

Training Systems for Hydraulics



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Drive & Control Academy

Knowledge – the decisive competitive advantage

www.boschrexroth.de/academy



As a leading specialist in drive and control technology worldwide, Bosch Rexroth has a unique level of technological expertise. At the Drive & Control Academy, we pass on our expertise and support in this way tailored training, development and qualification of technical specialists.

Knowledge is everything

Employees' specialist knowledge and expertise provide a crucial advantage for their company on a competitive global market. Under the tutelage of the Drive & Control Academy, Rexroth offers trainees an extensive portfolio of educational products in the field of drive and control technologies, which is solidly rooted in industrial practice.

The Drive & Control Academy sets the standard for training, especially when it comes to setting up effective learning systems for customers and employees and education and training institutions to support the acquisition of integrated expertise.

Everything we offer is based on the same principles:

- ▶ State-of-the-art, real-life equipment.
- ▶ Training tailored to specific target groups.
- ▶ Modern training methods

Training systems

For further information please visit:
www.boschrexroth.de/trainingsystems



A training system consists of the workstation, the components contained in the device sets and the project manuals. The training systems provide both novices and advanced trainees with practical knowledge in the fields of hydraulics, pneumatics, electrical drive and control technology, mechatronics and automation. They include industrial series-produced components and have internationally standardized programming languages and open interfaces.

Media

For further information please visit:
www.boschrexroth.de/trainingmedia



The software-based teaching and learning media from Rexroth are characterized by a high practical relevance and are tailored to the training courses and training systems. They include e-learning modules, technology and applications trainer, animations of components and systems and simulation-based learning units. Additionally, they include dictionaries, reference books, manuals for trainers and trainees and various tools.

Training

For further information please visit:
www.boschrexroth.de/training



New training courses and continuous development of training methods ensure that the knowledge that is transferred is the current state of the art. The methodological repertoire includes classroom training, e-learning, practical training and blended learning, which combines the advantages of face-to-face instruction with e-learning. The principle of proximity to customers is the focus of our training systems.



Terminology

Term	Explanation
Device set	A device set is an assembly of components used to carry out practical exercises.
Study topics	For a single study topic, it is possible to use more than one device set with the corresponding project manual. You can find the study topics in this catalog: On/off hydraulics, proportional servo valve technology and mobile hydraulics
Workstations	Workstations are used for receiving components from the device sets to carry out practical exercises according to the project manuals.
Training systems	A training system combines workstations, device sets and project manuals.
Spare parts	Spare parts are parts that are installed on components or workstations.
Accessories	Accessories are complementary products that can be used optionally.
BIBB	German Federal Institute for Vocational Training (Bundesinstitut für Berufsbildung)

