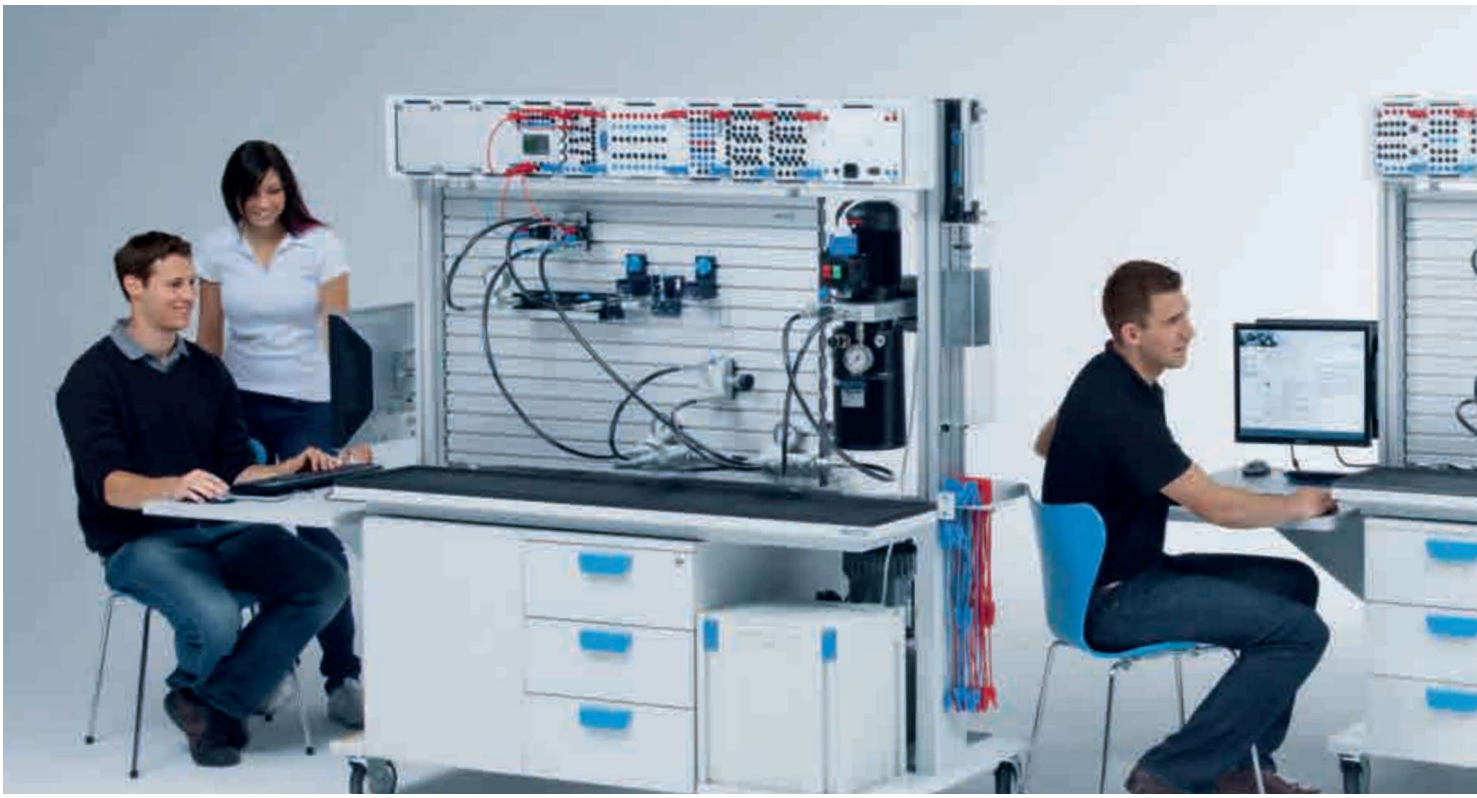
Hydraulics training packages

Tailored training in industrial and mobile hydraulics



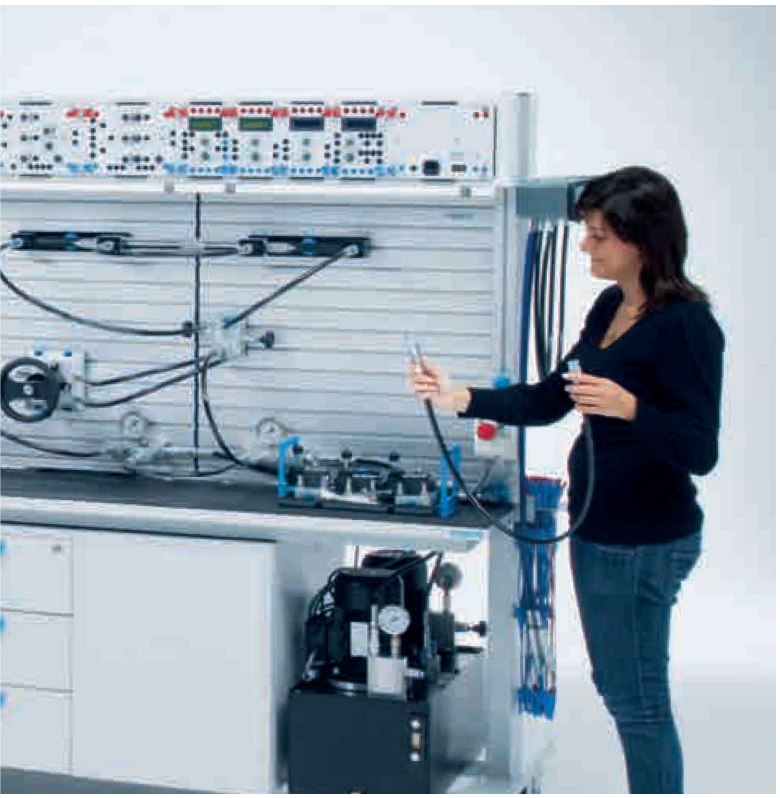
Modular for flexible expansion

Festo Didactic's training packages are modular in structure. For example, you could start with the basic level of electrohydraulics and then move onto the advanced level. Or are you more interested in electropneumatics? The choice is yours. You'd like to explore a particular specialised topic? All equipment set components can also be ordered separately, so you can turn your own ideas into reality.

Position it – clamp it – done!
With the Quick-Fix mounting system, you can mount all components easily and securely on the profile plate or on the profile column of a Learnline workstation. The electrical units are clamped into the ER frame and sequenced individually. The supports and the electrical units are the same for both hydraulics and pneumatics – a single investment, with double the functionality.

Everything where you want it – systematic storage
Most equipment sets are delivered in practical, Systainer-compatible equipment trays. This equipment tray fits in the drawers of the workstations. The large pictogram on the components, designed in accordance with the latest standards, provides clear instructions for connecting the components and ensures short preparation and follow-up times. When dismantling circuits, you can quickly and easily locate where the component goes in the equipment tray.

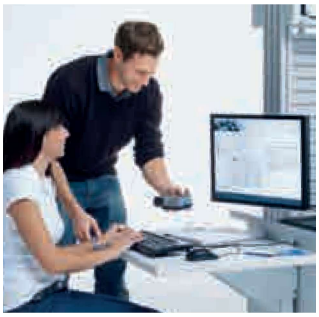
Connect it – power!
Hydraulic power is supplied by the tool-free connection of low-leakage couplings – the latest generation in high-grade stainless steel. The coupling is self-sealing when uncoupled. During the low-friction coupling procedure, only the front surface is coated with oil, which saves resources, is easy on the environment, and reduces contamination.



Didactic plus

The workbooks accompanying the training packages contain project-oriented exercises of increasing complexity. There are also positional sketches, illustrations, videos, animations, and cross-sectional drawings, which explain how things look in the real world. For a complete and expert treatment of the topic of hydraulics, the training also covers basic physics, technical calculations, safety, efficiency, analytical fault-finding, and professional documentation.

Hands-on basic and specialized training using industrial components provides the confidence to apply the acquired knowledge in the workplace. The components are specially selected for the exercises in the workbook. Note: nearly all hydraulic and electrical connections are located on the easily accessible upper side of the components.



Your choice of training environment
User-friendly training environments for specific topic areas:
- Self-study phases with the training programs
- Designing and documentation with FluidSIM®
- Hands-on experimentation with the training packages and the exercises in the workbooks
- Functional testing and optimization with measurement technology and FluidLab®

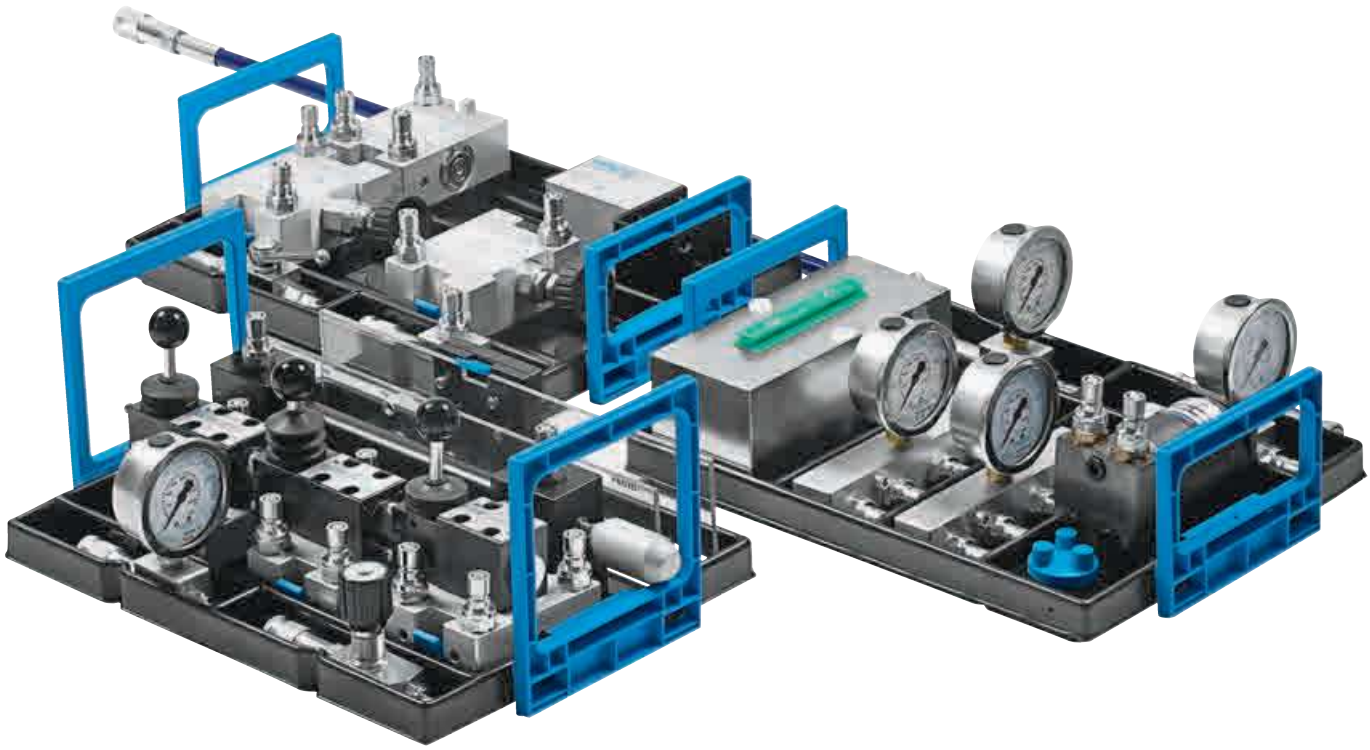
Quality not quantity!
Bigger is not necessarily better. Volumetric flow rates and pressures should be chosen with care and in coordination with the system as a whole. This especially applies to hydraulic training systems. High forces and cylinder speeds not only increase the danger for the user, but also require a larger hydraulic power pack with higher power consumption. So our offer is: as large as necessary and as small as possible, without compromising on teaching effectiveness.

New technologies – new skills needed
Modern measurement and diagnostic technology and cartridge valves are among the international trends in hydraulics. So you'll find those technologies in our learning systems as well. Benefit from the compact, integrated design, the low weight, ease of handling, and easy-to-read symbol system.

Mobile hydraulics
The new training packages for mobile hydraulics systematically and informatively explore complex topics and systems, such as work hydraulics, hydrostatic steering and drive systems for the agricultural, forestry, and construction vehicle sectors, and warehouse and municipal vehicles.

Equipment set TP 501 – Basic Level

Basic training in hydraulics



The classic reissued

The solid basis for hands-on basic and specialized education. Training package TP 501 contains only purely hydraulic control systems.

The number and version of the components are specifically adapted to the projects in the workbook. This is a cost-effective way of achieving the important training objectives.

TP 501, Basic Level is suitable for basic training in hydraulic control technology and imparts knowledge of the basic physical principles of hydraulics, as well as the function and use of hydraulic components.

Pure convenience

- Easy and exact switching of hand lever valves
- Ergonomic handwheels and fine resolution allow the simple and precise setting of the flow and pressure valves
- Tool-free, single-hand operation with quick action mounting system, Quick-Fix
- Easy and secure plugging and releasing of the new, low-leakage, self-sealing, quick connection couplings

Delivered in practical, Systainer-compatible equipment trays. The trays, in turn, fit exactly into the drawers in Learnline workstations.

Training content

Power packs and components:
- Design, function, and most important characteristics of a hydraulic power unit
- Design and function of pressure-relief valves, cylinders, and directional control valves
- Design and function of the non-return valve, one-way flow control valve, and piloted non-return valve
- Design and function of flow control valves

Measurements and calculations:
- Recording and interpreting the characteristic curve of a hydraulic pump
- Measuring the volume flow of a hydraulic control system
- Recording the characteristic curve of a pressure-relief valve
- Identifying and calculating times, pressures and forces during advancing and retracting of a cylinder
- Recording the characteristic curve of a flow control valve
- Calculating performance ratios when using 4/3-way valves with different mid-positions

Hydraulic circuits:
- Commissioning hydraulic circuits safely
- Using the flow control valve in the inflow and outflow and adjusting the drive speed
- Difference between a flow control valve and one-way flow control valve in hydraulic control systems
- Design and mode of operation of a differential circuit
- Effect of the piston surfaces on pressures, forces, speeds, and travel times
- Proper use of piloted non-return valves
- Circuits with different types of counter pressure
- Operating cylinders with varying loads

Complete equipment set TP 501 in equipment tray		**573035**

The most important components at a glance:

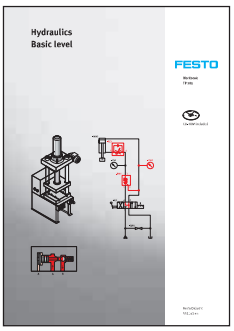
1	1x	Pressure relief valve	544335
2	1x	2-way flow control valve	544338
3	1x	One-way flow control valve	152843
4	1x	Non-return valve, delockable	544339
5	1x	Non-return valve, 0.6 MPa opening pressure	548618
6	1x	4/2-way hand lever valve, spring return	544342
7	1x	4/3-way hand lever valve, relieving mid-position (AB –› T), detenting	544344
8	1x	4/3-way hand lever valve, closed mid-position, detenting	544343
9	1x	Shut-off valve	152844
10	1x	Differential cylinder 16/10/200 with cover	572746
11	1x	Weight, 9 kg for cylinder	152972
12	1x	Hydraulic motor	152858
13	1x	T-distributor	152847
14	2x	4-way distributor with pressure gauge	159395
15	3x	Pressure gauge	152841
16	1x	Flow sensor	567191

Necessary accessories, also order:

7x	Hose line with quick release couplings, 600 mm	152960
3x	Hose line with quick release couplings, 1000 mm	152970
2x	Hose line with quick release couplings, 1500 mm	159386
	Digital multimeter	8040005
	Aluminum profile plate ➔ Page 39	
	Hydraulic power pack ➔ Pages 148 – 149	
	Protective cover for weight, 9 kg ➔ Page 143	
	Power supply unit for mounting frame ➔ Page 155	

Also order:

Workbook



The basic circuits for hydraulics are presented in 17 exercises. The symbols used in the circuit diagrams are according to DIN/ISO 1219. In order to carry out the exercises, students require the equipment set for TP 501 Hydraulics, Basic Level.

