organizing the learning material into a series of learning activity packets, which are further subdivided into three or more segments per packet. All learning material needed shall be contained in the packets including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. The specific cognitive skills taught by each text passage shall be identified next to the passage. Each lab activity shall be identified by the industrial task taught. All activities shall be highly detailed with step-by-step instructions to facilitate a self-directed learning environment. A combination of step-by-step enabling activities and creative, problem-solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment. The curriculum must be capable of both self-directed and instructor directed study. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams.

Teacher's Assessment/ Portfolio Guides

A teacher's guide shall be provided. It shall contain student data sheets, data sheet solutions, self-review answers, quizzes, quiz answers, student skill record sheets, and authentic assessment. A quiz shall be provided for each packet. A question shall be provided in each quiz for each cognitive objective taught. All tasks listed in the packet shall be listed on personalized student record sheets. The Instructor's Package shall include directions for authentic skill assessment.

Amatrol Model No. 850-CD2 or equal

850-CD2
BASIC FLUID POWER LEARNING SYSTEM – DOUBLE SIDED BENCH

B831-XA LAP 1 HYDRAULIC POWER SYSTEMS

SEGMENT 1	INTRODUCTION TO HYDRAULICS
OBJECTIVE 1	Define hydraulics and give an application
Activity 1	Video on fluid power
OBJECTIVE 2	Describe the functions of five basic components of a hydraulic system
Activity 2	Hydraulic Trainer Component Identification
OBJECTIVE 3	Define hydraulic pressure and give its units of measurement
SKILL 1	Read a hydraulic pressure gauge
SEGMENT 2	POWER UNIT OPERATION
OBJECTIVE 4	Describe the operation of a hydraulic power unit
Activity 3	Identification of 850 power unit components
Activity 4	Video on hydraulic trainer operation
SKILL 2	Read the liquid level and temperature in the reservoir
SKILL 3	Operate a hydraulic power unit
SEGMENT 3	CIRCUIT CONNECTIONS
OBJECTIVE 5	Describe the function of a hydraulic schematic
OBJECTIVE 6	Describe the function of a hydraulic quick disconnect fitting and give its schematic symbol
SKILL 4	Connect and disconnect a hydraulic hose that uses quick-connect fittings
OBJECTIVE 7	Describe the function of a tee and give its schematic symbol
SKILL 5	Use a tee to connect two circuit branches together
OBJECTIVE 8	Describe the operation of a pressure gauge and give its schematic symbol
SEGMENT 4	BASIC CYLINDER CIRCUITS
OBJECTIVE 9	Describe the function of a hydraulic cylinder and give an application
OBJECTIVE 10	Describe the operation of a double-acting hydraulic cylinder and give its schematic symbol
Activity 5	Basic operation of a double-acting cylinder
OBJECTIVE 11	Describe the function of a 4-way, 3-position DCV and give an application
OBJECTIVE 12	Describe the operation of a 4-way, 3-position DCV and give its schematic symbol
Activity 6	Flow paths of a 4-way, 3-position DCV
SKILL 6	Connect and operate a double-acting hydraulic cylinder using a 3-position, manually-operated DCV
SKILL 7	Design a dual cylinder hydraulic circuit

B831-XA LAP 2 BASIC HYDRAULIC CIRCUITS

SEGMENT 1	PUMPS
OBJECTIVE 1	Define flow rate and explain how it can be measured
OBJECTIVE 2	Describe the operation of two types of flowmeters and give their schematic symbol
SKILL 1	Connect and read a flow meter
Activity 1	Flowmeter accuracy
OBJECTIVE 3	Describe the operation of a fixed-displacement pump and give its schematic symbol
Activity 2	Fixed-displacement pump operation

OBJECTIVE 4	Describe the operation of three types of fixed displacement pumps and give an application of each
SEGMENT 2	NEEDLE VALVES
OBJECTIVE 5	Describe the main function of a needle valve
OBJECTIVE 6	Describe the operation of a needle valve and give its schematic symbol
Activity 3	Needle valve operation
SKILL 2	Connect and operate a needle valve to control the speed of an actuator
SKILL 3	Control the speed of an actuator using a manually-operated DCV
SEGMENT 3	BASIC MOTOR CIRCUITS
OBJECTIVE 7	Describe the function of a hydraulic motor and give an application
OBJECTIVE 8	Describe the operation of a hydraulic motor and give its schematic symbol
SKILL 4	Connect and operate a bi-directional hydraulic motor using a 3-position, manually-operated DCV
OBJECTIVE 9	List three types of hydraulic motors and give an application of each
SEGMENT 4	HYDRAULIC SCHEMATICS
OBJECTIVE 10	Describe eight basic rules for drawing hydraulic schematics
SKILL 5	Draw a hydraulic schematic from the actual circuit connections on a pictorial
SKILL 6	Draw a hydraulic circuit given a schematic
SKILL 7	Design a multiple actuator hydraulic circuit