Study topics

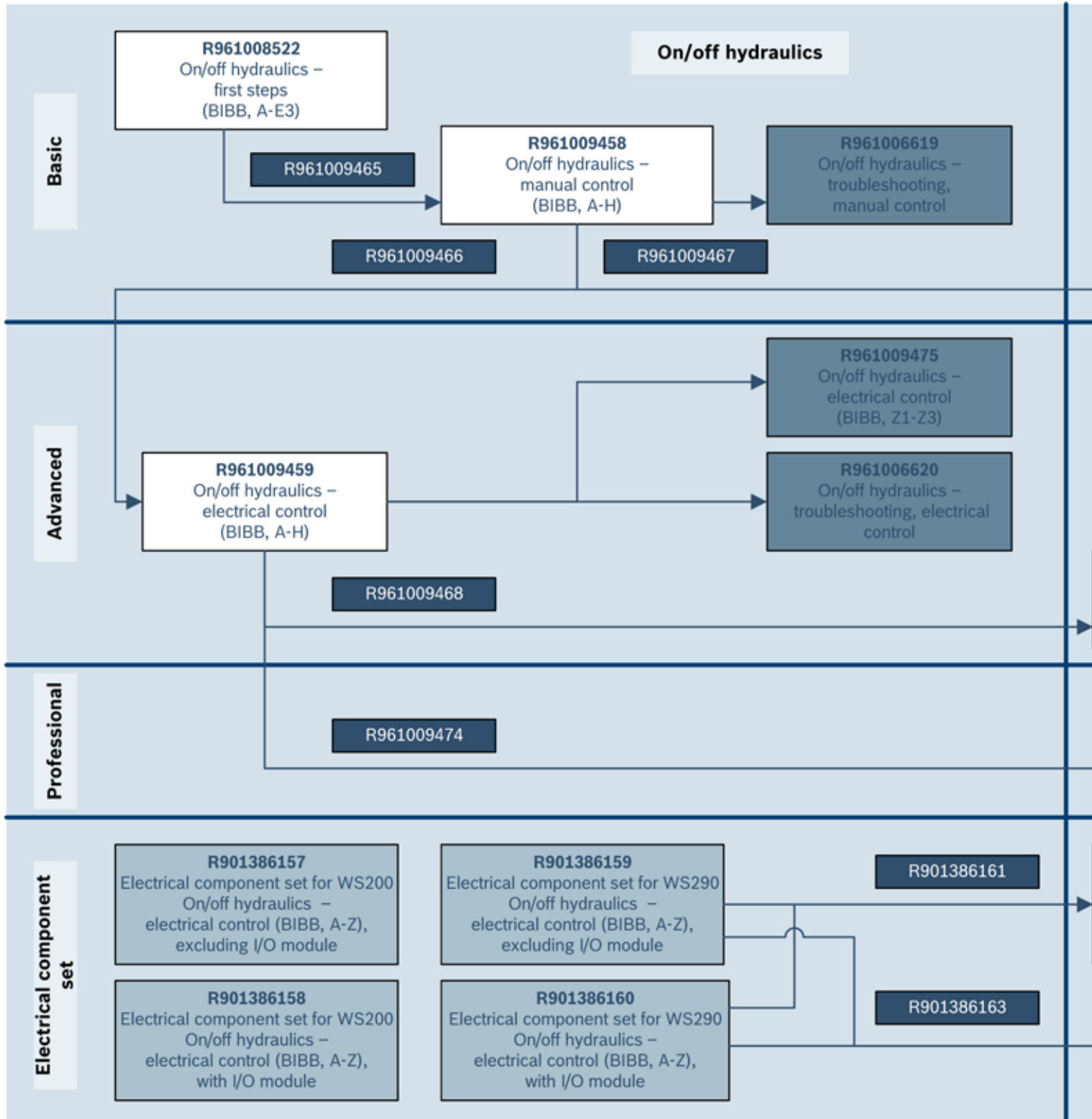


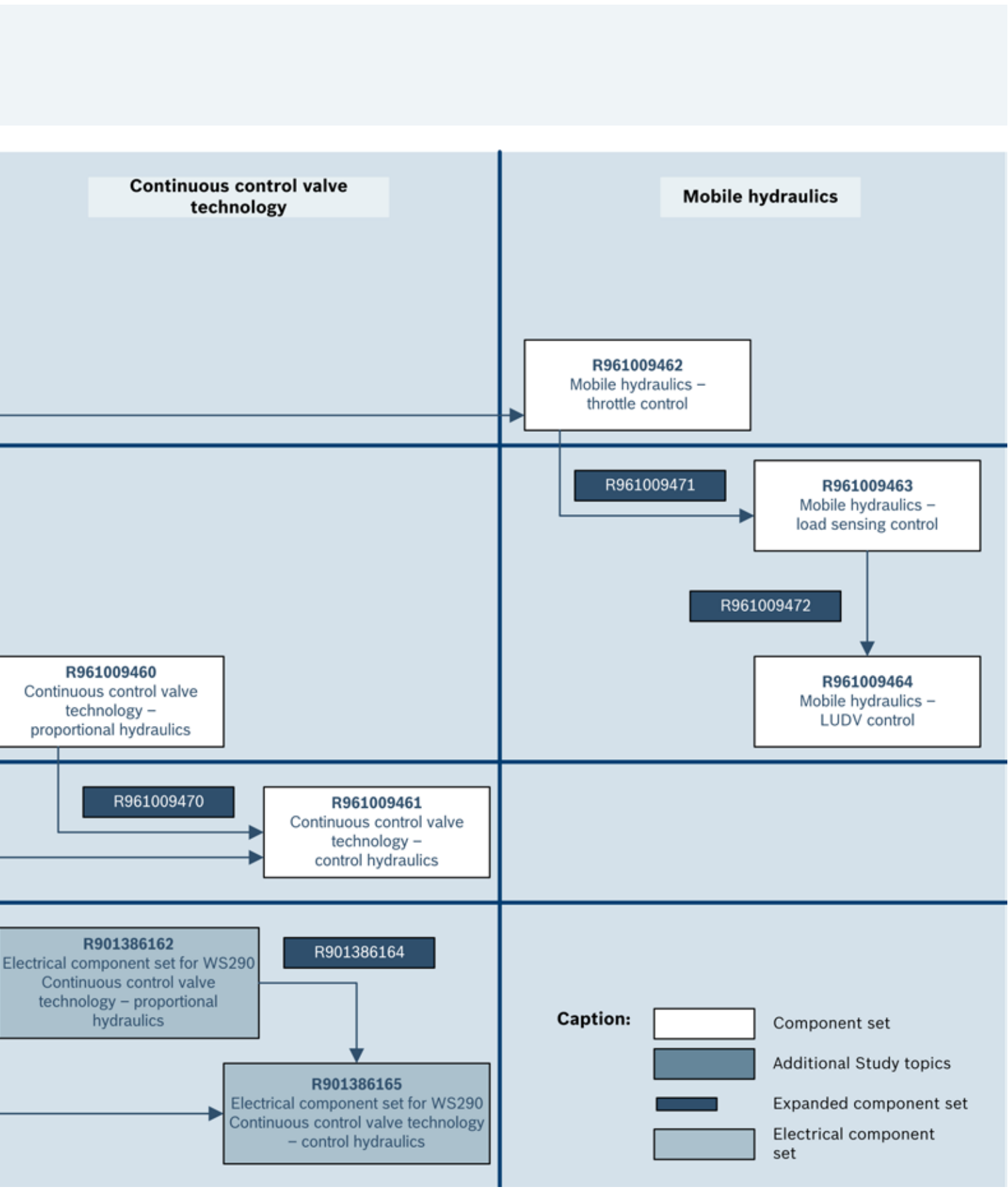
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Device sets

Overview of device and extension sets





Drive & Control Academy

Study topics

Workstations

Order examples

Components and Spare Parts

On/off hydraulics - getting started according to BIBB A-E3

The learning objectives are coordinated with the German Federal Institute for Vocational Training (BIBB) proposed topics. The project tasks are practice-oriented and match very closely orders from industrial and trade customers. The structure is planned according to didactic principles and explains the implementation of individual projects on a step-by-step basis.

Delivery includes:

- ▶ project manuals for instructors and trainees
- ▶ device set with components

Project manuals for instructors and trainees

The instructor's guide to imparting know-how is available to instructors and teachers of specific subjects. This project manual contains basic theoretical knowledge and guidance on practice-related project tasks in the field of hydraulic control technology. It contains additional details about projects and information for instructors. The trainee uses the student handbook. This manual is also used to enter measurement results and calculated parameters. Answering of project-related issues rounds off the project exercises.

Contents:

- ▶ theoretical basics on the basis of project exercises
- ▶ a practical introduction to the project exercises (identifying hydraulic components)
- ▶ commissioning a hydraulic system
- ▶ function and structure of pressure relief valves, hydraulic cylinders and directional control valves
- ▶ function of throttle check valves and pressure reducing valves



Comparison of the project exercises of Bosch Rexroth AG with the proposed exercises by the German Federal Institute for Vocational Training (BIBB)

No.	Exercise topic	BIBB exercise
01	Identify components	A
02	Commissioning	A
03	Function of a pressure relief valve	
04	Directional valves and hydraulic cylinders	B1
05	Load pressure with hydraulic cylinders	D1/E1

No.	Exercise topic	BIBB exercise
06	Supply throttling with hydraulic cylinders	D3/E1
07	Manipulating the travel velocity	E1
08		
09	The effects of discharge throttling (pressure conversion)	
10	Pressure reducing valves	E3

Trainer's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainer's manual On/off hydraulics - getting Started DE	DE	R961008759	Schalthydraulik - Erste Schritte	MANUAL TW-HY-LH 101DE	DCA-DE000147
Trainer's manual On/off hydraulics - getting Started EN	EN	R961008761	On/off hydraulics - getting started	MANUAL TW-HY-LH 101EN	DCA-EN000147

Trainee's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainee's manual "On/off hydraulics - getting started" DE	DE	R961008760	Schalthydraulik - Erste Schritte	MANUAL TW-HY-SH 101DE	DCA-DE000148
Trainee's manual "On/off hydraulics - getting started" EN	EN	R961008762	On/off-hydraulics - getting started	MANUAL TW-HY-SH 101EN	DCA-EN000148

Device set for WS200/WS290 On/off hydraulics - getting started

Material number	R961008522
Type short description	DEVICE SET TS-HS 101-1X

This device set is used to impart the basics of hydraulics based on project work. Only industrial components of size 6 are used that have been specially prepared for use in the training exercises.
 The device set matches the On/off Hydraulics - Getting Started training manual that deals with BIBB exercises A-E3. The exercises with the listed components can be performed on both the WS200 and WS290 workstations.