The workbook contains:
– Sample solutions
– Training notes
– Multimedia CD-ROM with graphics, photos of industrial applications, animations, and FluidSIM® circuit diagrams
– Worksheets for students

Campus license (➔ Page 19):

de	**550141**
en	**551141**
es	**551145**
fr	**551146**

Supplementary media
– Designing and simulating with FluidSIM®
– Measuring and controlling with FluidLab®
– WBT Hydraulics
– Textbook: Basic Principles of Hydraulics and Electrohydraulics
– Hydraulics poster set

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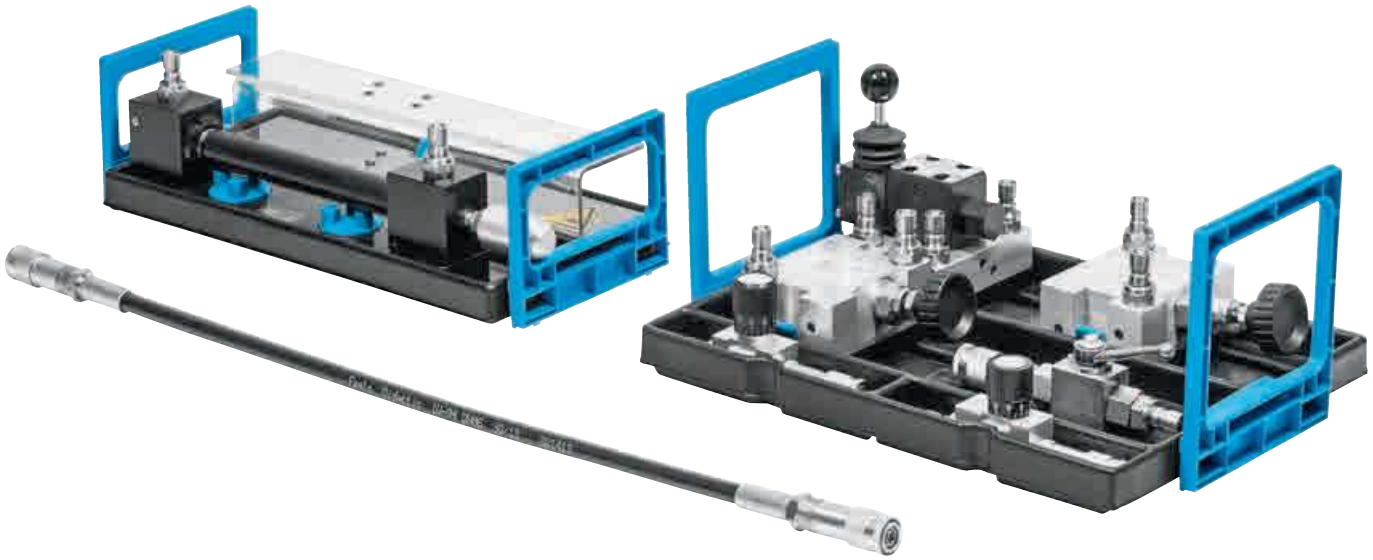
Equipment set TP 501+ – Advanced level

Systematic troubleshooting



Realistic

Equipment set TP 501+ from Festo Didactic is an extension to equipment set TP 501. TP 501+ contains components with specified, realistic defects. It enables hydraulic circuits to be constructed with the TP 501 and individual components to be replaced by defective ones.

Using our experience in industrial environments, we were able to define typical error patterns for hydraulic systems and adapt them to the components contained in equipment set TP 501+.

Professional

Systematic troubleshooting and professional error elimination are an essential part of everyday operations in many jobs in the fields of mechanics, mechatronics, and electrical engineering. In order to acquire skills in this area via a structured, yet safe, procedure, it is important that systematic troubleshooting is both learned and practiced. Keys to this are:

- Understanding circuits and discerning any non-conformities
- Delimiting/precluding any error areas
- Locating and rectifying errors

This procedure assumes specialist knowledge, such as modes of operation of individual components and their system limits

Pressure relief valve with broken spring

One example of a defective component is a pressure relief valve with a broken spring. This defect may be due to a continuous load or a material flaw. The defect results in the spring length being shortened and hence, in a reduction in the maximum pressure that can be set. The conspicuous symptoms result in a lower cylinder force. Pressure sensors or force sensors may not switch, which can lead to interruptions to operation cycles or process safety being put at risk.

Flow control valve with damaged pressure compensator

Another example of a defect is a two-way flow control valve with a damaged pressure compensator. While intact, the valve ensures a constant volumetric flow rate, regardless of the load pressure. However, in this case, the pressure compensator is not working. The differential pressure is no longer being regulated via the throttle valve. Here, the flow control valve behaves like an unregulated throttle valve. A fault like this occurs if dirt has entered the system and as a result, the pressure compensator's piston has seized up in the open position.

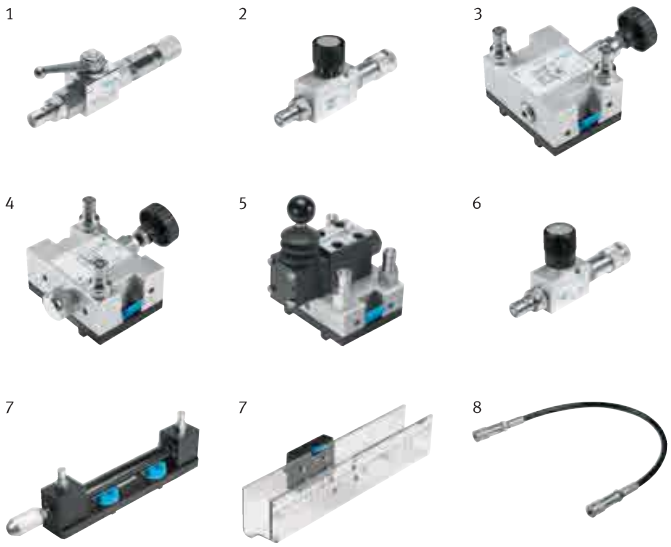
Complete equipment set TP 501+ in equipment tray		**8060229**

The most important components at a glance:

1	1x Shut-off valve, defective	8065301
2	1x One-way flow control valve , defective	8065298
3	1x Pressure relief valve, defective	8065175
4	1x 2-way flow control valve, defective	8065174
5	1x 4/3-way hand lever valve, H-center position, detenting (PTAB)	8065281
6	1x Flow control valve	152842
7	1x Differential cylinder 16/10/200, defective	8065195
8	1x Hose line with quick release couplings, clogged	8065327

Necessary accessories, also order:

Aluminum profile plate ➔ Page 39
Hydraulic power pack ➔ Pages 148 – 149



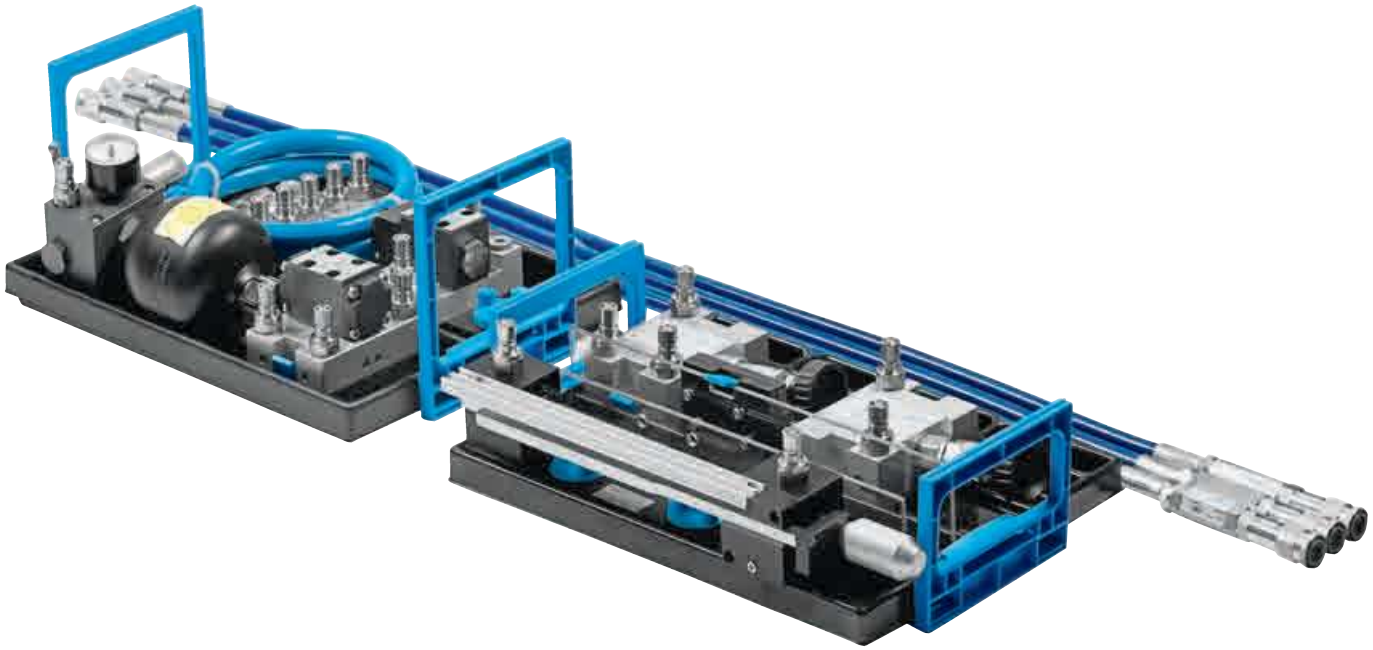
Requirements
Building on from Basic Level Hydraulics, the Advanced Level contains eight components appropriate for equipment set TP 501. Possible troubleshooting tasks are aimed at all job areas involving maintenance and repair activities. Special measuring equipment is not required since all symptoms are observable. However, error patterns can also be quantified using measuring equipment such as a flowmeter or pressure gauge.

Study materials
A description is included for each defective component describing both its function and the fault. A flow chart, which guides learners systematically from observation of the symptom to the repair task, is also included.

Supplementary media
– Design and simulation using FluidSIM®
– Diagnostic system TP 810 with FluidLab®-M
– Textbook: Basic principles of hydraulics and electrohydraulics
– WBT hydraulics
– Web-based training, electrohydraulics
– Hydraulics poster set

Equipment set TP 502 – Advanced Level

Hydraulics for advanced users



The new advanced level

The training package TP 502 builds on the material covered in training package TP 501 – Basic Level, and adds 15 new projects to it.

The course expands students' knowledge about the basic physical principles of hydraulics and the function and use of further hydraulic components.

In order to carry out the projects, users require the components and the necessary accessories from equipment set TP 501.

Hydraulics plus!

The new components provide added training value, and relevant project tasks form the basis for advanced training in fundamental principles.

Delivered in practical, Systainer-compatible equipment trays, which in turn, fit exactly into the drawers in Learnline workstations.

Training content

Power packs and components:
– Design and function of a hydraulic motor
– Setting the direction and rotation speed of a hydraulic motor
– Design, function, and use of a flow divider
– Using a hydraulic reservoir as a volume and pressure accumulator
– Design, function and use of a pressure regulator
– Specifying the cylinder pressure
– Difference between pressure-relief valves and pressure regulators

Measurements and calculations:
– Calculating performance ratios of hydraulic circuits from measured values
– Calculating forces on the cylinder
– Creating procedure descriptions

Hydraulic circuits:
– Implementing bypass circuits
– Ensuring synchronized forward and return strokes
– Getting to know the bypass circuit
– Getting to know the rapid traverse feed circuit
– Advancing and retracting of a cylinder after the pump from the reservoir is switched off
– Use of a hydraulic reservoir for a rapid traverse circuit
– Getting to know the rectifier circuit
– Configuration and description of a sequence control with two cylinders
– Getting to know the pressure sequence and pressure stage circuit
– Getting to know the fuse protection for tensile loads

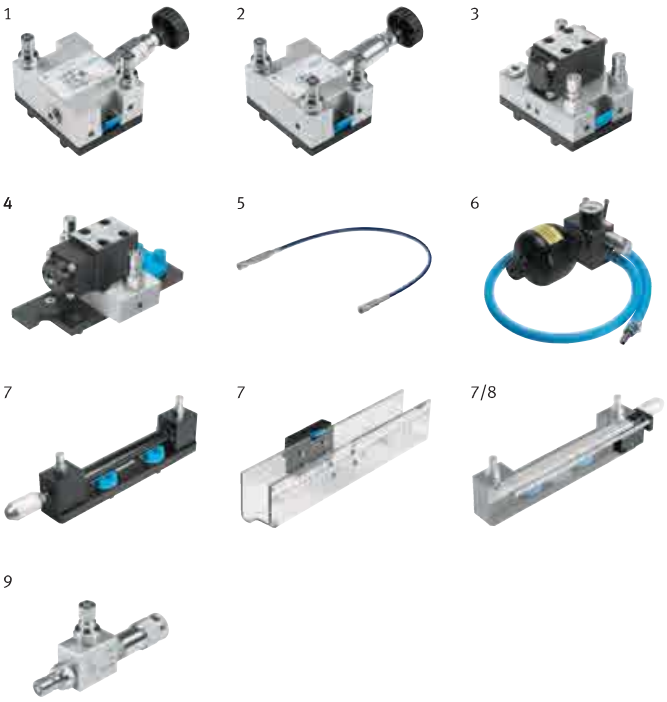
Complete equipment set TP 502 in equipment tray		**573036**

The most important components at a glance:

1	1x	Pressure relief valve, compensated	567237
2	1x	3-way pressure reducing valve	544337
3	1x	Flow dividing valve	544340
4	1x	2/2-way stem actuated valve, convertible	544353
5	3x	Non-return valve, 0.6 MPa opening pressure	548618
6	1x	Diaphragm accumulator with shut-off block	152859
7	1x	Differential cylinder 16/10/200 with cover	572746
8	1x	Mounting kit for cylinders	544371
9	5x	T-distributor	152847

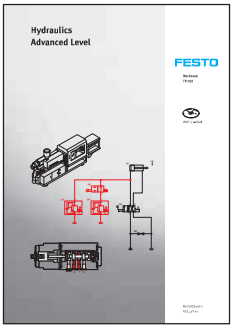
Necessary accessories, also order:

7x	Hose line with quick release couplings, 600 mm	152960
4x	Hose line with quick release couplings, 1000 mm	152970
2x	Hose line with quick release couplings, 1500 mm	159386
	4 mm Safety laboratory cables ➔ Page 155	
	Digital multimeter	8040005
	Aluminum profile plate ➔ Page 39	
	Hydraulic power pack ➔ Pages 148 – 149	
	Protective cover for weight, 9 kg ➔ Page 143	
	Power supply unit for mounting frame ➔ Page 155	



Also order:

Workbook



The tasks demonstrate advanced hydraulic circuits. The equipment set of package TP 501 – Hydraulics Basic Level and TP 502 – Advanced Level equipment set are needed to carry out the tasks.

