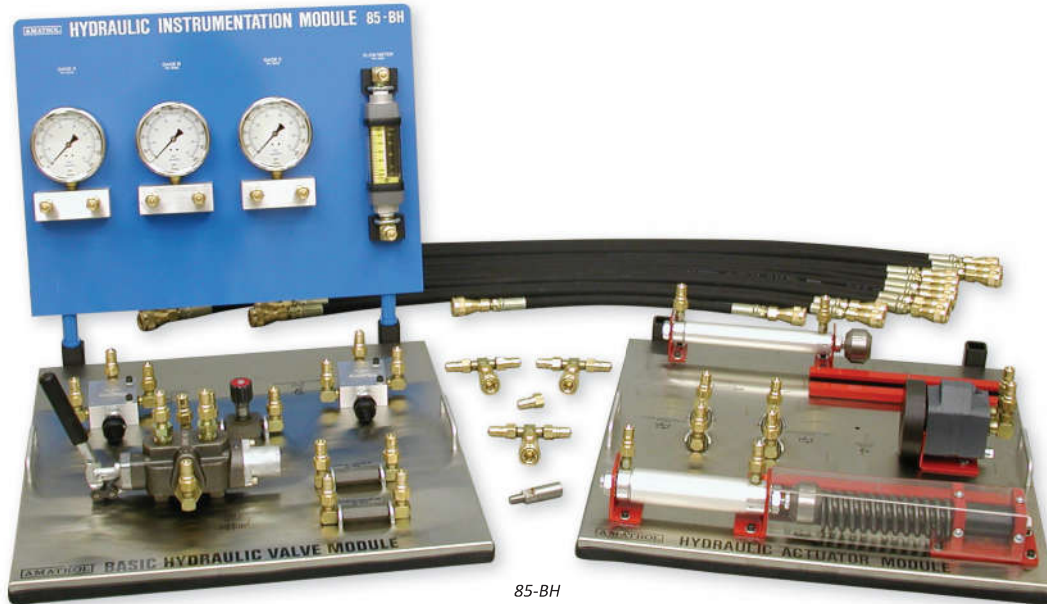


Basic Hydraulics Learning System

85-BH

Fp

FLUID
POWER



Interactive Multimedia and Student Reference Guide

Learning Topics:

- Hydraulic Power Systems
- Circuit Connections
- Basic Hydraulic Circuits
- Hydraulic Schematics
- Principles of Hydraulic Pressure and Flow
- Fluid Friction
- Hydraulic Speed Control
- Flow Control Valves
- Pressure Control Circuits
- Pressure Reducing Valves

Because hydraulic power is used in everything from automotive brakes to industrial robots, the skills taught by the 85-BH Basic Hydraulics System can open the doors to careers in various fields, such as manufacturing, transportation, agricultural, and construction. The 85-BH introduces the fundamentals of hydraulic principles, such as pressure and flow, while simultaneously teaching industry-relevant hydraulic skills; this signature Amatrol approach to curriculum reinforces both theory and practice, which produces a well-rounded understanding of the topic. As an example, after completing this training system, learners will not only be able to operate, install, design, and troubleshoot basic hydraulics for various applications, but also understand concepts like flow rate versus cylinder speed and pressure versus cylinder force.

The 85-BH includes gauges, manifolds, cylinders, valves (relief/sequence, pressure reducing, check, directional control), flow meter, and hydraulic motor. These components are all industrial quality not only to ensure durability, but also to help learners become better prepared for what they will encounter on the job. All Amatrol products are made from top-notch materials and carefully crafted (hand-welded, painted, and silk-screened) to create tough, attractive, well designed learning systems that facilitate learning and will serve teachers and students for years.



Technical Data

Complete technical specifications available upon request.