Item	Components of device set R961008522	Mat. no.	Quantity	Image	Page
1	Differential cylinder CD70F25/16-200 with protective housing and connection facility for load unit in WS201	R961009526	1		123
2	4/3-way directional control valve 4WMM6G5X	R961002550	1		106
3	Pressure reducing valve, directly operated DR6DP1-5X/	R961002544	1		113
4	Throttle check valve DRV06-1-1X/V	R961002495	2		117
5	Hydraulic distributor 4x	R961002485	1		134
6	Pressure gauge 0-100 bar with measuring hose	R961002715	3		159
7	Hose line 630 mm	R961002474	5		135
8	Hose line 630 mm with mini gauge port	R961002481	2		136

The recommended accessories can be found on page 30.

On/off hydraulics - manual operation according to BIBB A-H

The learning objectives are coordinated with the German Federal Institute for Vocational Training (BIBB) proposed topics. The project tasks are practical and conform to a large extent with customer orders from industry and trade. The structure is planned according to didactic principles and explains the implementation of individual projects on a step-by-step basis.

Delivery includes:

- ▶ project manuals for instructors and trainees
- ▶ device set with components

Project manuals for instructors and trainees

The instructor's guide to imparting know-how is available to instructors and teachers of specific subjects. This project manual contains basic theoretical knowledge and guidance on practice-related project tasks in the field of hydraulic control technology. It contains additional details about projects and information for instructors.

The trainee uses the student handbook. This manual is also used to enter measurement results and calculated parameters, as well as to process characteristics. Answering of project-related issues rounds off the project exercises.

Contents:

- ▶ hydraulic basics related to the project exercises
- ▶ a practical introduction to the project exercises (identifying hydraulic components)
- ▶ design of a hydraulic system (example calculation)
- ▶ hydraulic pump: function, pressure-flow characteristic
- ▶ differential cylinder function, pressure conversion, velocity, filling volume
- ▶ hydraulic motor function, torque, speed, pressure differential
- ▶ directional valve: set-up, function, piston shapes
- ▶ check valve function
- ▶ pilot-operated check valve: function
- ▶ throttle valve: function, pressure differential flow characteristic
- ▶ throttle valve: function, supply and discharge throttling
- ▶ flow control valve: function, flow pressure differential characteristic
- ▶ direct-operated pressure relief valve / pilot-operated function, pressure-flow characteristic
- ▶ direct-operated pressure relief valve: pressure level, series or parallel connection settings
- ▶ pressure reducing valve: function
- ▶ hydraulic accumulator: function
- ▶ differential circuit: control of a hydraulic circuit
- ▶ cyclical circuit: use and system behavior
- ▶ commissioning, troubleshooting



Comparison of the project exercises of Bosch Rexroth AG with the proposed exercises by the German Federal Institute for Vocational Training (BIBB)

No.	Exercise topic	BIBB exercise	No.	Exercise topic	BIBB exercise
01	hydraulic power unit	A1	10	throttle check valve	D3
02	hydraulic pump	A1	11	flow control valve	D2
03	differential cylinder (pressure conversion)	B1	12	pressure relief valve (direct-operated/pilot-operated)	E1/E2
04	differential cylinder (flow)	B1	13	control via pressure relief valve	E1
05	hydraulic motor	G2	14	pressure reducing valves	E3
06	4/3-way directional control valve	B2	15	hydraulic accumulator:	F1
07	check valve	C1	16	differential circuit:	G1
08	non-return valve, pilot-controlled	C1	17	cyclical circuit	B2/G4
09	throttle valve, adjustable	D1	18	commissioning, troubleshooting	H1

Trainer's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainer's manual "On/off hydraulics - manual operation (according to BIBB)" DE	DE	R901385280	Schalthydraulik – Manuelle Betätigung (nach BIBB)	MANUAL TW-HY-LH 201DE	DCA-DE000158
Trainer's manual "On/off hydraulics - manual operation (according to BIBB)" EN	EN	R901385282	On/Off-hydraulics – manual operation (according to BIBB)	MANUAL TW-HY-LH 201EN	DCA-EN000158
Trainer's manual "On/off hydraulics - manual operation" (according to BIBB) ES	ES	R901385286	Hidráulica de conmutación – Accionamiento manual (conforme a BIBB)	MANUAL TW-HY-LH 201ES	DCA-ES000158