The workbook contains:
– Sample solutions
– Training notes
– Multimedia CD-ROM with graphics, photos of industrial applications, animations, and FluidSIM® circuit diagrams
– Worksheets for students

Campus license (➔ Page 19):

de	**550142**
en	**551147**
es	**551148**
fr	**551149**

Supplementary media
– Designing and simulating with FluidSIM®
– Measuring and controlling with FluidLab®
– WBT Hydraulics
– Textbook: Basic principles of Hydraulics and Electrohydraulics
– Hydraulics poster set

Hydraulics – Basic level – TP 501 America

Equipment set

The Lab-Volt Hydraulics Fundamentals Successor

The Lab-Volt Fluid Power System has been re-engineered and transferred to Festo Didactic's Training Package series.

TP 501 America now combines the proven learning approach through object-oriented courseware from Lab-Volt with the project-orientation from Festo Didactic.

TP 501 America is the basic level for education in hydraulics and a prerequisite for TP 601 America, Electrohydraulics Basic Level.

TP 501 and TP 601 America support vocational training institutes in their mission to educate skilled, resourceful technicians and engineers, as required by the local industry.

Safe and sound system

The design of the system components ensures a high level of inherent safety.

The hydraulic hoses are equipped with leakage-free, self-sealing couplings in high-grade stainless steel that are easy on the environment and reduce contamination. The Spring load for cylinders comes with a safety cover to prevent potential hazards when high forces are involved.

The cylinders come with a safety cover, reducing the risk of injury, and include a guide for easy positioning and a tool-free quick-action mounting system.

All power pack motors are equipped with overload protection, protection against restart, and an easy-to-access emergency off button.

Pure convenience

- Easy and precise switching of hand-lever valves.
- Ergonomic handwheels with a high resolution allow the simple and precise setting of the flow and pressure valves.
- Tool-free, single-hand operation with Quick-Fix mounting system.
- The equipment trays fit exactly into the drawers in Learnline/Learntop workstations.
- The trays are compatible with the Systainer suitcases for enhanced mobility.
- The solid aluminum structure and profile bars can support heavy components without twisting or bending.
- Easy and precise positioning of components along the profile groove.

Training aims – TP 501 America

Introduction to hydraulics
- Familiarization with the training system
- Basic principles of hydraulics
- Hydraulic power unit and distribution equipment

Valves
- Pressure relief valve
- Flow control valves
- Flow regulating valves
- Pressure-reducing vales
- Directional control valves

Basic controls of cylinders
- Cylinders – Direction and speed
- Cylinders – Pressure and force

Basic hydraulic circuits
- Meter-in/Meter-out configurations
- Securing a load
- Regenerative circuit
- Sequential circuit

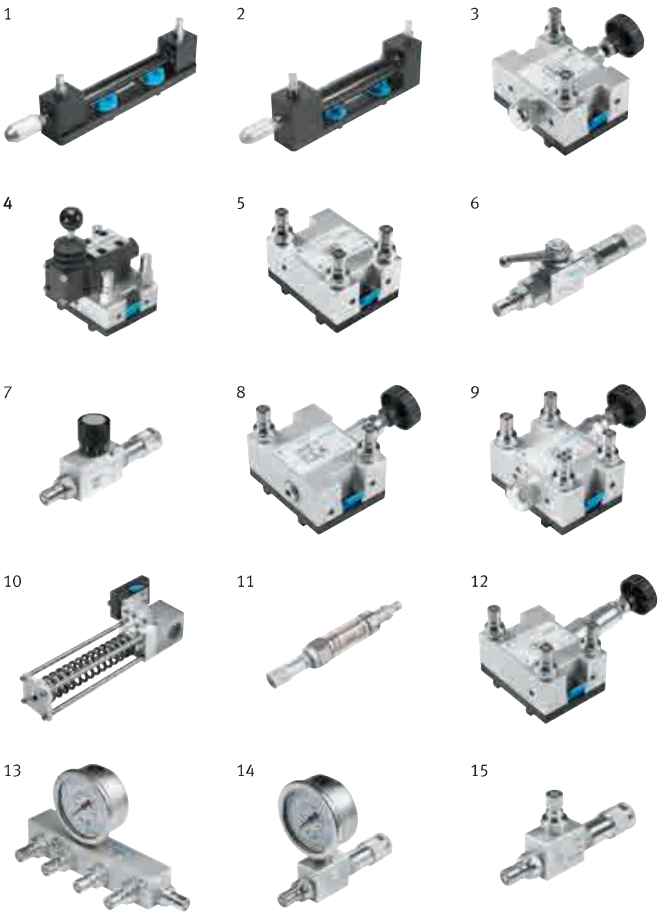
Complete equipment set TP 501 America in equipment tray		**8060227**

The most important components at a glance:

1	1x	Differential cylinder 16/10/200 with cover	572746
2	1x	Differential cylinder 25/18/200 with cover	572747
3	1x	2-way flow control valve	544338
4	1x	4/3-way hand lever valve, closed mid-position, detenting	544343
5	1x	Non-return valve, delockable	544339
6	1x	Shut-off valve	152844
7	1x	One-way flow control valve	152843
8	1x	Pressure relief valve	544335
9	1x	Pressure relief valve, piloted	8025067
10	1x	Spring load for cylinders, hydraulic	4914138
11	1x	Flow indicator with float	4857121
12	1x	3-way pressure reducing valve	544337
13	2x	4-way distributor with pressure gauge	159395
14	2x	Pressure gauge	152841
15	4x	T-distributor	152847

Necessary accessories, also order:

8x	Hose line with quick release couplings, 600 mm	152960
4x	Hose line with quick release couplings, 1000 mm	152970
4x	Hose line with quick release couplings, 1500 mm	159386
1x	Digital multimeter	8040005
	Workstation ➔ Page 39	
	Hydraulic power pack ➔ Pages 148 – 149	
1x	Power supply unit for mounting frame (NEMA 5-15 plug)	162411



Also order:

Courseware TP 501 America

The Campus License consists of an Instructor Guide and a Student Manual.

In the courseware, exercises progressively increase in complexity, providing an ideal introduction to hydraulics.

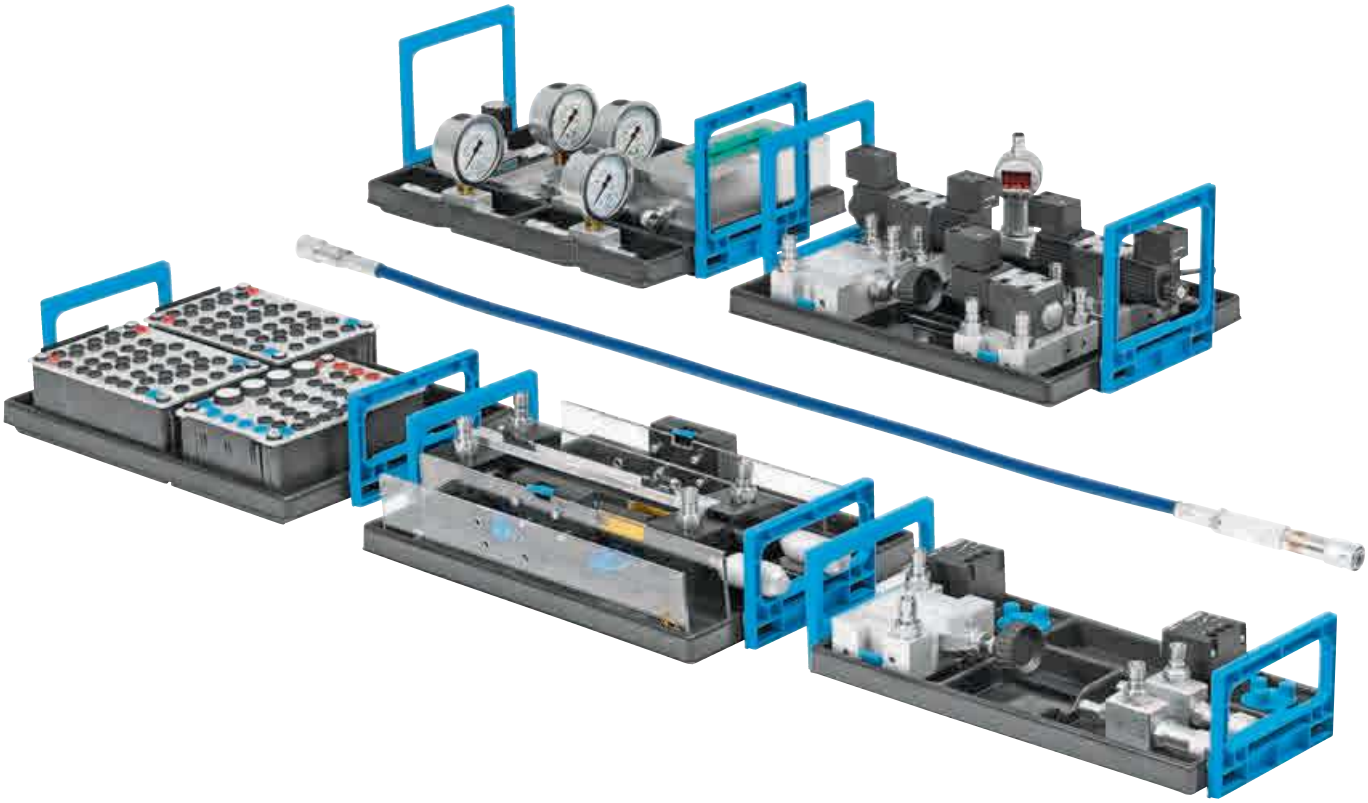
Detailed procedure descriptions with hydraulic diagrams, thorough analysis, troubleshooting exercises, and comprehensive theory coverage provide the ideal preparation for the real-life industrial environment

Campus license (➔ Page 19):

en	**793157**

Equipment set TP 601 – Basic Level

Basic training in electrohydraulics



New edition of electrohydraulics!

TP 601 is a logical further development of electrohydraulics for training and specialized education. The equipment set contains only electro-hydraulic circuits and control systems.

The number and version of the components are specifically adapted to the projects in the workbook. This is a cost-effective way of teaching the important training objectives.

This equipment set provides students with knowledge about the basic physical principles of electrical engineering and electrohydraulics, as well as how electrohydraulic and control technology components function and are used.

Training content

Power packs and components:
- Design, mode of operation, and areas of application of 2/2, 3/2, 4/2, and 4/3-way solenoid valves, as well as 4/2-way double solenoid valves
- Design and mode of operation of electrical pushbuttons, switches, and limit switches
- Design and mode of operation of a relay
- Knowing and accounting for the contact load capacity of electrical signal transmitters
- Selecting and using hydraulic and electrical components according to economic criteria
- Design and mode of operation of a pressure switch
- Knowing different ways of sensing a cylinder's end position and selecting the right one

Hydraulic circuits:
- Commissioning hydraulic circuits safely
- Explaining and designing direct and indirect actuation
- Creating and using a sequence table
- Explaining and designing signal storage in the hydraulic power section
- Selecting solenoid valves according to the technical control requirements
- Using and designing basic logic functions
- Explaining and designing an electric latching circuit with a dominant switch-off signal
- Designing and arranging pressure-dependent control systems
- Knowing simple operating modes and accounting for them in the circuit
- Electrical and mechanical locking of signals in a relay control system
- Expanding existing control systems and adjusting the documentation accordingly
- Implementing sequence control with two cylinders
- Getting to know and creating a procedure description as GRAFCET and as a function diagram
- Analyzing circuits and carrying out systematic fault finding and error elimination with restart

Measurements and calculations:
- Measuring and calculating the flow in an electrohydraulic installation
- Calculating electrical characteristic values

Complete equipment set TP 601 in equipment tray	**573037**

The most important components at a glance:

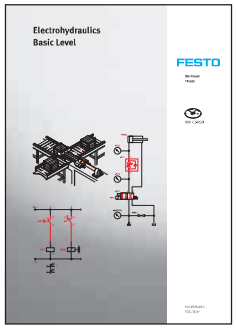
1	1x	Pressure relief valve	544335
2	1x	2-way flow control valve	544338
3	1x	One-way flow control valve	152843
4	1x	Non-return valve, 0.6 MPa opening pressure	548618
5	1x	4/2-way solenoid valve, spring return	544346
6	1x	4/3-way solenoid valve, closed mid-position	544347
7	1x	4/2-way double solenoid valve, detenting	544352
8	1x	Shut-off valve	152844
9	1x	Weight, 9 kg, for cylinder	152972
10	2x	Differential cylinder 16/10/200 with cover	572746
11	1x	Mounting kit for cylinders	544371
12	2x	T-distributor	152847
13	2x	4-way distributor with pressure gauge	159395
14	2x	Pressure gauge	152841
15	1x	Pressure switch, electronic	548612
16	2x	Relay, three-fold	162241
17	1x	Signal input, electrical	162242
18	1x	Limit switch, electrical, left-actuated	183322
19	1x	Limit switch, electrical, right-actuated	183345
20	2x	Proximity sensor, electronic	2342009

Necessary accessories, also order:

7x	Hose line with quick release couplings, 600 mm	152960
2x	Hose line with quick release couplings, 1000 mm	152970
4x	Hose line with quick release couplings, 1500 mm	159386
	4 mm Safety laboratory cables ➔ Page 155	
	Digital multimeter	8040005
	Aluminum profile plate ➔ Page 39	
	Hydraulic power pack ➔ Pages 148 – 149	
	Protective cover for weight, 9 kg ➔ Page 143	
	Tabletop power supply unit ➔ www.festo-didactic.com	
	Power supply unit for mounting frame ➔ Page 155	

Also order:

Workbook



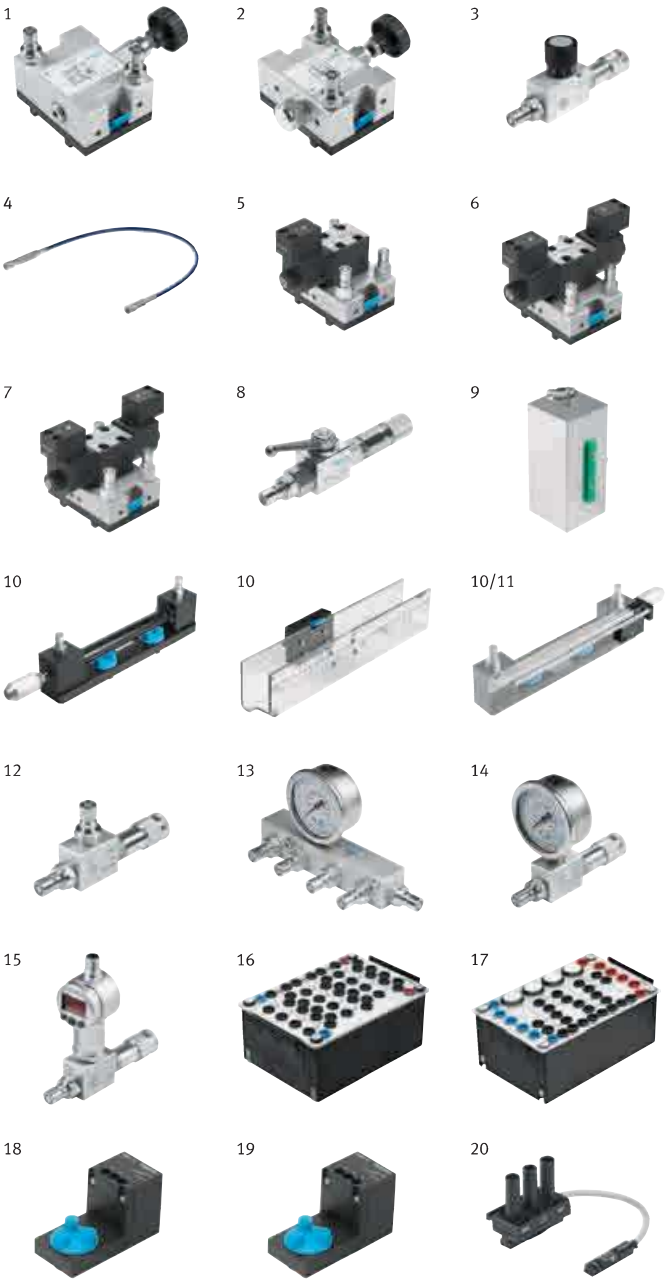
The basic electric circuits for hydraulic control technology are presented in 15 exercises. In order to carry out the exercises, students require the equipment set of TP 601 Electrohydraulics, Basic Level.