B831-XA LAP 3 PRINCIPLES OF HYDRAULIC PRESSURE AND FLOW

SEGMENT 1	PRESSURE VS. CYLINDER FORCE
OBJECTIVE 1	Describe how to calculate the force output of an extending cylinder
SKILL 1	Calculate the extension force of a cylinder given its size and pressure
SKILL 2	Measure the force output of an extending cylinder
OBJECTIVE 2	Describe how to calculate the force output of a hydraulic cylinder in retraction (pull)
SKILL 3	Calculate the retraction force of a cylinder given its size and pressure
SKILL 4	Measure the force output of a retracting cylinder
SEGMENT 2	HYDRAULIC LEVERAGE
OBJECTIVE 3	State Pascal's Law and explain its significance in hydraulics
Activity 1	Verification of Pascal's Law for hydraulics
OBJECTIVE 4	Explain how force is multiplied using Pascal's Law
Activity 2	Demonstrate how distance is sacrificed to obtain force multiplication
SEGMENT 3	FLUID FRICTION
OBJECTIVE 5	Describe two types of resistance in a hydraulic system
OBJECTIVE 6	Explain how Delta P describes hydraulic resistance
SKILL 5	Measure Delta P across a hydraulic component
Activity 3	Effect of flow and orifice size on Delta P
OBJECTIVE 7	Explain how pressure is distributed in a hydraulic system
Activity 4	Characteristics of circuit pressure drops
SEGMENT 4	ABSOLUTE VS. GAUGE PRESSURE
OBJECTIVE 8	Describe two methods of representing hydraulic pressure
SKILL 6	Convert between absolute pressure and gauge hydraulic pressure
OBJECTIVE 9	Describe how oil flows on the suction side of the pump

B831-XA LAP 4 **HYDRAULIC SPEED CONTROL**

SEGMENT 1	RELIEF VALVES
OBJECTIVE 1	Describe the function of a relief valve and give an application
OBJECTIVE 2	Describe the operation of a direct-acting relief valve and give its schematic symbol
OBJECTIVE 3	Describe how a relief valve is used for system protection
SKILL 1	Connect a relief valve in a circuit to limit pressure in the system
OBJECTIVE 4	Describe how a relief valve is used for speed control assistance
Activity 1	Relief valve operation with speed control
SEGMENT 2	CHECK VALVES
OBJECTIVE 5	Describe the function of a check valve and give an application
OBJECTIVE 6	Describe the operation of three types of check valves and give their schematic symbol
Activity 2	Check valve operation
SKILL 2	Design a circuit to provide bypass flow
SEGMENT 3	FLOW CONTROL VALVES
OBJECTIVE 7	Describe the function of the flow control valve and give an application
OBJECTIVE 8	Describe the operation of a flow control valve and give its schematic symbol
SKILL 3	Connect and adjust a flow control valve to control speed of an actuator
OBJECTIVE 9	Describe the effect of actuator load changes on flow control valve operation
Activity 3	Effect of actuator load changes on flow control valve operation
SEGMENT 4	METER-IN AND METER-OUT CIRCUITS
OBJECTIVE 10	Describe the operation of a meter-in flow control circuit and give an application
SKILL 4	Connect and operate a meter-in flow control circuit
OBJECTIVE 11	Describe the operation of a meter-out flow control circuit and give an application
SKILL 5	Connect and operate a meter-out flow control circuit
SEGMENT 5	FLOW CONTROL CIRCUIT DESIGN
OBJECTIVE 12	Define independent speed control and give an application
SKILL 6	Design an independent speed control circuit
OBJECTIVE 13	Explain how speed control valves can be used to provide multiple speeds
SKILL 7	Design a two-speed actuator circuit
SEGMENT 6	FLOW RATE VS. CYLINDER SPEED
OBJECTIVE 14	Describe how to calculate the extend speed of a hydraulic cylinder
SKILL 8	Calculate the extend speed of a hydraulic cylinder given its size and a flow rate
OBJECTIVE 15	Describe how to calculate the retract speed of a cylinder
SKILL 9	Calculate the retract speed of a cylinder given its size and a flow rate
OBJECTIVE 16	Describe how to calculate the stroke time of a cylinder
SKILL 10	Calculate the cylinder stroke time given its size and a flow rate

B831-XA LAP 5 **PRESSURE CONTROL CIRCUITS**

SEGMENT 1	SEQUENCE VALVES
OBJECTIVE 1	Describe the function of a pressure sequence valve and give an application