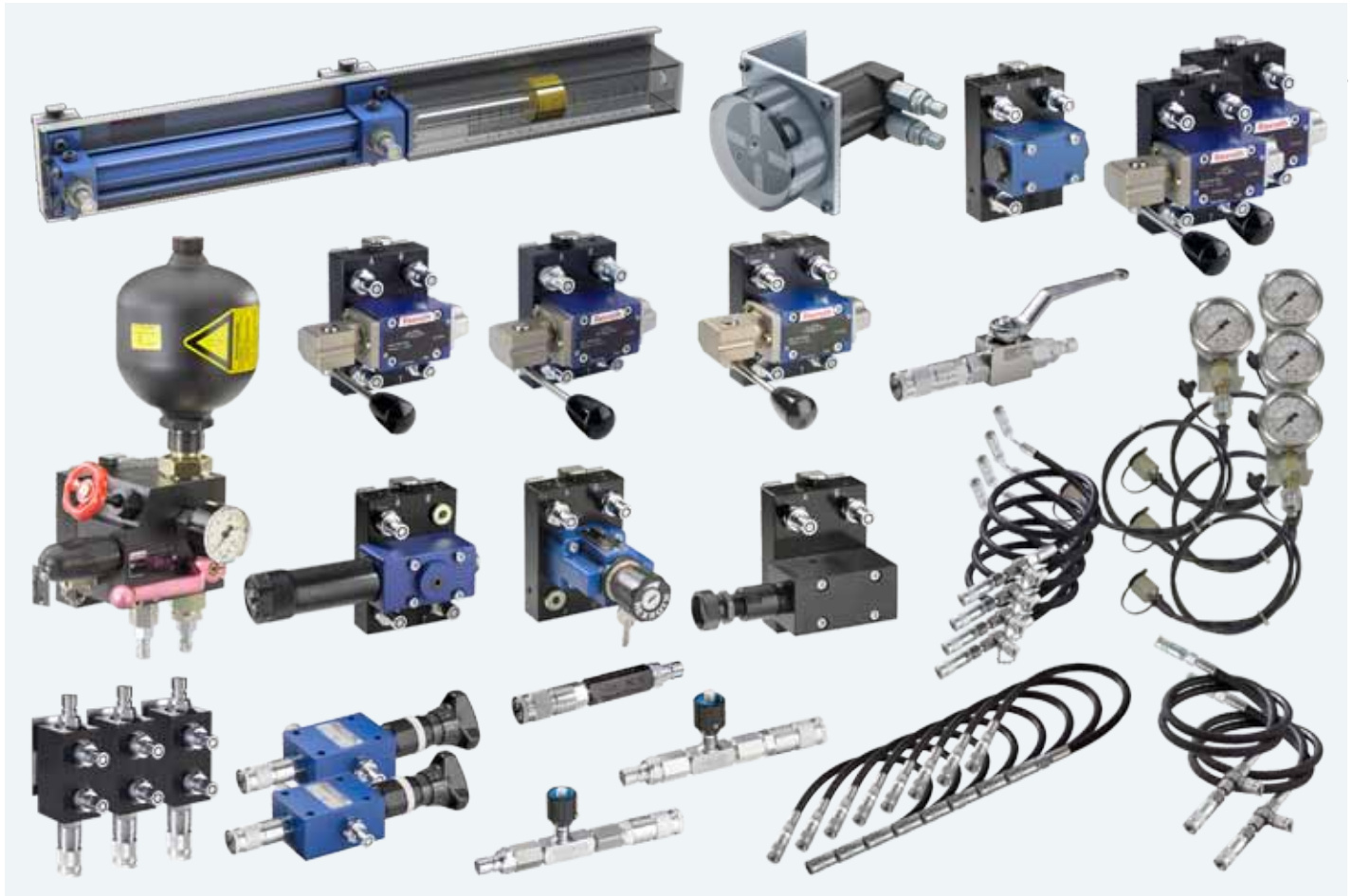
Trainee's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainee's manual "On/off hydraulics - manual operation (according to BIBB)" DE	DE	R901385281	Schalthydraulik – Manuelle Betätigung (nach BIBB)	MANUAL TW-HY-SH 201DE	DCA-DE000159
Trainee's manual "On/off hydraulics - manual operation (according to BIBB)" EN	EN	R901385283	On/off-hydraulics – manual operation (according to BIBB)	MANUAL TW-HY-SH 201EN	DCA-EN000159
Trainee's manual "On/off hydraulics - manual operation (according to BIBB)" ES	ES	R901385287	Hidráulica de conmutación – Accionamiento manual (conforme a BIBB)	MANUAL TW-HY-SH 201ES	DCA-ES000159





Device set for WS200/WS290 On/off hydraulics - manual control (according to BIBB, A-H), complete

Material number R961009458

Type short description DEVICE SET TS-HS 201-1X

This device set is used to impart the basics of hydraulics based on project work. Only industrial components of size 6 are used that have been specially prepared for use in the training exercises. The device set matches the On/off hydraulics - manual operation training manual (according to BIBB) that deals with BIBB exercises A-H. The exercises with the listed components can be performed on both the WS200 and WS290 workstations.



Item	Components of device set R961009458	Mat. no.	Quantity	Image	Page
1	Differential cylinder CD70F25/16-200 with protective housing and connection facility for load unit in WS201	R961009526	1		123
2	Planetary motor	R961008748	1		128
3	4/2-way directional control valve 4WMM6C5X	R961002552	1		106
4	4/3-way directional control valve 4WMM6G5X	R961002550	1		106

Item	Components of device set R961009458	Mat. no.	Quantity	Image	Page
5	4/3-way directional control valve 4WMM6J5X	R961002510	1		107
6	4/3-way directional control valve 4WMM6E5X/	R961002551	1		107
7	Pressure relief valve DBDH6G1X/	R961002520	2		113
8	Pressure relief valve, pilot-operated DB6K1-4X/50	R961002545	1		114
9	Pressure reducing valve, directly operated DR6DP1-5X/	R961002544	1		113
10	2-way flow control valve 2FRM6B36-3X/	R961002546	1		118
11	Throttle valve DRV06-1-1X/V	R961002539	1		117
12	Throttle check valve DRV06-1-1X/V	R961002495	1		117
13	Non-return valve S6A1.X	R961002489	1		121
14	Non-return valve, hydraulically pilot-operated SV 6 PB1-6X/	R961002513	1		122
15	Accumulator module	R961002503	1		132
16	Hydraulic distributor 4x	R961002485	3		134
17	Shut-off valve	R961002491	1		120
18	Pressure gauge 0-100 bar with measuring hose	R961002715	4		159
19	Hose line 630 mm	R961002474	8		135
20	Hose line 1000 mm with 90° fitting and mini gauge port	R961004330	4		138
21	Hose line 1500 mm with mini gauge port	R961002482	2		136

The recommended accessories can be found on page 30.

On/off hydraulics - electrical operation according to BIBB A-H and Z1-Z3

The learning objectives are coordinated with the German Federal Institute for Vocational Training (BIBB) proposed topics. The project tasks are practical and conform to a large extent with customer orders from industry and trade. The structure is planned according to didactic principles and explains the implementation of individual projects on a step-by-step basis.

Delivery includes:

- ▶ project manuals for instructors and trainees
- ▶ device sets with components

Project manuals for instructors and trainees

The instructor's guide to imparting know-how is available to instructors and teachers of specific subjects. This project manual contains basic theoretical knowledge and guidance on practice-related project tasks in the field of hydraulic control technology. It contains additional details about projects and information for instructors.

The trainee uses the student handbook. This manual is also used to enter measurement results and calculated parameters, as well as to process characteristics. Answering of project-related issues rounds off the project exercises.