The workbook contains:
– Sample solutions
– Training notes
– Multimedia CD-ROM with graphics, photos of industrial applications, animations, and FluidSIM® circuit diagrams
– Worksheets for students

Campus license (➔ Page 19):

de	**550143**
en	**551150**
es	**551151**
fr	**551152**

Supplementary media
– Designing and simulating with FluidSIM®
– Measuring and controlling with FluidLab®
– WBT Electrohydraulics
– Textbook: Basic principles of Hydraulics and Electrohydraulics
– Hydraulics poster set



Supplementary equipment sets
Electrohydraulics

1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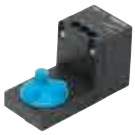

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Supplementary equipment set from Hydraulics, Basic level TP 501 to Electrohydraulics, Basic level TP 601

For training aims, see Electrohydraulics, Basic level TP 601 equipment set.

Complete supplementary equipment set TP 501 – TP 601	**573039**

The most important components at a glance:

1	2x	Relay, three-fold	162241
2	1x	Signal input, electrical	162242
3	1x	Limit switch, electrical, left-actuated	183322
4	1x	Limit switch, electrical, right-actuated	183345
5	1x	4/2-way double solenoid valve, detenting	544352
6	1x	4/2-way solenoid valve, spring return	544346
7	1x	4/3-way solenoid valve, closed mid-position	544347
8	1x	Differential cylinder 16/10/200 with cover	572746
9	1x	Mounting kit for cylinders	544371
10	1x	Pressure switch, electronic	548612
11	2x	Proximity sensor, electronic	2342009
12	1x	T-distributor	152847

Supplementary equipment set from Hydraulics, Basic level TP 501 and Advanced level TP 502 to Electrohydraulics, Basic level TP 601

For training aims, see Electrohydraulics, Basic level TP 601 equipment set.

Complete supplementary equipment set TP 501 and TP 502 – TP 601	**573040**

The most important components at a glance:

1	2x	Relay, three-fold	162241
2	1x	Signal input, electrical	162242
3	1x	Limit switch, electrical, left-actuated	183322
4	1x	Limit switch, electrical, right-actuated	183345
5	1x	4/2-way double solenoid valve, detenting	544352
6	1x	4/2-way solenoid valve, spring return	544346
7	1x	4/3-way solenoid valve, closed mid-position	544347
10	1x	Pressure switch, electronic	548612
11	2x	Proximity sensor, electronic	2342009

Supplementary equipment sets
Controllers for electrohydraulics

Supplementary equipment set Controlling using FluidSIM®/ EasyPort USB

With this package, the FluidSIM® software can be used to control training packages. FluidSIM® controls via EasyPort USB and processes the inputs and outputs connected to the universal connection unit according to their programming, e.g., using the digital module contained in FluidSIM®.

The Controlling using FluidSIM® package contains everything you need to control training packages TP 201 and TP 601. FluidSIM® Pneumatics is required for TP 201 and FluidSIM® Hydraulics for TP 601. A set of brief instructions provides information on the individual steps.

The sample solutions are included on a data storage medium as FluidSIM® CT programs.

Complete supplementary equipment set Controlling using FluidSIM/EasyPort USB in equipment tray	**556270**

The most important components at a glance:

1	1x	Brief instructions for FluidSIM, de/en/es/fr	556267
2	1x	EasyPort USB	548687
3	1x	Quick-Fix screw adapter	549806
4	1x	Universal connection unit, digital (SysLink)	162231
5	1x	I/O data cable with SysLink connectors (IEEE 488) at both ends, 2.5 m	34031

Prerequisite:

Equipment set TP 601 – Basic Level ➔ Pages 92 – 93
FluidSIM Hydraulics ➔ Pages 12 – 13
Aluminum profile plate ➔ Page 39

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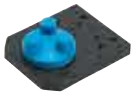

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Supplementary equipment set Controlling using LOGO! 8 TP EduTrainer® Compact TP/LOGO! Soft Comfort

A quick, straightforward, and inexpensive introduction to logical signal processing.

With its extensive basic and special control technology functions, LOGO! replaces a variety of conventional switchgears and control devices.

The LOGO! 8 TP EduTrainer® Compact training package contains everything you need to control training packages TP 201 and TP 601. A set of brief instructions provides information on the individual steps. Programming is carried out using the LOGO! programming software, Soft Comfort.

The sample solutions are included on a data storage medium as LOGO! Soft Comfort programs.

Complete supplementary equipment set with LOGO! 8 TP EduTrainer Compact TP/LOGO! Soft Comfort included in order	**8049517**

The most important components at a glance :

6	1x	Brief instructions for LOGO!, de/en/es/fr	8049519
7	1x	LOGO! 8 TP EduTrainer Compact TP	8040886
8	1x	LOGO! Soft Comfort, de/en/es/fr	8040050
9	1x	Ethernet cable	567280

Prerequisite:

Equipment set TP 601 – Basic Level ➔ Pages 92 – 93

Necessary accessories, also order:

Hydraulic power pack ➔ Pages 148 – 149
Power supply unit for mounting frame ➔ Page 155
4 mm Safety laboratory cables ➔ Page 155

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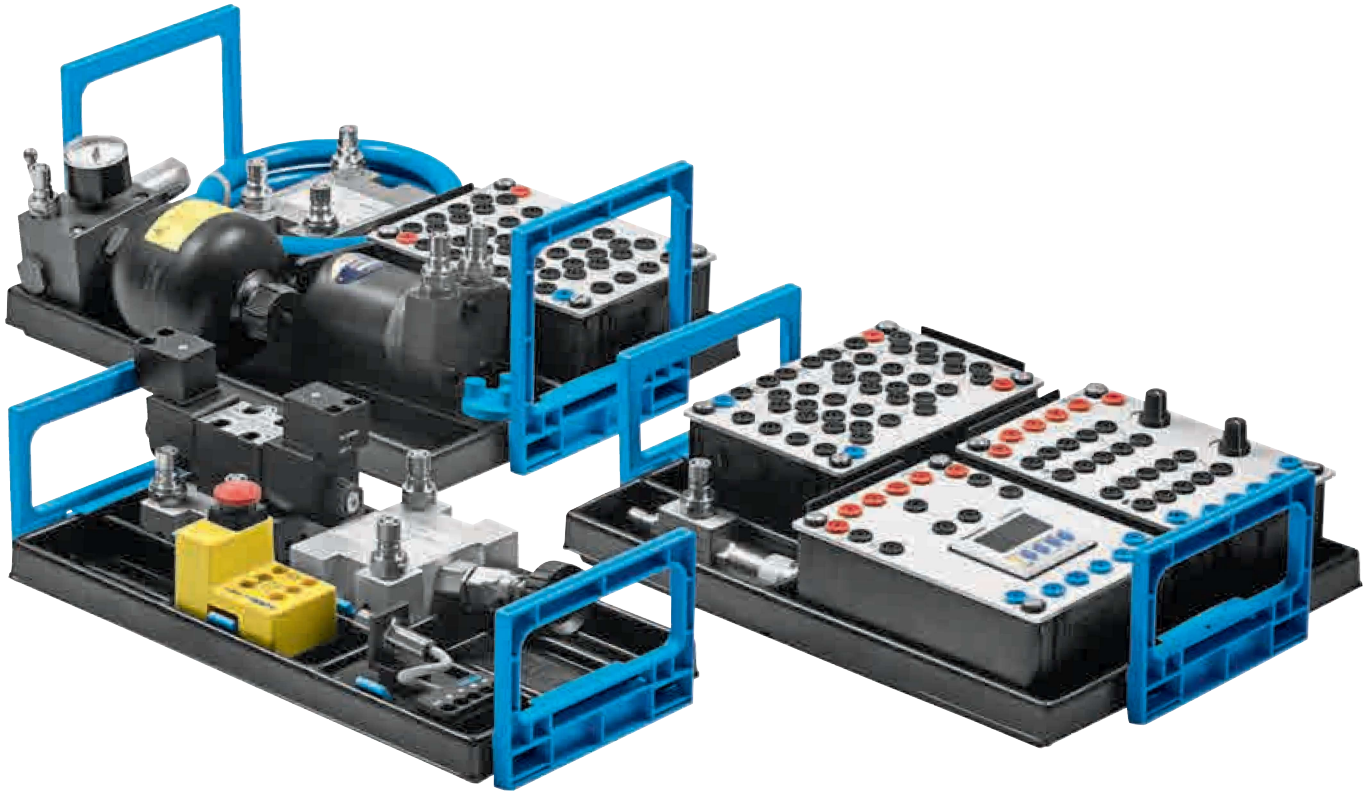
For additional controllers suitable for your requirements see:
➔ www.festo-didactic.com
Keyword “EduTrainer Compact”

Equipment set TP 602 – Advanced Level

Electrohydraulics for advanced students



The new advanced level

The training package TP 602 builds directly on the material covered in basic principles package TP 601 adding more in-depth projects.

It provides students with advanced knowledge about the basic physical principles of electrical engineering and electrohydraulics, as well as how electrohydraulic and control technology components function and are used.

In order to carry out the projects, users require the components and the necessary accessories from TP 601.

The number and version of the components are specifically adapted to the projects in the workbook. This makes it possible to achieve many important training objectives at little cost.

Training content

Power packs and components:
- Design and mode of operation of different proximity sensors
- Function and possible applications of a time relay with switch-on and switch-off delay
- Design and use of an electrical predetermining counter

Learning objectives for hydraulic circuits:
- Selecting proximity sensors according to the technical control requirements
- Expanding electrohydraulic control systems and adjusting the documentation
- Designing and arranging path- and pressure-dependent sequence controls
- Identifying signal overlaps in a sequence control and taking the appropriate action
- Designing and arranging sequence control as a standing sequencer
- Using memory to implement an emergency operation
- Implementing control systems with the operating modes single cycle and continuous cycle
- Querying time in electrohydraulic control systems
- Getting to know and using further logical connections
- Designing and arranging pressure sequence control
- Knowing safety-related conditions that could be needed for a drive
- Designing and arranging safety functions with a predefined motion sequence for a control system
- Implementing control systems with the operating modes inching and aligning
- Systematically identifying and eliminating errors in complex electrohydraulic control systems
- Creating sequence control as a displacement-step diagram
- Representing procedure descriptions with GRAFCET

Hydraulics plus!
Delivered in practical, Systainer-compatible equipment trays. The trays fit into the drawers in Learnline workstations. The new components, with added training value and relevant project tasks, form the basis for advanced training in fundamental principles.

Complete equipment set TP 602 in equipment tray		**573038**

The most important components at a glance:

1	1x	Time relay, two-fold	162243
2	2x	Relay, three-fold	162241
3	1x	Preset counter, electronic	1677856
4	1x	Diaphragm accumulator with shut-off block	152859
5	1x	Hydraulic motor	152858
6	1x	4/3-way solenoid valve, relieving mid-position (AB –› T)	544348
7	1x	Proximity sensor, inductive, M12	548643
8	1x	Emergency stop pushbutton, electrical	183347
9	1x	T-distributor	152847
10	1x	Non-return valve, delockable	544339
11	1x	Pressure relief valve, compensated	567237

Necessary accessories, also order:

8x	Hose line with quick release couplings, 600 mm	152960
4x	Hose line with quick release couplings, 1000 mm	152970
2x	Hose line with quick release couplings, 1500 mm	159386
	4 mm Safety laboratory cables ➔ Page 155	
	Digital multimeter	8040005
	Aluminum profile plate ➔ Page 39	
	Hydraulic power pack ➔ Pages 148 – 149	
	Protective cover for weight, 9 kg ➔ Page 143	
	Tabletop power supply unit ➔ www.festo-didactic.com	
	Power supply unit for mounting frame ➔ Page 155	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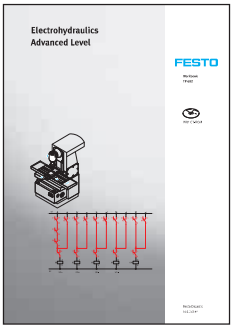
Also order:

Workbook



The basic practical circuits in electrohydraulics are presented in 12 exercises. In order to carry out the exercises, students require the equipment set of TP 601 Electro-hydraulics, Basic Level and Advanced Level TP 602.

The workbook contains:
– Sample solutions
– Training notes
– Multimedia CD-ROM with graphics, photos of industrial applications, animations, and FluidSIM® circuit diagrams
– Worksheets for students

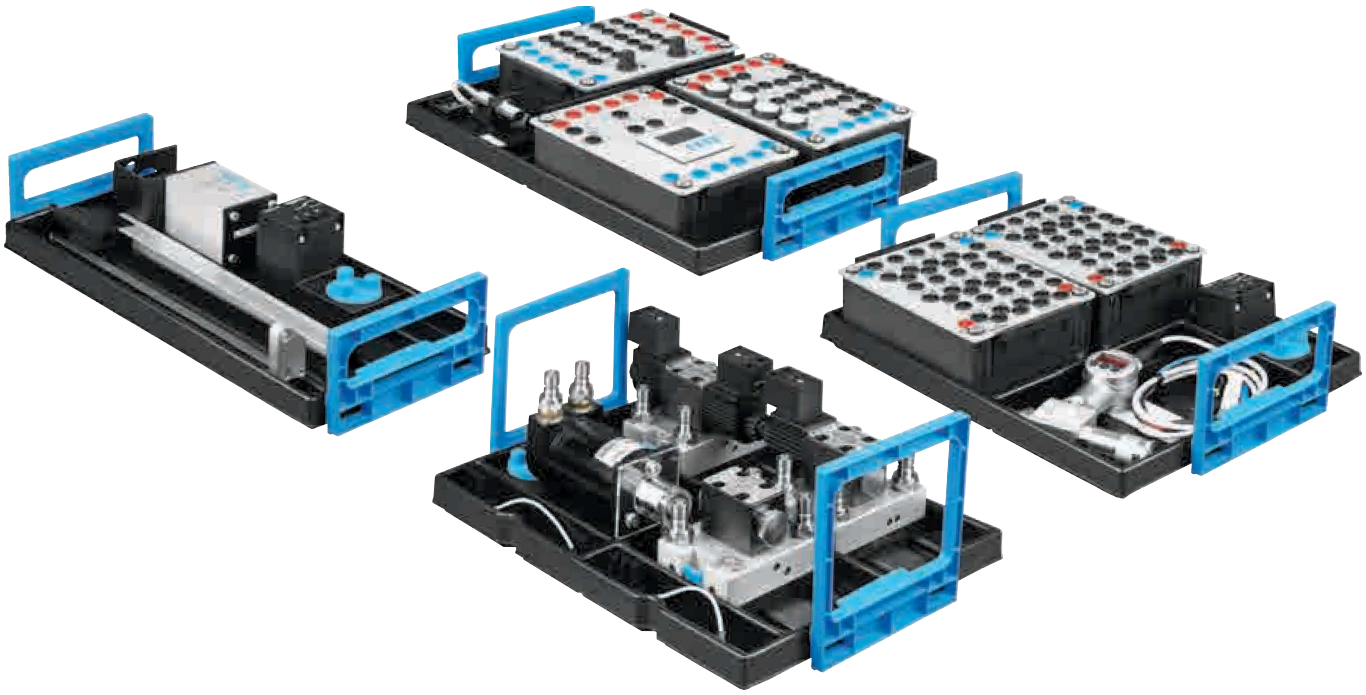
Campus license (➔ Page 19):

de	**550144**
en	**551153**
es	**551154**
fr	**551155**

Supplementary media
– Designing and simulating with FluidSIM®
– Measuring and controlling with FluidLab®
– WBT Hydraulics
– WBT Electrohydraulics
– Textbook: Basic principles of Hydraulics and Electrohydraulics
– Hydraulics poster set

Electrohydraulics – Basic level – TP 601 America

Supplementary equipment set TP 501 A – TP 601 A



The Lab-Volt Hydraulics Electrical Control successor

The Lab-Volt Fluid Power System has been re-engineered and transferred to Festo Didactic's Training Packages series.