Basic Hydraulic Valves Module

- Relief/Sequence Valve
- Pressure Reducing Valve Assembly
- Needle Valve Assembly
- Check Valve Assembly
- Directional Control Valve Assembly

Basic Hydraulic Actuator Module

- CAM Operators
- Double Acting Cylinder Assemblies
- Rail Assemblies

Basic Hydraulic Instrumentation Panel

- Flow Meter Assembly
- Gauge and Manifold Assembly

Hydraulic Hose and Fittings Package (85-HHF)

- 5-ft. Hose (3)
- 4-ft. Hose (6)
- 3-ft. Hose (2)
- 1.5-ft. Hose
- Open End Plug – Quick Connect
- Tee Assembly – Quick Connect

Interactive Multimedia Curriculum w/ Virtual Trainer (NB831)

Instructor's Guide (CB831)

Installation Guide (DB831)

Student Reference Guide (HB831)

Additional Requirements:

- Hydraulic Power Supply (85-HPS) or a shared power supply from Basic Fluid Power Learning System (850-C1) or Basic Hydraulics Learning System (850-H1) systems
- Satellite Manifold Kit (16137)
- Hand Tool Package (41220)
- Hydraulic Controls Technology Workstation (850-CTB-A) workstation or equivalent

Utilities:

- Electric (120 VAC/60 Hz/1 phase)

Industrial Standard Components

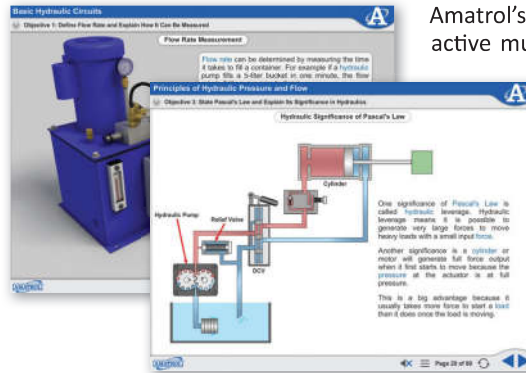
Each 85-BH system features standard industrial grade components. This attention to quality gives learners experience they would normally only get on the job by helping them recognize industrial components and how to troubleshoot them more effectively. Components included with the 85-BH are pre-mounted on circuit panels with silk-screened labels next to each, which facilitates ease of use and identification. Additionally, the system's orderly, user-friendly design helps learners to easily recognize how each component fits into a hydraulic circuit.



Hydraulic Cylinder, 1.5 inch bore and Load Spring

Real World Applications

Within the 85-BH curriculum, learners begin by studying 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. By taking this approach, learners will understand each component's function in a circuit, which makes troubleshooting easier in later lessons and on more advanced learning systems. Learners will also study about pumps, gauges, hydraulic motors, cylinders, and numerous valves, including schematic symbols for each component, creating the ability to read and draw their own hydraulic schematics.

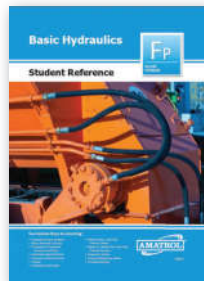


Amatrol's 85-BH's curriculum is presented in an interactive multimedia format. This format features stunning 3D animations, video, voiceovers, and interactive quizzes. This multimedia also includes the 85-BH virtual trainer that recreates hydraulic equipment in such realistic detail that learners can seamlessly transition to actual hands-on equipment.

Expanded Teaching Options

Learners can build on the skills they have acquired from the 85-BH by moving onto the intermediate (85-IH) and advanced (85-AH) Amatrol hydraulics learning systems, as well as the Electro-Hydraulics learning system (85-EH). For convenience, Amatrol offers the 85-BH as part of the 850-H1 Basic Hydraulics package, which also includes an Amatrol workstation (850-CTB) that features welded-steel frame construction for durability, lockable casters for mobility, slide-in storage racks, and the 85-HPS Hydraulic Power Unit.

Student Reference Guide



A sample copy of the Basic Hydraulics Student Reference Guide is also included with the system for your evaluation. Sourced from the system's multimedia curriculum, the Student Reference Guide takes the entire series' technical content contained in the learning objectives and combines them into one perfect-bound book.