Contents:

- ▶ hydraulic fundamentals related to the project exercises
- ▶ electronic fundamentals related to the project exercises
- ▶ a practical introduction to the project exercises (identifying hydraulic components)
- ▶ interpretation of a hydraulic system (example assessment)
- ▶ hydraulic pump: function, pressure-flow characteristic
- ▶ differential cylinder function, pressure conversion, velocity, filling volume
- ▶ hydraulic motor function, torque, speed, pressure differential
- ▶ directional valve: set-up, function, piston shapes
- ▶ check valve function
- ▶ pilot-operated check valve: function
- ▶ throttle valve: function, pressure differential flow characteristic
- ▶ throttle valve: function, supply and discharge throttling
- ▶ flow control valve: function, flow pressure differential characteristic
- ▶ direct-operated pressure relief valve / pilot-operated function, pressure-flow characteristic
- ▶ direct-operated pressure relief valve: pressure level, series or parallel connection settings
- ▶ pressure reducing valve: function
- ▶ hydraulic accumulator: function
- ▶ differential circuit: control of a hydraulic circuit
- ▶ cyclical circuit: use and system behavior
- ▶ commissioning, troubleshooting
- ▶ pressure switch function, hysteresis
- ▶ hydraulic circuits: rapid traverse/creep speed switching cycle, load-holding circuit, bridge rectifier, cyclical circuit for high-volume flows, accumulator charging circuits

Comparison of the project exercises of Bosch Rexroth AG with the proposed exercises by the German Federal Institute for Vocational Training (BIBB)

No.	Exercise topic	BIBB exercise	No.	Exercise topic	BIBB exercise
01	hydraulic power unit	A1	13	control via pressure relief valve	E1
02	hydraulic pump	A1	14	pressure reducing valve	E3
03	differential cylinder (pressure conversion)	B1	15	hydraulic accumulator:	F1
04	differential cylinder (flow)	B1	16	differential circuit:	G1
05	hydraulic motor	G2	17	cyclical circuit	B2/G4
06	4/3-way directional control valve	B2	18	commissioning, troubleshooting	H1
07	check valve	C1	19	pressure switch (incl. hysteresis)	E4
08	non-return valve, pilot-controlled	C1	20	rapid traverse/creep speed control	G3
09	throttle valve, adjustable	D1	21	load-holding circuit with jerk-free reduction	Z1
10	throttle check valve	D3	22	bridge rectifier	Z2
11	flow control valve	D2	23	cyclical circuit for high-volume flows	Z3
12	pressure relief valve (direct-operated/pilot-operated)	E1/E2	24	accumulator charging circuits	Z3

Trainer's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainer's manual "On/off hydraulics - electrical operation (according to BIBB)" DE	DE	R901385278	Schalthydraulik – Elektrische Betätigung (nach BIBB)	MANUAL TW-HY-LH 202DE	DCA-DE000160
Trainer's manual On/off hydraulics - electrical operation (according to BIBB) EN	EN	R901385284	On/off hydraulics - electrical operation (according to BIBB)	MANUAL TW-HY-LH 202EN	DCA-EN000160
Trainer's manual "On/off hydraulics - electrical operation (according to BIBB)" ES	ES	R901385288	Hidráulica de conmutación - Accionamiento eléctrico (conforme a BIBB)	MANUAL TW-HY-LH 202ES	DCA-ES000160

Trainee's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainee's manual "On/off hydraulics - electrical operation (according to BIBB)" DE	DE	R901385279	Schalthydraulik – Elektrische Betätigung (nach BIBB)	MANUAL TW-HY-SH 202DE	DCA-DE000161
Trainee's manual "On/off hydraulics - electrical operation (according to BIBB)" EN	EN	R901385285	On/off hydraulics - electrical operation (according to BIBB)	MANUAL TW-HY-SH 202EN	DCA-EN000161
Trainee's manual "On/off hydraulics - electrical operation (according to BIBB)" ES	ES	R901385289	Hidráulica de conmutación - Accionamiento eléctrico (conforme a BIBB)	MANUAL TW-HY-SH 202ES	DCA-ES000161





Device set for WS200/WS290 On/off hydraulics - electrical operation (BIBB, A-H), complete

Material number R961009459

Type short description DEVICE SET TS-HS 202-1X

This device set is used to impart the basics of hydraulics based on project work. Only industrial components of size 6 are used that have been specially prepared for use in the training exercises. The device set is aligned with the training manual "On/off Hydraulics - Getting Started", which deals with BIBB exercises A-H and Z1-Z3. The exercises with the listed components can be performed on both the WS200 and WS290 workstations.



Item	Components of device set R961009459	Mat. no.	Quantity	Image	Page
1	Differential cylinder CD70F25/16-200 with protective housing and connection facility for load unit in WS201	R961009526	1		123
2	Planetary motor	R961008748	1		128
3	4/2-way directional control valve 4WE6C6X/	R961002547	2		109
4	4/3-way directional control valve 4WE6G6X/	R961002548	1		109

Item	Components of device set R961009459	Mat. no.	Quantity	Image	Page
5	4/3-way directional control valve 4WE6J6X/	R961002554	1		110
6	4/3-way directional control valve 4WE6E6X/	R961002549	1		110
7	Pressure relief valve DBDH6G1X/	R961002520	2		113
8	Pressure relief valve, pilot-operated DB6K1-4X/50	R961002545	1		114
9	Pressure reducing valve, directly operated DR6DP1-5X/	R961002544	1		113
10	2-way flow control valve 2FRM6B36-3X/	R961002546	1		118
11	Throttle valve DRV06-1-1X/V	R961002539	1		117
12	Throttle check valve DRV06-1-1X/V	R961002495	1		117
13	Non-return valve S6A1.X	R961002489	1		121
14	Non-return valve, hydraulically pilot-operated SV 6 PB1-6X/	R961002513	1		122
15	Accumulator module	R961002503	1		132
16	Hydraulic distributor 4x	R961002485	3		134
17	Shut-off valve	R961002491	1		120
18	Pressure gauge 0-100 bar with measuring hose	R961002715	4		159
19	Hose line 630 mm	R961002474	8		135
20	Hose line 1000 mm with 90° fitting and mini gauge port	R961004330	4		138
21	Hose line 1500 mm with mini gauge port	R961002482	2		136

The recommended accessories can be found on page 30.

22 **Training Systems for Hydraulics** | Study topics
 On/off hydraulics - electrical operation according to BIBB A-H and Z1-Z3

Electrical device set for WS200, On-off hydraulics - electrical operation (BIBB A-H), excluding I/O module

Material number R901386157

Type short description DEVICE SET TS-HS 501-1X

To be used together with the device set on/off hydraulics - electrical operation and related project manuals.
 The electrical device set is intended for use at the WS200 workstation.



Item	Components of electrical device set R901386157	Mat. no.	Quantity	Image	Page
1	Control unit housing version BIBB module	R961009678	1		146
2	Electrical pressure switch	R961003488	1		152
3	Proximity switch, inductive	R961003106	2		151
4	Solenoid cable with LED, shape A, black	R900846807	2		149
5	Solenoid cable with LED, shape A, gray	R900846808	1		149
6	Measurement cable set, small	R900029597	1		150

Electrical device set for WS200, On-off hydraulics - electrical operation (BIBB A-H), with I/O module

Material number R901386158
 Type short description DEVICE SET TS-HS 502-1X

To be used together with the device set on/off hydraulics - electrical operation and related project manuals.
 The electrical device set is intended for use at the WS200 workstation.