TP 601 America is an extension to TP 501 America and a comprehensive introduction to electrohydraulics.

Equipment set TP 501 America is a prerequisite to use TP 601 America.

The electrical symbols in the courseware and on the modules are drawn according to NEMA standards. The design and simulation software FluidSIM® provides all required NEMA symbols in easy-to-access component libraries. In addition, all circuits in the courseware procedures are available in FluidSIM® for reference.

Next step:
our additions – your choice
A variety of possibilities can be added according to your educational needs.

Supplementary equipment sets:
TP 610 – Measurement and control
TP 810 – Diagnostic system for measurement, visualization, and analysis

Mobile Hydraulics training packages addressing the needs of future professionals dealing with vehicles e. g. from the construction, mining, and agriculture industries:
TP 801 – Mobile Hydraulics/Working Hydraulics I
TP 802 – Hydrostatic steering system
TP 803 – Working Hydraulics II (Load-Sensing)

Hydraulics energy supply
A variety of hydraulic power packs are available.

For basic hydraulic education workstations, a small hydraulic power pack with a single, constant-displacement pump is recommended. For double-sided workstation arrangements, two power packs are required to power each workplace individually.

For double-sided workstations covering basic and advanced hydraulics, a hydraulic power pack with two constant-displacement pumps and a higher flow rate is recommended. The power pack can be fitted with a wheel set to make it mobile beside the workstation.

The hydraulic power pack combining a load sensing controller and a variable and constant displacement pump is required only for TP 803 – Working Hydraulics II (Load-Sensing) but can be used also for the basics by using the constant pump.

Training aims – TP 601 America
Introduction to electrohydraulics
– Familiarization with the equipment
– Electrical concepts
– Basic electricity
– Ladder diagrams and logic operators
– Basic electrohydraulic circuits

Sequence systems
– Limit switches
– Pressure switches
– Electrical counters and continuous reciprocation
– Multi-pressure systems
– Time-delay relays

Hydraulic motors and industrial applications
– Hydraulic motors
– Optical proximity sensors
– Flow divider valves
– Deceleration of cylinders
– Industrial drilling systems
– Garbage compactor circuit

Troubleshooting
– Troubleshooting electrical control circuits
– Troubleshooting electrohydraulic systems

Complete supplementary equipment set TP 501 A – TP 601 A in equipment tray		**8060228**

The most important components at a glance:

1	1x	Flow dividing valve	544340
2	1x	4/2-way solenoid valve, spring return	544346
3	1x	4/3-way solenoid valve, bypass mid-position (P –› T)	544349
4	1x	Mounting kit for cylinders	544373
5	1x	Hydraulic motor	152858
6	1x	Pressure switch, electronic	548612
7	1x	Flow sensor	567191
8	1x	Signal input, electrical	8062950
9	1x	Time relay, two-fold	8062960
10	1x	Proximity sensor, optical, M12	8062967
11	1x	Limit switch, electrical, left-actuated	183322
12	1x	Limit switch, electrical, right-actuated	183345
13	1x	Preset counter, electronic	8062962
14	2x	Relay, three-fold	8062958
15	2x	Proximity sensor, electronic	2342009

Necessary accessories, also order:

8x		Hose line with quick release couplings, 600 mm	152960
4x		Hose line with quick release couplings, 1000 mm	152970
4x		Hose line with quick release couplings, 1500 mm	159386
1x		4 mm Safety laboratory cables, 106 pieces, red, blue, and black	571806
1x		Digital multimeter	8040005
		Workstation ➔ Pages 39	
		Hydraulic power pack ➔ Pages 148 – 149	
1x		Power supply unit for mounting frame (NEMA 5-15 plug)	162411

Only required when upgrading to TP 610

1x		4/3-way solenoid valve, closed mid-position	544347

Also order:

Courseware TP 601 America

The Campus License consists of an Instructor Guide and a Student Manual.

In the courseware, exercises progressively increase in complexity, providing an ideal introduction to electrohydraulics.

Detailed procedure descriptions with hydraulic and electrical diagrams, thorough analysis, troubleshooting exercises, and comprehensive theory coverage provide the ideal preparation for the real-life industrial environment.

Campus license (➔ Page 19):

en	**793158**

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Equipment set TP 610 – Advanced level

Measurement and control in Hydraulics with FluidLab®-H

Fit for tomorrow?

The equipment set for TP 610 expands the training content of TP 501 and TP 601 to include the topic of hydraulics measurement and control. The material covered ranges from recording simple characteristic curves of individual hydraulic valves through to the basic principles of cylinder control. In addition, awareness is raised in a clear and striking manner about the effective use of hydraulic energy, e.g. with resistance experiments.

New features of FluidLab®-H include the measurement experiments for proportional technology with recording characteristic curves, and applications such as pressure stages and rapid traverse feed circuits, as well as control technology with position, sequence and pressure control.

Exercises for the measurement and analysis of system and control behavior point to a future in which diagnostics, preventative maintenance, and saving energy are becoming more and more important.

Something extra special

In order to the complete the exercises, sensors (e.g., pressure, flow and position) are connected to the inputs, and control signals are transmitted to the EasyPort USB outputs. The FluidLab®-H software included in the scope of delivery interprets and visualizes the signals. Analog values are displayed as measurement curves.

Each exercise includes notes on its implementation, with positional sketches and block circuit diagrams. Students are guided step-by-step through the experiments. Measured results are then interpreted and compared with sample solutions, and questions are asked to check students' understanding.

Training content

- Basic principles of analog processing
- Using and adjusting sensors
- Interpreting measurement results
- Reading and understanding technical data and measurement curves
- Getting to know fluid engineering components and their influence and function
- Demonstrating fluid engineering effects and special features
- Analytical fault finding
- Hydraulic energy
- Evaluating changes of state
- Proportional technology
- Control technology with position, sequence and pressure control

Your advantages

- Fast, PC-supported recording of measured values
- Greater training success through measurement of components and interpretation of results
- Sensors that enable students "to look into" the circuit and components
- Suppositions regarding system behavior can be easily proven
- Learning the principles of measurement and analysis and applying them directly in other circuits
- Demonstrate and understand the principles of fluid engineering faster
- System analysis via a PC: State-of-the-art diagnostic method
- Better understanding of fluid engineering components and processes and thus better training outcomes

Complete equipment set TP 610 in equipment tray	**567194**

The most important components at a glance:

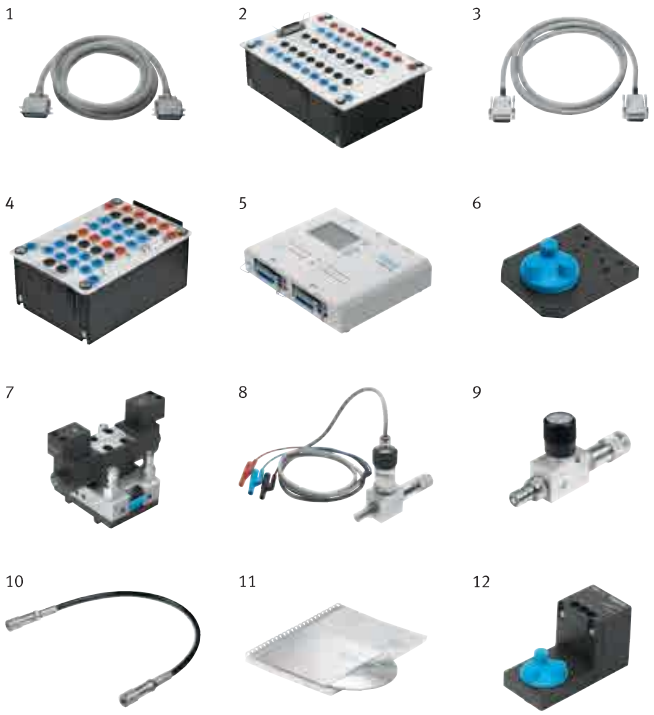
1	1x	I/O data cable with SysLink connectors (IEEE 488) at both ends, 2.5 m	34031
2	1x	Universal connection unit, digital (SysLink)	162231
3	1x	Analog cable, parallel, 2 m	529141
4	1x	Connection unit, analog	567232
5	1x	EasyPort USB	548687
6	1x	Quick-Fix screw adapter	549806
7	1x	4/3-way solenoid valve, relieving mid-position (AB –› T)	544348
8	2x	Pressure sensor	525964
9	1x	Flow control valve	152842
10	1x	Resistance hose line with quick release couplings, 1000 mm	549858
11	1x	FluidLab-H Single license, de/en	573286
12	1x	Limit switch, electrical, left-actuated	183322

The exercises for proportional and control hydraulics also require:

Proportional amplifier	162255
Displacement encoder for cylinder, 200 mm stroke	167090
Mounting kit for cylinders	544371
4/3-way proportional valve	544350
Proportional pressure relief valve	544351
Pressure filter	548609

Optionally, the regulating valve can be used instead of the proportional amplifier with the proportional valves for the control technology exercises.

4/3-way regulating valve	567269



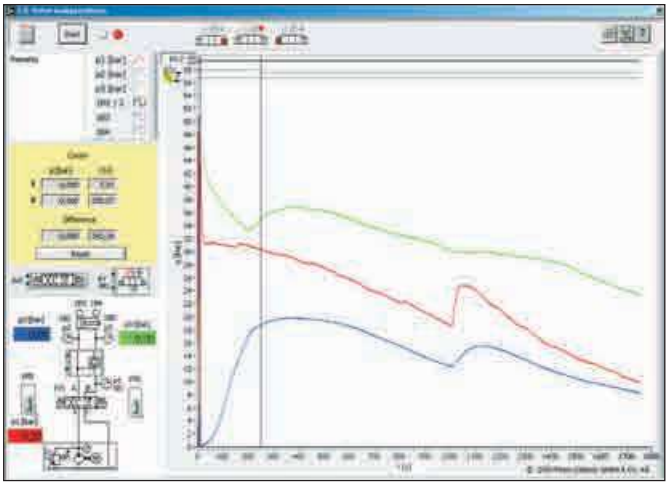
Includes FluidLab®-H measurement software

The FluidLab®-H software is an important component of the training package TP 610. Just a few simple steps are needed to configure the interface, adapt the sensors, and select the language (de/en). Then the exercises can begin, which are divided into the areas of basic experiments, cylinder controls, proportional technology and control engineering. Connection diagrams, descriptions, and sample solutions support students during the exercises. The software also controls the measurement sequence. Diagrams can be dimensioned and printed out using the cursors. The software also includes the complete book of exercises, with sample solutions, in PDF format.

System requirements

– PC with Windows 7/8/10
– Pentium® III or equivalently
– 2 GB RAM
– CD-ROM disk drive
– USB 2.0 or serial interface
– 1280 x 1024 pixels
– NI LabView 2012 Runtime (included in scope of delivery)

To carry out the exercises, students require the components and appropriate accessories from training packages 501 and 601.



Equipment set TP 701 – Basic level

Basic proportional hydraulics training

Proportional hydraulics, Basic Level

Proportional valves are continuous valves that, thanks to proportional magnets, not only permit simple switching positions, but also enable a continuous transition in the valve opening.

These valves are specifically used in hydraulics where variable volumetric flows (proportional directional control valve or proportional throttle) are needed together with load compensation (proportional flow control valve) or variable pressures (proportional pressure-relief valve). The equipment set provides information about proportional valves, how they function, and how they are activated using proportional amplifiers and a setpoint value card. The set can be used to design, set, and commission simple proportional control systems.

Training content

Components:
- Design and function of different proportional valves
- Characteristic curves and characteristics of proportional valves
- Design and function of amplifiers and setpoint specification
- Getting to know the characteristics of the 1 and 2-channel amplifier
- Completely setting the 1-channel amplifier
- Setting the basic current, step current, and maximum current
- Getting to know the characteristics of the 4/3-way proportional valve and the proportional pressure-relief valve
- Deriving the settings for the 2 channel amplifier
- Setting ramps
- Deriving the ramp settings from the function diagram

Measurements and calculations:
- Determining characteristic curves and characteristics of valves and equipment
- Measuring parameters such as pressure, volumetric flow, and time
- Calculating the flow for proportional directional control valves
- Calculating speeds for double-acting cylinders with varying load
- Calculating the natural frequency of a cylinder drive
- Calculating times for acceleration and braking

Hydraulic circuits:
- Controlling pressure and speed
- Reading and creating hydraulic and electric circuit diagrams
- Creating a function diagram
- Designing and commissioning control systems, including fault finding
- Basic circuits for proportional hydraulics, such as pressure stage circuit, rapid traverse feed circuit, pump bypass, approaching positions, controlled acceleration and braking, logically connecting setpoint values, load-independent speeds
- Getting to know the pressure stage control system
- Braking a cylinder feed
- Reversing a hydraulic motor
- Setting process-dependent pressure stages
- Externally and logically interconnecting setpoint values
- Approaching a position with braking
- Creating a load-independent feed speed

Complete equipment set TP 701	**184465**

The most important components at a glance:

1	1x	Relay, three-fold	162241
2	1x	Proportional amplifier	162255
3	1x	Setpoint value card	162256
4	1x	Signal input, electrical	162242
5	2x	Proximity sensor, inductive, M12	548643
6	1x	4/3-way proportional valve	544350
7	1x	4/2-way solenoid valve, spring return	544346
8	1x	Proportional pressure relief valve	544351
9	1x	Pressure filter	548609
10	1x	Pressure balance (proportional flow control valve)	159351
11	1x	Pressure relief valve	544335
12	1x	Differential cylinder 16/10/200 with cover	572746
13	1x	Hydraulic motor	152858
14	1x	Flow control valve	152842
15	1x	One-way flow control valve	152843
16	2x	Pressure gauge	152841
17	2x	T-distributor	152847
18	1x	Weight, 9 kg, for cylinder	152972

Necessary accessories, also order:

5x	Hose line with quick release couplings, 600 mm	152960
2x	Hose line with quick release couplings, 1500 mm	159386
	Measuring case	177468
	Pressure relief unit	152971
	4 mm Safety laboratory cables ➔ Page 155	
	Aluminum profile plate ➔ Page 39	
	Hydraulic power pack ➔ Pages 148 – 149	
	Protective cover for weight, 9 kg ➔ Page 143	
	Tabletop power supply unit ➔ www.festo-didactic.com	
	Power supply unit for mounting frame ➔ Page 155	

Also order:

Workbook

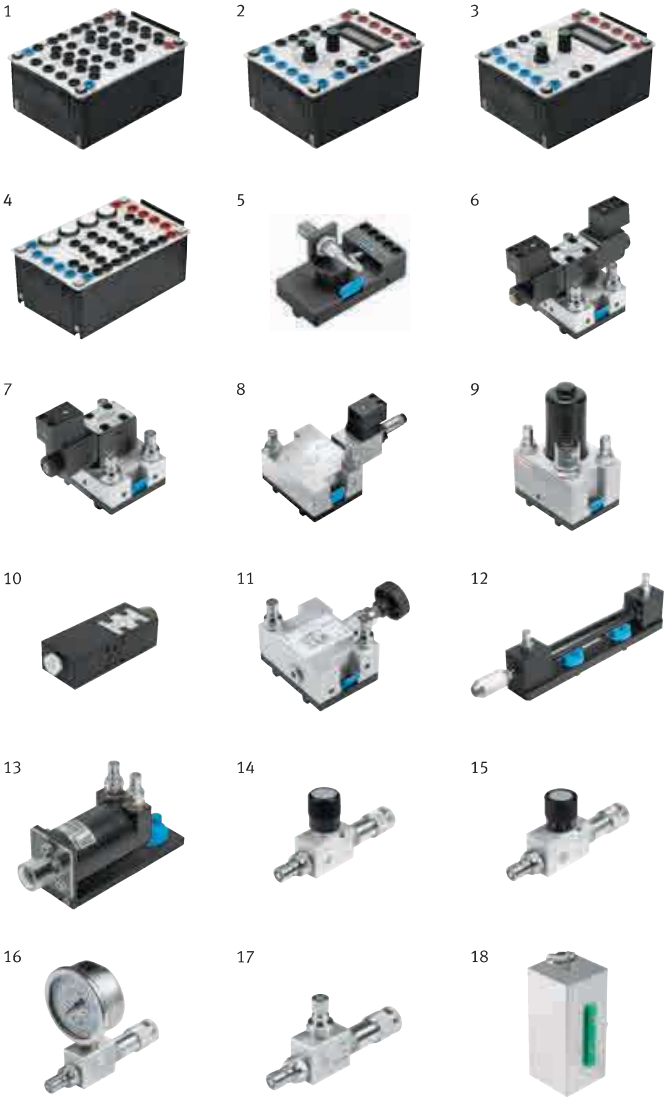
Ten exercises provide an introduction to the equipment and circuits for proportional hydraulics. Individual items of equipment are presented and their settings are tested. The progressively complex exercises then provide a complete solution.