BASIC HYDRAULICS LEARNING SYSTEM

This system introduces the fundamentals of hydraulic principles, such as pressure and flow, while simultaneously teaching industry-relevant hydraulic skills. This system requires a Hydraulic Power Supply (85-HPS) with Satellite Manifold Kit (16137), Hand Tool Package (41220), and Hydraulic Controls Technology Workstation (850-CTB-A) or equivalent or a shared power supply from one of the following:

- Basic Fluid Power Learning System - Single Surface Bench (850-C1)
- Basic Fluid Power Learning System - Double Sided A-Frame Bench with Two Hydraulic Manifolds (850-CD1)
- Basic Fluid Power Learning System - Double Sided A-Frame Bench with One Hydraulic Manifolds (850-CD2)
- Basic Hydraulics Learning System - Single Surface Bench with One Hydraulic Manifold (850-H1)
- Basic Hydraulics Learning System - Double Sided A-frame Bench with Two Hydraulic Manifolds (850-HD1)

Each module shall allow quick setup and easy inventory by providing hydraulic components pre-mounted on circuit panels; silk-screened identifications next to each component showing each component's standard symbol, description and part number; and double-check quick connect fittings. To give equipment durability and realistic exposure all components shall be 1000 PSI min. rated - industrial grade and the circuit panels shall be of welded stainless steel construction.

Provisions shall also be made to allow each module to be used on mobile workstation or as a satellite station on any standard work surface. These provisions shall include as a minimum: (2) permanent-mounted lift handles for mobility, mounting surface scuff protection, and mounting guides for the instrumentation module. The components for each module shall include as a minimum:

Basic Hydraulic Valves Panel

- Relief/Sequence Valve
- Pressure Reducing Valve Assembly
- Needle Valve Assembly
- Check Valve Assembly (2)
- Directional Control Valve Assembly

Basic Hydraulic Actuator Panel

- CAM Operator, 1 1/8-in. Bore
- CAM Operator, 1 1/2-in. Bore
- Shaft
- Load Device
- Friction Coupling
- Hydraulic Motor Assembly
- Double Acting Cylinder Assembly, 1 1/2-in. Bore
- Double Acting Cylinder Assembly, 1 1/8-in. Bore
- Flow Control Assembly (2)
- Spring, Load
- Shaft Extension
- Flywheel with Key
- Rail Assembly 11-in.
- Rail Assembly 12 3/4-in.

Basic Hydraulic Instrumentation Panel

- Flow Meter Assembly
- Gauge and Manifold Assembly (3)

Hydraulic Hose and Fitting Package (85-HFF)

- Hose Assembly 5-ft. (3)

- Hose Assembly 4-ft. (6)
- Hose Assembly 3-ft. (2)
- Hose Assembly 1 1/2-ft.
- Open End Plug – Quick Connect
- Tee Assembly – Quick Connect (3)

Student Curriculum

The student curriculum shall consist of an interactive multimedia course divided into five (5) modules covering forty (40) skills in basic hydraulic system. The topics shall include basic hydraulic principles, Pascal's law, reading flow and pressure gauges, 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 curriculum must be capable of completely self-directed and instructor-directed study.

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 interactive multimedia modules, which are further subdivided into three or more segments per module. All learning material needed shall be contained in the modules 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. 85-BH or equal

85-BH
BASIC HYDRAULICS LEARNING SYSTEM

LAP 1 HYDRAULIC POWER SYSTEMS

SEGMENT 1	INTRODUCTION TO HYDRAULICS
OBJECTIVE 1	Define hydraulics and give an application
OBJECTIVE 2	Describe the functions of five basic components of a hydraulic system
Activity 1	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 2	Identification of 850 power unit components
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-connect 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 3	Basic operation of a double-acting cylinder
OBJECTIVE 11	Describe the function of a 3-position, 4-way DCV and give an application
OBJECTIVE 12	Describe the operation of a 3-position, 4-way DCV and give its schematic symbol
Activity 4	Flow paths of a 3-position, 4-way 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

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	Flow meter 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

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

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

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
- Activity 2 Sequence valve drain operation

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 3 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