Item	Electrical device set R901386158	Mat. no.	Quantity	Image	Page
1	Control unit housing version - BIBB module + I/O module	R961009675	1		146
2	Electrical pressure switch	R961003488	1		152
3	Proximity switch, inductive	R961003106	2		151
4	Solenoid cable with LED, shape A, black	R900846807	2		149
5	Solenoid cable with LED, shape A, gray	R900846808	1		149
6	Measurement cable set, small	R900029597	1		150

24 **Training Systems for Hydraulics** | Study topics
 On/off hydraulics - electrical operation according to BIBB A-H and Z1-Z3

Electrical device set for WS200, On-off hydraulics - electrical operation (BIBB A-H), excluding I/O module

Material number R901386159

Type short description DEVICE SET TS-HS 503-1X

The electrical device set is intended for use along with the on/off hydraulics - electrical operation device set and the related manual.
 The electrical device set is intended for use at the WS200 workstation.











Item	Electrical device set R901386159	Mat. no.	Quantity	Image	Page
1	Control unit 19" version - BIBB module	R961009676	1		147
2	Adapter plate 19" version - 1 switch, IEC socket, power supply cable	R901384795	1		148
3	Electrical pressure switch	R961003488	1		152
4	Proximity switch, inductive	R961003106	2		151
5	Solenoid cable with LED, shape A, black	R900846807	2		149
6	Solenoid cable with LED, shape A, gray	R900846808	1		149
7	Measurement cable set, small	R900029597	1		150

Electrical device set for WS200, On-off hydraulics - electrical operation (BIBB A-H), with I/O module

Material number R901386160
 Type short description DEVICE SET TS-HS 504-1 X




The electrical device set is intended for use along with the on/off hydraulics - electrical operation device set and the related manual.
 The electrical device set is intended for use at the WS290 workstation.



Item	Electrical device set R901386160	Mat. no.	Quantity	Image	Page
1	Control unit 19" version - BIBB module	R961009676	1		147
2	Control unit 19" version - I/O module	R961009677	1		147
3	Adapter plate 19" version - 1 switch, IEC socket, power supply cable	R901384795	1		148
4	Electrical pressure switch	R961003488	1		152
5	Proximity switch, inductive	R961003106	2		151
6	Solenoid cable with LED, shape A, black	R900846807	2		149
7	Solenoid cable with LED, shape A, gray	R900846808	1		149
8	Measurement cable set, small	R900029597	1		150

Additional study topic “On/off hydraulics - extension BIBB Z1-Z3”

Expanded device set for WS200/WS290 for On/off hydraulics - electrical control (BIBB, Z1-Z3)	
Material number	R961009475
Type short description	DEVICE SET TS-HS 412-1X
The device set is matched to the “On/off Hydraulics - Getting Started” training manual that deals with BIBB exercises A-H and Z1-Z3. The exercises with the listed components can be performed on both the WS200 and WS290 workstations.	

Item	Components of device set R961009475	Mat. no.	Quantity	Image	Page
1	Pressure relief valve pilot-operated DBW10A1-5X/	R961002553	1		116
2	Non-return valve S6A1.X	R961002489	3		121
3	Electrical pressure switch	R961003488	1		152

The recommended accessories can be found on page 30.

On/off hydraulics - hydraulics troubleshooting

Troubleshooting relates to hydraulic circuits with manually or electrically operated directional valves. The device sets are based on the contents of the BIBB device sets and deepen the subject area of commissioning and troubleshooting. The experiments provide help with acquiring practical knowledge of systematic troubleshooting. The experiments can be performed at both the WS200 and WS290 workstations.

Delivery includes:

- ▶ 1 project folder with instructor and trainee manual
- ▶ Device set with manipulated components for manually operated directional valves
- ▶ Device set with manipulated components for electrically operated directional valves

Project manuals for instructors and trainees

The following experiments are included in the troubleshooting manual:

- ▶ Experiment 1: Introduction to systematic troubleshooting, orientation guide
- ▶ Experiment 2: Various types of errors, adjustment errors, system errors
- ▶ Experiment 3: Various combined errors, adjustment errors, system errors

The troubleshooting manual can be used with the device sets for on/off hydraulics - troubleshooting, manual operation and electrical operation. The electrical control is not explicitly described in the manual.








Instructor/trainee manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainer's/trainee's manual On/off hydraulics - troubleshooting DE	DE	R900054511	Fehlersuche in Hydraulikanlagen	MANUAL TW-HY-AL 204DE	RD 00261
Trainer's/trainee's manual On/off hydraulics - troubleshooting EN	EN	R961003805	Fault detection in hydraulic systems	MANUAL TW-HY-AL 204EN	RE 00261
Trainer's/trainee's manual On/off hydraulics - troubleshooting ES	ES	R961003954	Búsqueda de fallos en instalaciones hidráulicas	MANUAL TW-HY-AL 204ES	RS 00261

Additional study topic “On/off hydraulics - extension troubleshooting manual operation”

Device set for WS200/WS290 On/off hydraulics - troubleshooting, manual operation	
Material number	R961006619
Type short description	DEVICE SET TS-HS 203-1X
The device set includes components with integrated defects for training setups for systematic troubleshooting in hydraulic systems. The device set is aligned with the manual On/off hydraulics - troubleshooting. The exercises with the listed components can be performed on both the WS200 and WS290 workstations.	



Item	Device set R961006619	Mat. no.	Quantity	Image	Page
1	4/3-way directional control valve 4WMM6G5X manipulated	R961006553	1		106
2	Pressure relief valve DBDH6G1X/100 manipulated	R961006549	1		*
3	Pilot-controlled pressure relief valve DB6K1-4X/50YV manipulated	R961006550	1		*
4	Non-return valve S6A1.X with hose 630 mm manipulated	R961006552	1		*
5	Inspection glass	R961006596	1		133

*Items 2 to 4 not available separately

The recommended accessories can be found on page 30.






Additional study topic “On/off hydraulics - extension troubleshooting electrical operation”

Device set for WS200/WS290 On/off hydraulics - troubleshooting, electrical operation

Material number R961006620
 Type short description DEVICE SET TS-HS 204-1X

Except for the electrically operated directional valve 4WMM6G5X (R961006553), the device set is identical with the device set R961006619. Exercise installations can be taken from the previous manual. The electrical control is not explicitly described in the manual.