The workbook contains:
– Sample solutions
– Training notes
– Multimedia CD-ROM with graphics, photos of industrial applications, animations, and FluidSIM® circuit diagrams
– Worksheets for students

Campus license (➔ Page 19):

de	**94457**
en	**94472**
es	**94404**
fr	**94352**

Supplementary media
– Designing and simulating with FluidSIM®
– Measuring and controlling with FluidLab®
– WBT Hydraulics
– WBT Electrohydraulics
– WBT Open- and closed-loop control
– Textbook: Proportional hydraulics, Basic level
– Hydraulics poster set



Equipment set TP 702 – Advanced level

Advanced proportional hydraulics training

Proportional hydraulics, Advanced Level

The training package TP 702 builds directly on the material covered in package TP 701, Basic Level, and adds nine additional more in-depth and real-life case studies.

The package includes the following steps:
- Understanding the task using a positional sketch, diagram and problem description
- Designing the hydraulic circuit diagram
- Determining the necessary signal transmitters
- Compiling the sequence table
- Designing the electric signal control system
- Structuring and commissioning the proportional hydraulic control system
- Settings and evaluating the result

Training content

Components:
- Determining characteristics curves and characteristics of different sensors
- Coordinating electrical and hydraulic equipment
- Creating characteristic curves for displacement, pressure, and temperature sensors

Measurements and calculations:
- Measuring and processing parameters such as displacement, time, pressure, and temperature
- Further signal processing of analog signals

Hydraulic circuits:
- Controlling pressure, speed, acceleration, delay, and position
- Reading and creating proportional hydraulic and electric circuit diagrams
- Reading motion diagrams
- Designing and commissioning proportional hydraulic control systems, including fault finding
- Adjusting and coordinating as per the specified procedure description
- Using basic circuits for proportional hydraulics such as: speed, rotational speed, stage, acceleration, braking, and differential circuits, as well as positioning
- Implementing specific displacement-time and positioning programs
- Setting precise switch-off positions
- Implementing drive acceleration with a proportional pressure-relief valve
- Implementing oscillating movements for a cylinder with a proportional hydraulic control system
- Implementing the specified speed profile by means of an additional bypass circuit and slow retraction to the end positions
- Implementing a travel process with a 2/2-way proportional valve and a proportional pressure-relief valve

Complete equipment set TP 702		**184466**

The most important components at a glance:

1	1x	Setpoint value card	162256
2	1x	Comparator	162257
3	1x	Time relay, two-fold	162243
4	1x	Indicator unit and distributor, electrical	162244
5	3x	Relay, three-fold	162241
6	1x	Limit switch, electrical, left-actuated	183322
7	1x	Limit switch, electrical, right-actuated	183345
8	1x	Proximity sensor, capacitive, M12	548651
9	1x	Proximity sensor, optical, M12	572744
10	1x	Non-return valve, delockable	544339
11	1x	T-distributor	152847
12	1x	Non-return valve, 0.05 MPa opening pressure	548617
13	1x	Displacement encoder for cylinder, 200 mm stroke	167090
14	1x	Mounting kit for cylinders	544371

Necessary accessories, also order:

5x	Hose line with quick release couplings, 600 mm	152960
3x	Hose line with quick release couplings, 1000 mm	152970
2x	Hose line with quick release couplings, 1500 mm	159386
	Measuring case	177468
	Pressure relief unit	152971
	4 mm Safety laboratory cables ➔ Page 155	
	Aluminum profile plate ➔ Page 39	
	Hydraulic power pack ➔ Pages 148 – 149	
	Protective cover for weight, 9 kg ➔ Page 143	
	Power supply unit for mounting frame ➔ Page 155	

Also order:

Workbook

Nine exercises illustrate the most important circuits and equipment in proportional hydraulics. To carry out the exercises, the equipment sets for proportional hydraulics TP 701 (Basic Level) and TP 702 (Advanced Level) are required.

The workbook contains:
– Sample solutions
– Training notes
– Worksheets for students

Campus license (➔ Page 19):

de	**94458**
en	**94473**
es	**94450**

Supplementary media
– Designing and simulating with FluidSIM®
– Measuring and controlling with FluidLab®
– WBT Hydraulics
– WBT Electrohydraulics
– WBT Open- and closed-loop control
– Textbook: Proportional hydraulics, Basic level
– Hydraulics poster set

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Equipment set TP 511

Basic closed-loop hydraulics training

Closed-loop hydraulics, Basic Level

Hydraulic closed-loop control circuits are normally operated with continuous valves. A control valve with integrated electronics, linear characteristic curve (volumetric flow to control piston position), and zero overlap makes commissioning easy and provides good results in the closed-loop control circuit.

Training content

Position control circuits:
- Characteristic curve of a displacement sensor
- Flow rate characteristics of a continuous directional control valve
- Linear unit as a controlled system for position control
- Designing and commissioning a position control circuit
- Lag errors in the position control circuit
- Position control with a changed controlled system
- Commissioning a position control circuit with disturbances
- Characteristics and transition functions of a status controller
- Parameterizing a status controller

Pressure control circuits:
- Characteristic curve of a pressure sensor
- Controlled system for pressure control
- Characteristics of a PID controller board
- Transition function of a P controller
- Control performance of a pressure control circuit with P controller
- Transition functions of I and PI controllers
- Transition functions of D, PD and PID controllers
- Empirical parameterization of a PID controller
- Parameterizing using the Ziegler-Nichols method
- Changed controlled system with disturbances

Controllers in hydraulics:
- Controlled systems with and without compensation
- Low-delay hydraulic controlled systems
- First, second, and third order hydraulic controlled systems
- Classifying controlled systems according to their step response
- Operating point and controller amplification
- Discontinuous controllers
- Block diagrams for discontinuous and continuous controllers
- P, I, D, PI, PD and PID controllers
- Status controllers
- Selecting the controller structure
- Disturbance reaction and control factor
- Designing control circuits
- Hydraulic, mechanical and electrical controllers
- Analog and digital controllers
- Selection criteria for controllers

Valves and measuring systems:
- Designation, circuit symbols and function of continuous directional control valves
- Stationary characteristics and dynamic behavior of continuous directional control valves
- Function, design, and mode of operation of a pressure regulating valve
- Pressure control with a directional control valve
- Mode of operation and interface of a measuring system

Complete equipment set TP 511 in equipment tray	**8028723**

The most important components at a glance:

1	1x	PID controller	162254
2	1x	Status controller	162253
3	2x	Pressure sensor	525964
4	1x	Pressure gauge	152841
5	1x	Hydraulic motor	152858
6	1x	Flow sensor	567191
7	1x	Pressure filter	548609
8	1x	Flow control valve	152842
9	1x	Shut-off valve	152844
10	2x	4-way distributor with pressure gauge	159395
11	2x	T-distributor	152847
12	1x	4/3-way regulating valve	567269
13	1x	Linear drive	8028726
14	2x	Weight, 5 kg, for linear drive	34065

Necessary accessories, also order:

4x	Hose line with quick release couplings, 600 mm	152960
3x	Hose line with quick release couplings, 1000 mm	152970
2x	Hose line with quick release couplings, 1500 mm	159386
2x	Hose line with quick release couplings, 3000 mm	158352
1x	Pressure relief unit	152971
1x	Function generator	152918
3x	Cable BNC – 4 mm	152919
1x	Cable BNC – BNC	158357
1x	T-connector BNC	159298
	4 mm Safety laboratory cables ➔ Page 155	
	Digital multimeter	8040005
	Aluminum profile plate ➔ Page 39	
	Digital storage oscilloscope ➔ Page 154	
	Hydraulic power pack q > 3.5 l/min ➔ Pages 148 – 149	
	Power supply unit for mounting frame ➔ Page 155	

Also order:

Workbook

The 20 exercises in this book are used to introduce the fundamentals of analog closed-loop hydraulics: pressure and position control with PID controllers, and position control with status controllers. For extra task number 21, which deals with position control with disturbance variables and an active load, the cushioning cylinders for linear drives (order no. 152295), three additional tubing lines with quick connection coupling and a shut-off valve (order no. 152844) are required. These are not included in the scope of delivery.

The workbook contains:
– Sample solutions, training notes
– Worksheets for students

Campus license (➔ Page 19):

de	**94460**
en	**94469**
es	**94368**
fr	**94348**

Supplementary media
– FluidSIM®
– FluidLab®
– WBT Hydraulics
– WBT Electrohydraulics
– WBT Open- and closed-loop control
– Textbook: Proportional hydraulics, Basic level
– Hydraulics poster set

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BIBB hydraulics equipment sets

Suitable for BIBB hydraulics course, lessons A – Z

BIBB hydraulics equipment set – basic equipment set
Matches BIBB hydraulics instruction course, exercises A-Z

Training content
The 21 exercises in the BIBB hydraulics course teach the fundamentals of hydraulic control engineering. Topics covered: hydraulic power pack, directional control valves and drives, shut-off and flow control valves, pressure regulators and pressure switches, hydraulic reservoirs, application switches, hoisting a load, Grätz switches, neutral circulation of the pump delivery, commissioning, and maintenance.

Basic equipment set in the equipment tray	**8025069**

The most important components at a glance:

1x	Differential cylinder 16/10/200 with cover	572746
1x	3-way pressure reducing valve	544337
1x	2-way flow control valve	544338
1x	Flow control valve	152842
1x	One-way flow control valve	152843
4x	T-distributor	152847
1x	Diaphragm accumulator with shut-off block	152859
1x	Weight, 9 kg, for cylinder	152972
1x	Pressure switch, electronic	548612
1x	Flow sensor	567191
2x	Hydraulic motor	152858
1x	Pressure relief valve, piloted	8025067
1x	Pressure relief valve	544335
1x	Non-return valve, delockable	544339
1x	Shut-off valve	152844
2x	Non-return valve, 0.05 MPa opening pressure	548617
2x	Non-return valve, 0.6 MPa opening pressure	548618
2x	Pressure gauge	152841
2x	4-way distributor with pressure gauge	159395

Necessary accessories, also order:

6x	Hose line with quick release couplings, 600 mm	152960
4x	Hose line with quick release couplings, 1000 mm	152970
4x	Hose line with quick release couplings, 1500 mm	159386
	Pressure relief unit	152971
	4 mm Safety laboratory cables ➔ Page 155	
	Digital multimeter	8040005
	Aluminum profile plate ➔ Page 39	
	Hydraulic power pack ➔ Pages 148 – 149	
	Protective cover for weight, 9 kg ➔ Page 143	
	Tabletop power supply unit ➔ www.festo-didactic.com	
	Power supply unit for mounting frame ➔ Page 155	

Possible combinations (only available when ordered as combination)
– Basic equipment set and electro-hydraulics equipment set extension
(Order no. 8025069 and order no. 8025073)
– Basic equipment set and hand lever valve equipment set extension
(Order no. 8025069 and order no. 8025072)
– Basic equipment set and hand lever valve equipment set extension and electro-hydraulics equipment set extension
(Order no. 8025069 and order no. 8025072 and order no. 8025073)

BIBB hydraulics equipment set – electro-hydraulics extension set
Required for the BIBB hydraulics instruction course, exercises A-Z

When combined with the BIBB basic equipment set (order no. 8025069), the electro-hydraulics extension set covers all the devices required to complete the BIBB hydraulics instruction course tasks A – Z.

Electro-hydraulics equipment set extension	**8025073**

The most important components at a glance:

1x	4/2-way solenoid valve, spring return	544346
1x	4/3-way solenoid valve, closed mid-position	544347
1x	4/3-way solenoid valve, bypass mid-position (P –› T)	544349
1x	4/3-way solenoid valve, relieving mid-position (AB –› T)	544348
2x	Relay, three-fold	162241
1x	Signal input, electrical	162242
1x	Time relay, two-fold	162243
1x	Proximity sensor, inductive, M12	548643

BIBB hydraulics equipment set – hand lever valve extension set
Optional for the BIBB hydraulics instruction course, exercises without electro-hydraulics

When combined with the BIBB basic equipment set (order no. 8025069), the hand lever valve extension set covers all the devices required to complete the BIBB hydraulics instruction course, except for the electro-hydraulics section of the course.

Hand lever valve extension set	**8025072**

The most important components at a glance:

1x	4/2-way hand lever valve, spring return	544342
1x	4/3-way hand lever valve, closed mid-position, detenting	544343
1x	4/3-way hand lever valve, bypass mid-position (P –› T), detenting	544345
1x	4/3-way hand lever valve, relieving mid-position (AB –› T), detenting	544344

Recommended training media
– WBT Hydraulics
– Design and simulation program FluidSIM® Hydraulics

Also order:

BIBB hydraulics instruction course
(on request)

Equipment set TP 800 – Mobile hydraulics

From basic principles to mobile machine

Mobile hydraulics from Festo Didactic

Mobile hydraulics has a range of specific features compared to conventional industrial hydraulics. These are normally taught directly on a vehicle. But what if the components or the vehicle are not accessible or the entire system is too complex for teaching purposes?

Simplified
In contrast to a vehicle, with a learning system each hydraulic subsystem can be separately and individually constructed and examined. And measured values can be recorded almost everywhere for improved understanding.

Accessible
While in a vehicle there is usually little room and access is restricted to qualified personnel, the elements of a learning system are manageable, easy to identify and fault-tolerant.

Clean
Work on a vehicle usually means dealing with dirt and unpleasant weather. A learning system is clean and ergonomic.

With the mobile hydraulics equipment set, Festo Didactic closes the gap between the basic principles of hydraulics and hydraulic systems on a vehicle.

For an ideal introduction to mobile hydraulics, a hydraulic power unit is available, with variable displacement pump and load sensing controller and a constant displacement pump. This enables both basic and advanced levels to be taught and load simulations to be carried out with just one power unit.