OBJECTIVE 2	Describe the operation of a direct-acting sequence valve and give its schematic symbol
SKILL 1	Connect and adjust the pressure setting of a sequence valve
SKILL 2	Connect and operate a pressure sequence circuit
SEGMENT 2	SEQUENCE VALVE APPLICATIONS
OBJECTIVE 3	Describe the function of a bypass check valve in a sequence valve circuit
Activity 1	Sequence valve operation with a check valve
OBJECTIVE 4	Describe the operation of an integral check valve and give its schematic symbol
SKILL 3	Design a pressure sequence circuit
OBJECTIVE 5	Describe the function of a two-sequence valve control circuit
SKILL 4	Design a two-sequence valve control circuit
OBJECTIVE 6	Explain why a sequence valve is externally drained
SEGMENT 3	PRESSURE REDUCING VALVES
OBJECTIVE 7	Describe the function of a pressure reducing valve and give an application
OBJECTIVE 8	Describe the operation of a direct-acting PRV and give its schematic symbol
SKILL 5	Connect and adjust the pressure setting of a PRV
SKILL 6	Connect and operate a reduced pressure circuit
SEGMENT 4	PRV APPLICATIONS
OBJECTIVE 9	Describe the function of a PRV's bypass check valve
Activity 2	PRV operation with a check valve
SKILL 7	Design a hydraulic circuit that uses a pressure reducing valve
OBJECTIVE 10	Explain why a PRV is externally drained
Activity 4	PRV drain operation

B834-BA LAP 1 PNEUMATIC POWER SYSTEMS

SEGMENT 1	INTRODUCTION TO PNEUMATICS
OBJECTIVE 1	Define pneumatics and give an application
OBJECTIVE 2	Describe the functions of basic components of a pneumatic system
Activity 1	Pneumatic trainer
OBJECTIVE 3	Define pneumatic pressure and give its units of measurement
SKILL 1	Read a pneumatic pressure gauge
OBJECTIVE 4	Describe the function of a pneumatic schematic
SEGMENT 2	PNEUMATIC POWER
OBJECTIVE 5	Explain six pneumatic safety rules
Activity 2	Video on pneumatic trainer operation
OBJECTIVE 6	Describe the function of a pressure regulator valve and give an application
OBJECTIVE 7	Describe the operation of a pressure regulator and give its schematic symbol
SKILL 2	Connect and adjust a pressure regulator
OBJECTIVE 8	Describe the function of an air filter
OBJECTIVE 9	Describe the operation of an air filter and give its schematic symbol
SKILL 3	Drain a pneumatic filter
SEGMENT 3	CIRCUIT CONNECTIONS
OBJECTIVE 10	Describe the function of a pneumatic quick-connect fitting and give its schematic symbol
SKILL 4	Connect a pneumatic hose that uses quick-connect fittings
OBJECTIVE 11	Describe the function of a tee and a cross and give their schematic

- symbols
- SKILL 5 Use a tee to connect two circuit branches together
- SKILL 6 Use a cross to connect three circuit branches together

SEGMENT 4 BASIC CYLINDER CIRCUITS

- OBJECTIVE 12 Describe the function of a pneumatic cylinder and give an application
- OBJECTIVE 13 Describe the operation of a double-acting pneumatic cylinder and give its schematic symbol
- Activity 3 Basic operation of a double-acting cylinder
- OBJECTIVE 14 Describe the function of a 4-way, 3-position pneumatic DCV and give an application
- OBJECTIVE 15 Describe the operation of a 4-way, 3-position pneumatic DCV and give its schematic symbol
- SKILL 7 Connect and operate a double-acting pneumatic cylinder using a 3-position, manually-operated DCV
- SKILL 8 Design a multiple cylinder pneumatic circuit

B834-BA LAP 2 BASIC PNEUMATIC CIRCUITS

SEGMENT 1 SINGLE-ACTING CYLINDER CIRCUITS

- OBJECTIVE 1 Describe the function of a single-acting pneumatic cylinder and give an application
- OBJECTIVE 2 Describe the operation of a single-acting, spring-return cylinder and give its schematic symbol
- Activity 1 Basic operation of a single-acting, spring-return cylinder
- OBJECTIVE 3 Describe the function of a 3/2 pneumatic DCV and give an application
- OBJECTIVE 4 Describe the operation of a 3/2 pneumatic DCV and give its schematic symbol
- SKILL 1 Connect and operate a single-acting pneumatic cylinder using a 3/2 manually-operated DCV

SEGMENT 2 BASIC MOTOR CIRCUITS

- OBJECTIVE 5 Describe the function of a pneumatic motor and give an application
- OBJECTIVE 6 Describe the operation of a pneumatic motor and give its schematic symbol
- SKILL 2 Connect and operate a unidirectional pneumatic motor using a 3-way, manually-operated DCV
- OBJECTIVE 7 Describe the function of a muffler and give its schematic symbol
- Activity 2 Air muffler operation
- OBJECTIVE 8 List three common pneumatic motor designs and explain where they are used