Item	Device set R961006620	Mat. no.	Quantity	Image	Page
1	4/3-way directional control valve 4WMM6G5X manipulated	R961006551	1		*
2	Pressure relief valve DBDH6G1X/100 manipulated	R961006549	1		*
3	Pilot-controlled pressure relief valve DB6K1-4X/50YV manipulated	R961006550	1		*
4	Non-return valve S6A1.X with hose 630 mm manipulated	R961006552	1		*
5	Sight glass	R961006596	1		133






*Items 1 to 4 not available separately

The recommended accessories can be found on page 30.

On/off hydraulics - Accessories

Measuring equipment is needed for the exercises in on/off hydraulics to measure the flow, speed and pressure. Further accessories can be found on page 64.

We recommend:

Item	Components	Mat. no.	Quantity	Image	Page
1	Basic measuring device set	R961009563	1		155
2	Measuring glass for WS201	R961009485	1		161
or	Measuring glass 2.5l for WS290	R961002564	1		166
3	Filling and test equipment for hydraulic accumulators	0538103012	1		132
4	Pressure relief coupling	R961002927	1		138

Proportional servo valve technology - proportional hydraulics

In preparation for their future careers, students should work practically and largely independently and they should learn how to act in a professional context. This means that core and technical skills are taught in an integrated manner including independent planning, execution and monitoring of all practical project tasks.

Delivery range:

- ▶ “Proportional servo valve technology” project manual for instructors and trainees
- ▶ Device sets for WS290 proportional servo valve technology - proportional hydraulics with the components

Project manuals for instructors and trainees

This manual is intended for instructors and trainers of proportional servo valve technology. Project exercises are performed at the WS290 workstation and are described in detail. The projects are based on practical examples from electro-hydraulic control technology. Trainees are expected to have a basic knowledge of hydraulics and electrics. Before the projects are executed, the previous project manuals up to “On/off hydraulics - Electrical operation” should have been completed. General explanations of proportional servo valve technology form the introduction to this topic.

Before carrying out the project exercises, general aspects of safety and safety information indicate potential hazards. In general, the results that are documented in the manual for teachers and trainers should serve as a guide.



Numbers of the project exercises and the respective topic					
01	Set up cylinders with external potentiometer as command value specification	07	Set motion sequence with 4 square ramps		
02	Set up cylinders with SWMA1 setpoint module as command value specification	08	Set discharge with 2 proximity switches		
03	Set SWMA1 setpoint module with 4 command values	09	Set automatic discharge with 3 proximity switches		
04	Set SWMA1 setpoint module with 4 command values	10	Set system pressure with external potentiometer		
05	Set braking distance using proximity switch signal	11	Set up cylinders with 2 different pressure levels		
06	Pressure conditions at the proportional servo valve and influence on the speed and braking distance	12	Automatic discharge with proportional servo valve		

Trainer's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainer's manual "Proportional servo valve technology - proportional hydraulics" DE	DE	R961003779	Projekthandbuch Stetigventiltechnik (Proportionaltechnik)	MANUAL TW-HY-LH 231DE	RD 00847
Trainer's manual "Proportional servo valve technology - proportional hydraulics" EN	EN	R961003873	Project manual proportional servo valve technology	MANUAL TW-HY-LH 301EN	RE 00847
Trainer's manual "Proportional servo valve technology - Proportional hydraulics" ES	ES	R961003872	Manual de proyecto Técnica de válvulas continuas	MANUAL TW-HY-LH 301ES	RS 00847

Trainee's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainee's manual "Proportional servo valve technology - proportional hydraulics" DE	DE	R961003780	Projekthandbuch Stetigventiltechnik (Proportionaltechnik)	MANUAL TW-HY-SH 301DE	RD 00848
Trainee's manual "Proportional servo valve technology - proportional hydraulics" EN	EN	R961003875	Project manual proportional servo valve technology	MANUAL TW-HY-SH 301EN	RE 00848
Trainee's manual "Proportional servo valve technology - proportional hydraulics" ES	ES	R961003874	Manual de proyecto Técnica de válvulas continuas	MANUAL TW-HY-SH 301ES	RS 00848

Device set for WS290 Proportional servo valve technology - proportional hydraulics, complete

Material number	R961009460
Type short description	DEVICE SET TS-HS 301-1X

The device set is used to impart practical examples from electro-hydraulic control technology based on project work. Only components which meet industry standards and which are specially prepared for use in the training exercises are used. The device set is aligned with the proportional servo valve technology - proportional hydraulics manual. The exercises with the listed components can be performed at the WS290 workstation.



Item	Components of device set R961009460	Mat. no.	Quantity	Image	Page
1	Differential cylinder CD70F25/16-400 with protective housing	R961003495	1		124
2	4/3-way directional control valve 4WE6E6X/	R961002549	1		110
3	4/3-way proportional directional control valve 4WREE6E08-2X/ with int. elec. and load simulation	R961003533	1		111
4	Pressure relief valve DBDH6G1X/	R961002520	1		113
5	Proportional pressure relief valve DBEE6-1X/50	R961003924	1		116
6	Throttle check valve DRV06-1-1X/V	R961002495	1		117
7	Non-return valve S6A1.X	R961002489	1		121
8	Pressure gauge 0-100 bar with measuring hose	R961002715	3		159
9	Hose line 630 mm	R961002474	4		135
10	Hose line 1000 mm with 90° fitting and mini gauge port	R961004330	3		138

The recommended accessories can be found on page 41.







Electrical device set for WS290 proportional servo valve technology - proportional hydraulics






Material number R901386162

Type short description DEVICE SET TS-HS 506-1X

To be used together with the device set proportional servo valve technology - proportional hydraulics and related project manuals.
This electrical device set is intended for use at the WS290 workstation.



Item	Components of electrical device set R901386162	Mat. no.	Quantity	Image	Page
1	Control unit 19" version - BIBB module	R961009676	1		147
2	Switching element 19" version - 1 switch + 2 push buttons, 3 NO contacts, 3 NC contacts	R961009617	1		139
3	Display unit 19" version - 2 displays, max. display range 0-20 V	R961009623	1		141
4	Adapter plate 19" version - circular connector / lab jack	R961009630	1		142
5	Command value encoder 19" version - with ramp	R961009631	1		141
6	Command value encoder 19" version - +/- 10 V	R961009632	1		141

Item	Components of electrical device set R901386162	Mat. no.	Quantity	Image	Page
7	Adapter plate 19" version - 1 switch, IEC socket, power supply cable	R901384795	1		148
8	Electrical pressure switch	R961003488	1		152
9	Proximity switch, inductive	R961003106	3		151
10	Cable, 7-pin for integrated electronics	R961003550	1		151
11	Cable set for setpoint measurement	R961009488	1		151
12	Measurement cable set, large	R900021502	1		150

Proportional servo valve technology device sets - control hydraulics

In preparation for their future careers, students should work practically and largely independently and they should learn how to act in a professional context. This means that core and technical skills are taught in an integrated manner including independent planning, execution and monitoring of all practical project tasks

Delivery range:

- ▶ “Analog control loop” project manual for instructors and trainees
- ▶ Device sets for WS290 proportional servo valve technology - hydraulic control with the components

Project manuals for instructors and trainees

This manual is intended for instructors and trainers of proportional servo valve technology. Project exercises are performed at the WS290 workstation.