Equipment sets:

Working hydraulics – Basic level
At the basic level, flow control with directional valves with different mid positions are compared in terms of their energy usage. This is done using a cylinder load simulator which, depending on the design, is capable of simulating a wide variety of different load situations.

In addition, the topics of holding and lowering the load and two 6/3 way valves for actuation of two drives are discussed using the series, parallel, and tandem circuits.

As a transition to the Working hydraulics – Advanced level, a simple load sensing controller with constant pump is implemented.

Working hydraulics – Advanced level
Here, the focus is on load sensing systems with variable displacement pump. This includes the construction, operation, and adjustment of a variable displacement pump with a load sensing controller and mobile or control block. The energy usage with flow control, open center load sensing, and closed center load sensing with a variable displacement pump can then be compared.

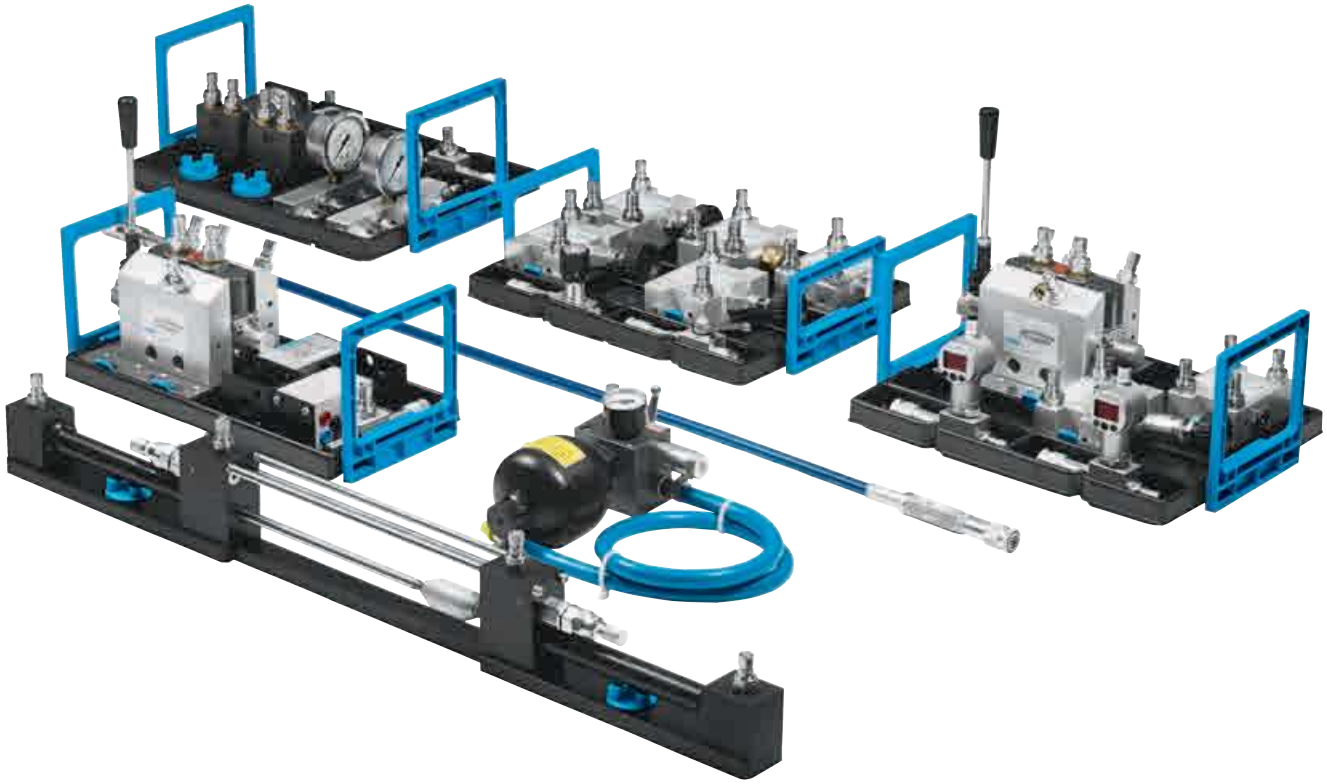
Remote control and hydraulic pilot control of mobile blocks can also be discussed and developed. In addition, the effects of upstream and downstream pressure balances can be tested.

Hydrostatic steering system
The working hydraulics can also be extended with a steering system. This teaches the construction and functioning of a hydrostatic steering system, with typical shock and suction valves and double-rod cylinders.

The influence and effect of loads on the steering cylinder are investigated. Combinations of working hydraulics and a steering system based on different priorities can also easily be set up. This illustrates the effect of steering activity on the downstream working hydraulics.

Equipment set TP 801 – Basic level

Mobile hydraulics – Working hydraulics 1



Mobile hydraulics from Festo Didactic

Mobile hydraulics has a range of specific features compared to conventional industrial hydraulics. Training content is therefore usually explained and demonstrated directly on the vehicle.

But what if the hydraulic components being explained or the vehicle are not accessible or the system is too complex for teaching purposes?

Festo Didactic's new training system closes the gap between the basic principles of hydraulics and the hydraulic systems on a vehicle.

Complexity clarified

The new training packages for mobile hydraulics take components which often appear in vehicles as highly integrated, functional modules and present them as separate, individual elements with unique symbols and clear terminal identification codes.

The teaching principle behind this is that of guiding students step-by-step from a simple component to a complex, complete picture, with practical demonstrations. The universal compatibility of the single elements allows them to be used for other function units, making this equipment set highly flexible.

Fully compatible

With uniform interfaces and a modular structure, it is possible to put together even quite complex, entire systems. All mobile hydraulics elements are compatible with the current Festo Didactic equipment sets for hydraulics fundamentals, electrohydraulics, proportional, and closed-loop hydraulics.

However, it is the double pump power unit with a pressure-limited constant displacement pump, and variable displacement pump with load sensing control, which forms the basis for the perfect training station and workstation. It also allows assembly of the load sensing system with TP 803.

Alternatively, it is possible to use a hydraulic power unit with a constant displacement pump and a volumetric flow rate of about 4 l/min for TP 801 and TP 802.

TP 801 – training content

Many vehicles and applications make use of constant displacement pumps which continue to provide volumetric flow even when no hydraulic power is required. In TP 801, the energy usage of different systems – also when under load – is compared and assessed. Systems with multiple consuming devices are set up, connected in parallel, tandem, and series, and examined in terms of characteristics, such as priority, flow rate distribution, and pressure dependency.

The training also looks into the basics of holding the load with poppet valves and lowering the load with counter pressure and a counterbalancing valve.

Complete equipment set TP 801 in equipment tray		**574161**

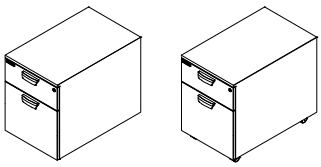
The most important components at a glance:

1	1x	Counterbalance valve	572149
2	1x	Pressure compensator for open center load sensing	572123
3	1x	3-way pressure reducing valve	544337
4	2x	Pressure relief valve	544335
5	1x	Flow control valve	152842
6	1x	Non-return valve, 0.6 MPa opening pressure	548618
7	1x	Shuttle valve	572122
8	1x	Double non-return valve, delockable	572151
9	1x	Shut-off valve	152844
10	2x	6/3-way proportional hand lever valve	572141
11	1x	Loading unit/cylinder load simulator	572145
12	1x	Diaphragm accumulator with shut-off block	152859
13	2x	Hydraulic motor	152858
14	2x	4-way distributor with pressure gauge	159395
15	3x	T-distributor	152847
16	2x	Pressure switch, electronic	548612
17	2x	Flow sensor	567191

Necessary accessories, also order:

10x	Hose line with quick release couplings, 600 mm	152960
4x	Hose line with quick release couplings, 1000 mm	152970
2x	Hose line with quick release couplings, 1500 mm	159386
2x	Digital multimeter	8040005
	4 mm Safety laboratory cables ➔ Page 155	
	Hydraulic power pack ➔ Pages 148 – 149	
	Power supply unit for mounting frame ➔ Page 155	

The equipment tray
The training package is supplied with an equipment tray, which also fits in the drawers of the workstations. A fixed drawer unit for mobile hydraulics with two drawers is recommended for particularly large components.



Fixed drawer unit for mobile hydraulics (2 drawers)
Order no. **574153**

Wheeled drawer unit for mobile hydraulics (2 drawers)
Order no. **574152**

The media on offer for TP 801
– Workbook for mobile hydraulics TP 800
– Diagnostic system TP 810 with FluidLab®-M
– Designing and simulating with FluidSIM®
– WBT Hydraulics
– WBT Electrohydraulics
– Hydraulics poster set

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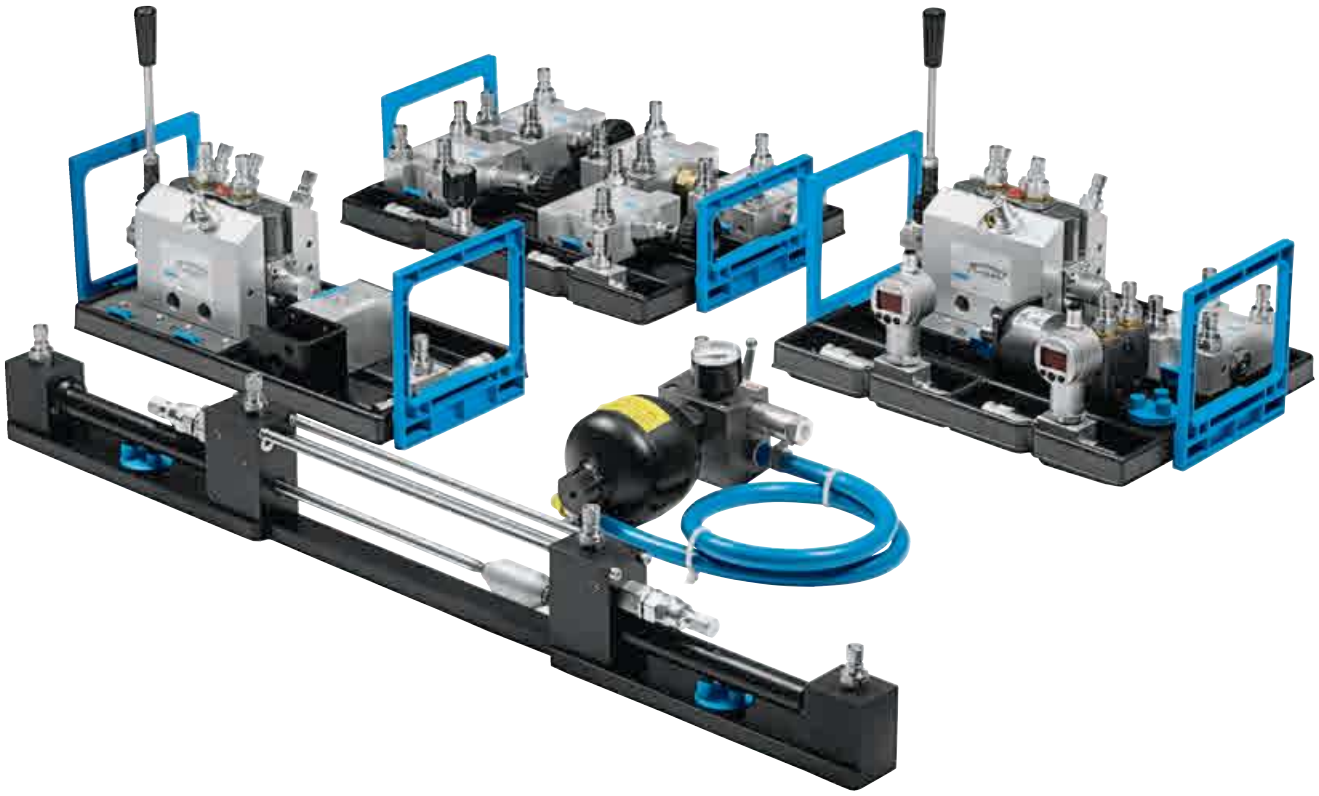
Supplementary equipment set
Mobile hydraulics



Supplementary equipment set from Hydraulics, Basic level TP 501 to Mobile hydraulics, Working hydraulics 1 TP 801

The supplementary equipment set extends TP 501 (order no. 573035) to form TP 801. The necessary accessories from TP 801 are required in order to carry out the exercises. Supplements are available on request for other/older equipment sets.

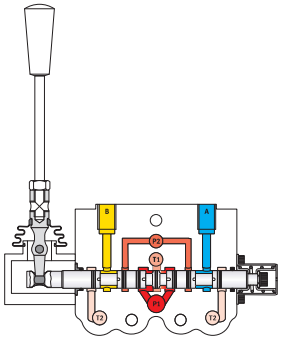
For training content, see Equipment set, Mobile hydraulics, Working hydraulics 1 TP 801.

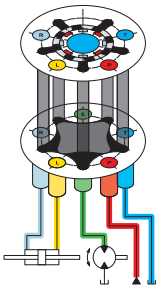
Complete supplementary equipment set TP 501 – TP 801 in equipment tray	**574160**

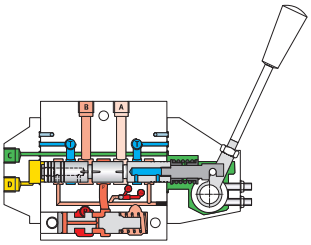
The most important components at a glance:

1x	Counterbalance valve	572149
1x	Pressure compensator for open center load sensing	572123
1x	3-way pressure reducing valve	544337
1x	Pressure relief valve	544335
1x	Flow control valve	152842
1x	Shuttle valve	572122
1x	Double non-return valve, delockable	572151
2x	6/3-way proportional hand lever valve	572141
1x	Diaphragm accumulator with shut-off block	152859
1x	Loading unit/cylinder load simulator	572145
1x	Hydraulic motor	152858
2x	T-distributor	152847
2x	Pressure switch, electronic	548612
1x	Flow sensor	567191

Mobile hydraulics TP 800
Workbook







The workbook contains 21 project exercises designed for equipment sets TP 801, TP 802 and TP 803 together with the corresponding exercise sheets and sample solutions. It thus provides a comprehensive course companion, conveying the essential knowledge and basic principles of the hydraulic systems of mobile machines.

The workbook contains:
– Basic information
– Exercise sections comprising project exercises, and sample solutions for TP 801, TP 802 and TP 803
– Training notes
– Multimedia CD-ROM with supplementary media
– Worksheets for students

The basic level contains the following topics:
– Definition of terms and basic principles of hydraulics
– Closed hydraulic circuit
– Load-sensing systems and variable displacement pumps
– Flow divider
– Mobile control blocks
– 6/3-way proportional valves and valve configurations
– Pressure balances
– Holding and lowering loads
– Hydraulic pilot control (joystick)
– Priority valves
– Steering systems

Exercise section TP 801
Working hydraulics 1
This training section, made up of nine project exercises, is designed for the equipment set TP 801.

Each project exercise begins by presenting the training objectives. Next, the vehicle or application under discussion is presented. Parameters are provided to ensure a uniform starting point, and the project goal ensures a structured approach.

Energy usage
– Of flow control
– Of open center load sensing
– Of a proportional valve (supply)
– Of a proportional valve (supply and discharge) with and without open center load sensing
– Of a proportional valve with pump bypass with and without loaded cylinder

Holding load, lowering load
– Holding load (piloted non-return valves)
– Lowering load (counter pressure)
– Lowering load (counterbalancing valve)

Circuits with multiple loads
– Features of parallel connection
– Features of tandem connection
– Features of series connection

Exercise section TP 802
Hydrostatic steering system
This training section, made up of five project exercises, is designed for the equipment set TP 802.