SEGMENT 3 PNEUMATIC SCHEMATICS

- OBJECTIVE 9 Describe the line symbols used with fluid power circuits
- SKILL 3 Identify pneumatic symbols
- OBJECTIVE 10 Describe seven basic rules for drawing pneumatic schematics
- SKILL 4 Draw a pneumatic schematic from the actual circuit connections on the machine
- SKILL 5 Connect a pneumatic circuit given a schematic
- SKILL 6 Design a multiple actuator pneumatic circuit

B834-BA LAP 3 PRINCIPLES OF PNEUMATIC PRESSURE AND FLOW

SEGMENT 1 PRESSURE VS. CYLINDER FORCE

OBJECTIVE 1	Describe how to calculate the force output of an extending cylinder
SKILL 1	Calculate the extension force of a cylinder given its size and pressure
SKILL 2	Measure the force output of an extending cylinder
OBJECTIVE 2	Describe how to calculate the force output of a cylinder in retraction (pull)
SKILL 3	Calculate the retraction force of a cylinder given its size and pressure

SEGMENT 2

PNEUMATIC LEVERAGE

OBJECTIVE 3	State Pascal's Law and explain its significance in pneumatics
Activity 1	Verification of Pascal's Law
OBJECTIVE 4	Explain how force is multiplied using Pascal's Law
Activity 2	Demonstrate how distance is sacrificed to obtain force multiplication

SEGMENT 3

PRESSURE AND VOLUME

OBJECTIVE 5	Describe two methods of representing pressure
SKILL 4	Convert between gauge and absolute pressures
OBJECTIVE 6	Explain how air pressure is created in a pneumatic system
OBJECTIVE 7	State Boyle's Law and explain its significance
SKILL 5	Use Boyle's Law to calculate changes in pressure and volume
Activity 3	Verification of Boyle's Law

SEGMENT 4

AIR FLOW AND RESISTANCE

OBJECTIVE 8	Explain how a pneumatic system creates air flow
OBJECTIVE 9	Describe two types of resistance in a pneumatic system
OBJECTIVE 10	Explain how Delta P describes pneumatic resistance and explain its importance
SKILL 6	Measure Delta P across pneumatic components
OBJECTIVE 11	Describe what determines the speed of a pneumatic actuator
Activity 4	Effect of pressure on pneumatic actuator speed

B834-BA LAP 4 PNEUMATIC SPEED CONTROL CIRCUITS

SEGMENT 1

AIR FLOW CONTROL AND MEASUREMENT

OBJECTIVE 1	Describe the main function of a pneumatic needle valve and give an application
OBJECTIVE 2	Describe the operation of a needle valve and give its schematic symbol
SKILL 1	Connect and operate a needle valve to control actuator speed
OBJECTIVE 3	Define air flow rate and give its units of measurement
SKILL 2	Convert air volumes at pressures to free air volumes
OBJECTIVE 4	Describe the function of a flowmeter and give an application
OBJECTIVE 5	Describe the operation of a rotameter and give its schematic symbol
SKILL 3	Connect and read a flowmeter

SEGMENT 2

FLOW CONTROL VALVES

OBJECTIVE 6	Describe the function of a pneumatic check valve and give an application
OBJECTIVE 7	Describe the operation of two types of pneumatic check valves and give their schematic symbol
SKILL 4	Connect and operate a check valve
OBJECTIVE 8	Describe the function of the flow control valve and give an application
OBJECTIVE 9	Describe the operation of a flow control valve and give its schematic symbol
SKILL 5	Connect and adjust a flow control valve to control speed of an actuator
OBJECTIVE 10	Describe the effect of actuator load changes on flow control operation
Activity 1	Effect of actuator load changes on flow control valve operation

SEGMENT 3

SPEED CONTROL

OBJECTIVE 11	Describe the operation of a meter-in flow control circuit and give an application
SKILL 6	Connect and operate a meter-in flow control circuit
OBJECTIVE 12	Describe the operation of a meter-out flow control circuit and give an application
SKILL 7	Connect and operate a meter-out flow control circuit
OBJECTIVE 13	Describe the operation of an exhaust port speed control and give an application
SKILL 8	Connect and operate an exhaust port speed control circuit
OBJECTIVE 14	Describe the operation of a pressure port speed control and give an application
SKILL 9	Connect and operate a pressure port speed control circuit
SKILL 10	Design speed control circuits
OBJECTIVE 15	Define independent speed control and give an application
SKILL 11	Design an independent speed control circuit