During all project exercises, trainees set up a circuit as per the instructions and the relevant circuit diagram, and carry out measurements and calculations. Each project exercise ends with a series of questions to test trainees' understanding. The measurements, calculations, and answers can then be compared with the sample solutions and discussed.

Basic principles of hydrostatic steering
– Structure of a steering system with through-rod cylinders
– Structure of a steering system with two differential cylinders
– Displacement of the steering valve
– Emergency steering characteristics of the steering valve
– Loads and overloads in the steering system
– Torque dependency of the steering valve
– Priorities of the steering system and secondary loads

Exercise section TP 803
Working hydraulics 2
This training section, made up of seven project exercises, is designed for the equipment set TP 803.

The content builds on the training content of TP 801, Working hydraulics 1 and expands it to include the complex topic of systems with a variable displacement pump with load sensing control. However, the complexity is kept to a manageable level because the project exercises are progressive, each building on the one before.

Load-sensing systems
– Design and function of a control block
– Control block with closed center load sensing
– Control block with two loads
– Flow rate limitation on the control block
– Pilot control of a control block
– Dependencies of load and flow
– Functioning of an upstream pressure balance
– Pressure compensation for load sensing
– Characteristics of upstream pressure balances when there is more than one load
– Characteristics of downstream pressure balances when there is more than one load

L. Unan, U. Schedel, C. Löffler
Edition 2013, 540 pages, colour, in folder.

Campus license (➔ Page 19):

de	**574165**
en	**574166**
es	**8042424**

Equipment set TP 802 – Advanced level

Mobile hydraulics – Hydrostatic steering system

Hydrostatic steering system

Hydrostatic steering is an essential subsystem in many mobile machines and is especially well-suited to managing high steering forces.

The number and design of the components are specifically adapted to the projects in the workbook. This ensures a maximum return on the training with minimum effort.

For multiple use

As with all Festo Didactic training packages, including mobile hydraulics, all components are designed to be used as parts of a single, compatible system. This means that many parts at basic level can also be used for experiments at advanced levels. Long-term maintenance of the interfaces is also an important part of the design, whether mechanical with Quick-Fix, hydraulic with low-leakage couplings, or electrical with safety plug technology.

Components and accessories from the equipment set TP 801 are required to carry out the projects.

Safety first!

Safety in the use of our training system is top priority. Many mobile hydraulics elements are not designed to be pressure resistant. This is why our oil return ports use an open coupling system. Students should nonetheless be made fully aware of safety matters. Making sure connections are correct will minimize impact on resources and the environment.

TP 802 – training content

TP 802 promotes the practical testing and technical measurement of the structure and method of operation of a hydrostatic steering system, comprising a steering valve, anti-shock and anti-cavitation valves, steering cylinder(s), constant-displacement pump, and (if needed) secondary loads.

The basics include the structure of different steering systems with through-rod and differential cylinders, and determining the displacement and the torque dependencies of the steering unit. In addition, emergency steering characteristics are explored and tested. An overload is applied to the system, its behavior is analyzed and anti-shock valves are set accordingly. The steering system's priority over a secondary load also forms part of this training package.

Complete equipment set TP 802 in equipment tray		**574162**

The most important components at a glance:

1	1x Steering unit (Orbitrol)	572146
2	1x Shock and anti-cavitation valve	572148
3	1x 4/3-way hand lever valve, relieving mid-position (AB –› T), detenting	544344
4	1x Tubing line for unpressurized return	573024
5	1x 4-way return header, unpressurized	573026

Necessary accessories, also order:

9x	Hose line with quick release couplings, 600 mm	152960
4x	Hose line with quick release couplings, 1000 mm	152970
3x	Hose line with quick release couplings, 1500 mm	159386
2x	Digital multimeter	8040005
	4 mm Safety laboratory cables ➔ Page 155	
	Hydraulic power pack ➔ Pages 148 – 149	
	Power supply unit for mounting frame ➔ Page 155	

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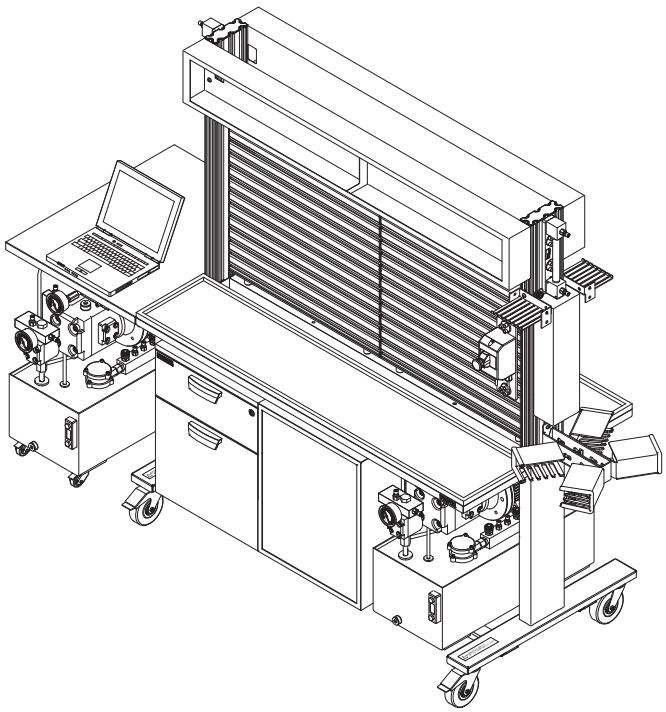
The media on offer for TP 802
- Workbook for mobile hydraulics TP 800
- Diagnostic system TP 810 with FluidLab®-M
- Designing and simulating with FluidSIM®
- WBT Hydraulics
- WBT Electrohydraulics
- Hydraulics poster set

The workstation system
Learnline has a modular design and offers an almost unlimited range of configuration possibilities for the Learnline workstation, such as the table extension for PC-assisted measurement with TP 810 and FluidLab®.

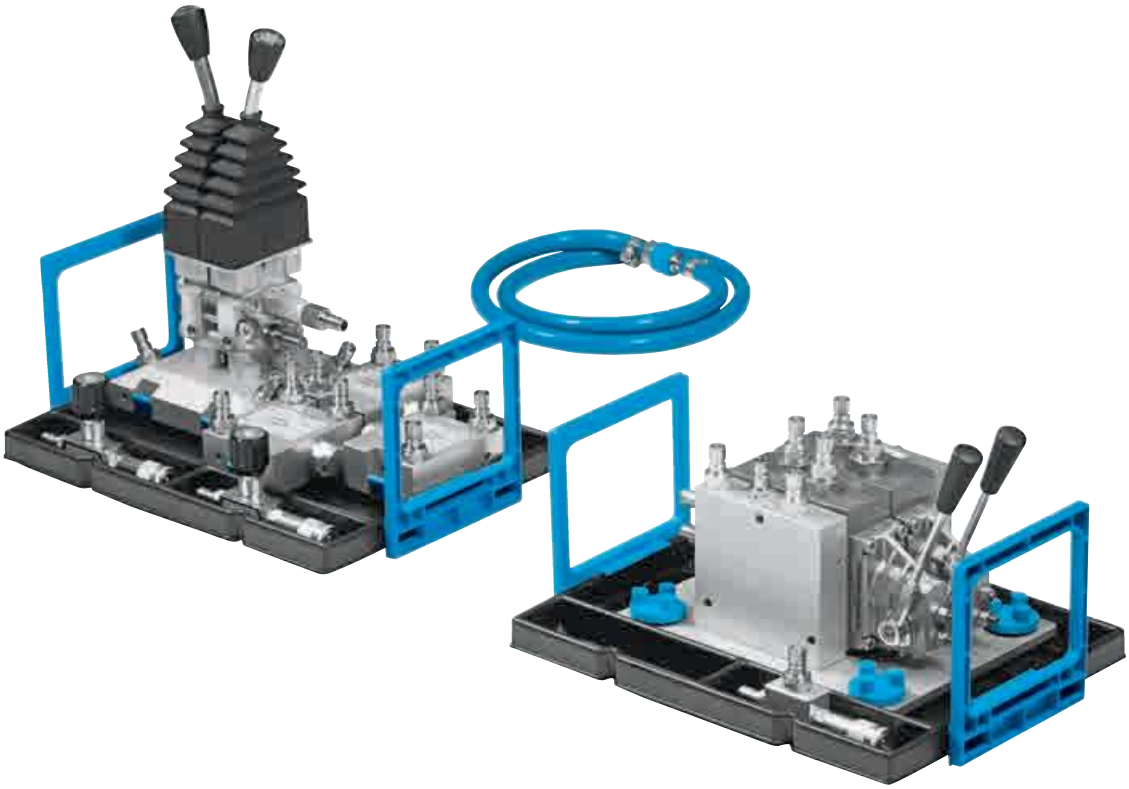
Learnline has a profile surface area of 1400 x 700 mm per side – lots of room for large components and complex circuits.

Quality isn't compromised, as its construction and functionality are the very best. The torsionally rigid design and the high-quality coating on the work surface and frame guarantee a long service life despite high loads. Learnline can handle the hard daily lesson routine, as well as a vibrational load during the hydraulic position control.



Equipment set TP 803 – Advanced level

Mobile hydraulics – Working hydraulics 2



Working hydraulics 2

The challenge for the efficient operation of machines is how to handle frequently changing loads and fluctuating speeds during the operation cycle.

Constant displacement pump systems generally have a very poor degree of efficiency in such cases, as they are always designed for the highest, most likely pressure and flow rate.

Load-sensing systems are different. Both the pressure and the flow rate are adapted to the actual needs. This requires a variable displacement pump with a load-sensing (LS) controller, as well as valves with the right type of control paths for load feedback to the pump controller.

System behavior under load

In practical applications, the challenge is to handle continuously changing large loads reliably and efficiently. To reflect this challenge properly in the training system, we have developed a cylinder load simulator which allows an extremely wide range of load types, even with the TP 801 set.

An active or passive hydraulic counteracting force is applied to a combination of two differential or through-rod cylinders.

By doing away with large working loads and integrating an overload safeguard, the cylinder load simulator is not just highly flexible, but also safe to use and extremely manageable.

TP 803 – Working hydraulics advanced level training content

The advanced level focuses on the load-sensing system with variable displacement pump, control block, pilot control, and up to two loads.

Components and accessories from the equipment sets TP 801 and TP 802 are required to carry out the projects.

The content:

- Design, mode of operation, and setting of a variable displacement pump with load sensing controller and control block.
- Comparing and assessing the energy usage of flow control, open center load sensing and closed center load sensing with a variable displacement pump.
- Remote control and hydraulic pilot control of control blocks.
- Characteristics of load sensing systems with upstream and downstream pressure balances (flow distribution independent of load pressures).

Complete equipment set TP 803 in equipment tray		**574163**

The most important components at a glance:

1	1x	Pilot valves (Joystick), 2x2-channel	572147
2	1x	Mobile valve block, Load sensing	572144
3	1x	Pressure compensator, upstream (pre)	573023
4	2x	Pressure compensator, downstream (post)	572741
5	2x	Flow control valve	152842
6	1x	T-distributor	152847
7	1x	Tubing line for unpressuriZed return	573024

Necessary accessories, also order:

10x	Hose line with quick release couplings, 600 mm	152960
6x	Hose line with quick release couplings, 1000 mm	152970
3x	Hose line with quick release couplings, 1500 mm	159386
2x	Digital multimeter	8040005
	4 mm Safety laboratory cables ➔ Page 155	
	Hydraulic power pack ➔ Pages 148 – 149	
	Power supply unit for mounting frame ➔ Page 155	

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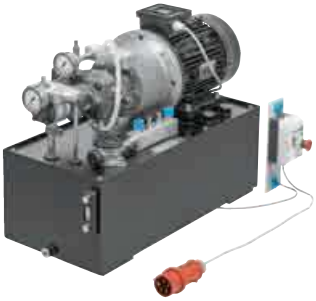
The hydraulic power unit
The power unit used for the mobile hydraulics training packages is a variable and constant displacement pump combination. The constant displacement pump is ideal both for the basic principles of hydraulics and electrohydraulics and for the mobile hydraulics sets TP 801 and TP 802. With TP 803, the focus shifts to the variable displacement pump with LS controller, with the function of the constant-displacement pump now being applied to active hydraulic loads on the cylinder load simulator.



The media on offer for TP 803
- Workbook for mobile hydraulics TP 800
- Diagnostic system TP 810 with FluidLab®-M
- Designing and simulating with FluidSIM®
- WBT Hydraulics
- WBT Electrohydraulics
- Hydraulics poster set

Equipment set TP 810 – Advanced level

Diagnostic system FluidLab®-M: Measurement – Visualization – Analysis

A greater understanding of diagnostic systems

System diagnostics, condition monitoring, and energy efficiency are becoming more important all the time.

A fluid power system can only be optimally set if measurements are taken at the correct points. The correct conclusions must then be drawn from the measurement data. However, with dynamic system conditions, measuring techniques such as the use of a pressure gauge are pushed to their limits. That is why permanent measured data acquisition with visualization of measurement curves is necessary. Servicing and maintenance personnel then have access to crucial information for the tasks at hand and settings required. FluidLab®-M is the universal measuring tool for all pneumatic and hydraulic training packages.

The new FluidLab-M®

Do you want the measuring system for your fluid power circuits, processes, or systems to be simple but high quality? To start with, any number of sensors with voltage output and connected to a PC via EasyPort, can be adapted to the measurement software in a few simple steps. Your sensor settings, designations, and ranges of values are stored and immediately ready to use next time. FluidLab-M® can record up to four analog and digital inputs simultaneously.

Reproducible measurement processes

Simply start the measurement and record digital and analog input and output signals. During the measurement, you can set and reset the digital outputs manually and control the analogue outputs. A reproducible, controlled measurement process is important if you want to be able to compare series of measurements. This is a particularly strong point of FluidLab®-M. The measurement process can be programmed and saved directly in a text editor using a simple programming code. For example, delay times, jump or repeat commands, and periodic analog output signals can all be programmed.

Visualization and analysis

Two display modes are available for measured-data data acquisition. One displays up to two Y-axes over time (X-axis). For example, changes in pressure and flow rate over the course of a cycle can be recorded. The other is an XY graph to record e.g., a flow control or pump characteristic; in other words, pressure over flow rate. The measured values can be saved and superimposed over other records within the software, or compared and analyzed. There are two measuring cursor and zoom and detail functions available for the purpose of analysis. Alternatively, a spreadsheet program such as Microsoft Excel can be used to open and work with the measured values.

Complete equipment set TP 810 in equipment tray	**574164**

The most important components at a glance:

1	1x	EasyPort USB	548687
2	1x	Analog cable, parallel, 2 m	529141
3	1x	I/O data cable with SysLink connectors (IEEE 488) at both ends, 2.5 m	34031
4	1x	Universal connection unit, digital (SysLink)	162231
5	1x	Quick-Fix screw adapter	549806
6	1x	Connection unit, analog	567232
7	1x	FluidLab-M Single license, de/en	573029

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System requirements
– PC with Windows 7/8/10
– Pentium® III or equivalently
– 2 GB RAM
– CD-ROM disk drive
– USB 2.0 or serial interface
– 1280 x 1024 pixels
– NI LabView 2012 Runtime (included in scope of delivery)

Measurements can be carried out with any sensor with voltage output and 4 mm safety plug. Sensors are not included in scope of delivery.

The media on offer for TP 810
– Workbook for mobile hydraulics TP 800
– Designing and simulating with FluidSIM®
– WBT Hydraulics
– WBT Electrohydraulics
– Hydraulics poster set