In the “analog control loop” project manual, practical exercises are described for understanding hydraulic control technology. These exercises are intended as an introduction to practical control technology.

First, the problem of maintaining a position at different loads with an open control distance is dealt with. This makes it possible to recognize the need for and the advantages of a closed control circuit.

Subsequently, components of the electro-hydraulic control circuit are presented, their structure and function are explained and basic safety instructions for performing the exercises are given.

Contents of the project exercises:

- ▶ 1. Adjusting the position of the 4/3 directional valve
- ▶ 2. Adjusting the proportional servo valve
- ▶ 3. Position control



Trainer's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainer's manual "Proportional servo valve technology - control hydraulics" DE	DE	R961005011	Projekthandbuch Analoger Positionsregelkreis	MANUAL TW-HY-LH 302DE	RD 09979
Trainer's manual "Proportional servo valve technology - control hydraulics" EN	EN	R961005091	Project manual Analog position control loop	MANUAL TW-HY-LH 302EN	RE 09979






Trainee's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainee's manual "Proportional servo valve technology - control hydraulics" DE	DE	R961005010	Projekthandbuch Analoger Positionsregelkreis	MANUAL TW-HY-SH 302DE	RD 09980
Trainee's manual "Proportional servo valve technology - control hydraulics" EN	EN	R961005092	Project manual Analog position control loop	MANUAL TW-HY-SH 302EN	RE 09980

Component set for WS290 Proportional servo valve technology - control hydraulics, complete


Material number	R961009461
Type short description	DEVICE SET TS-HS 302-1X

This device set is used to impart practical applications of a simple electro-hydraulic position control loop. Only components which meet industry standards and which are specially prepared for use in the training exercises are used. The device set is matched to the MANUAL "Proportional servo valve technology - control hydraulics". The exercises with the listed components can be performed at the WS290 workstation.



Item	Components of device set R961009461	Mat. no.	Quantity	Image	Page
1	Load unit, controllable, for dynamic load simulation	R961004486	1		126
2	4/4-way closed loop control valve 4WRPEH6 with integrated electronics	R961002509	1		112
3	4/2-way directional control valve 4WE6C6X/	R961002547	1		109
4	4/3-way directional control valve 4WE6E6X/	R961002549	1		110
5	Pressure relief valve DBDH6G1X/	R961002520	1		113

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 Proportional servo valve technology device sets - control hydraulics

Item	Components of device set R961009461	Mat. no.	Quantity	Image	Page
6	Pressure reducing valve, directly operated DR6DP1-5X/	R961002544	1		113
7	Non-return valve S6A1.X	R961002489	1		121
8	Hydraulic distributor 4x	R961002485	2		134
9	Pressure gauge 0-100 bar with measuring hose	R961002715	4		159
10	Hose line 630 mm	R961002474	7		135
11	Hose line 1000 mm with 90° fitting and mini gauge port	R961004330	5		138







The recommended accessories can be found on page 41.

Electrical component set for WS290 Proportional servo valve technology - control hydraulics







Material number R901386165
 Type short description DEVICE SET TS-HS 509-1X

To be used together with the device set "Proportional servo valve technology - control hydraulics" and related project manuals.
 This electrical device set is intended for use at the WS290 workstation.



Item	Components of electrical device set R901386165	Mat. no.	Quantity	Image	Page
1	Control unit 19" version - BIBB module	R961009676	1		147
2	Operating module TS-BPS 30,0, analog controller module, 30DU	R961004782	1		142
3	Switching element 19" version - 1 switch + 2 push buttons, 3 NO contacts, 3 NC contacts	R961009617	1		139
4	Display unit 19" version - 2 displays, max. display range 0-20 V	R961009623	1		141
5	Adapter plate 19" version - circular connector / lab jack	R961009630	1		142
6	Command value encoder 19" version - with ramp	R961009631	1		141






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 Proportional servo valve technology device sets - control hydraulics

Item	Components of electrical device set R901386165	Mat. no.	Quantity	Image	Page
7	Command value encoder 19" version - +/- 10 V	R961009632	1		141
8	Adapter plate 19" version - 1 switch, IEC socket, power supply cable	R901384795	1		148
9	Proximity switch, inductive	R961003106	1		151
10	Cable, 7-pin for integrated electronics	R961003550	1		151
11	Cable set for setpoint measurement	R961009488	2		151
12	Measurement cable set, large	R900021502	1		150

Continuous valve technology - Accessories

Measuring equipment, such as a multimeter for flow and pressure measurement, is necessary for the exercises in continuous valve technology. Further accessories can be found on page 64.

We recommend:

Item	Components	Mat. no.	Quantity	Image	Page
1	Basic measuring device set	R961009563	1		155
and	Measuring glass 2.5 l for WS290	R961002564	1		166
2	Gear volumetric flow sensor	R961002508	1		157
and	Measurement cable for ISDS	R900733207	1		157
and	Measuring device set 3020	R913038909	1		154
3	Multimeter VC175	R913038027	1		154
4	Pressure relief coupling	R961002927	1		138

Mobile hydraulics - throttle control

In preparation for their future careers, students should work practically and largely independently and they should learn how to act in a professional context. This means that core and technical skills are taught in an integrated manner including independent planning, execution and monitoring of all practical project tasks.

Delivery range:

- ▶ Project manual “Mobile hydraulics throttle control 3SM-12” for teachers and for trainees
- ▶ Device sets for WS290 mobile hydraulics - throttle control with the components

Project manuals for instructors and trainees

The projects are based on practical examples from mobile control technology. Project exercises are performed at the WS290 workstation.

It is recommended to complete each project in sequence. Trainees are expected to have a basic knowledge of hydraulics. Before the projects are executed, the previous project manuals up to “On/off hydraulics - Manual operation” should have been completed.

Structure of the project manual:

- ▶ Overview of the historical development of mobile hydraulics
- ▶ Technological classifications of throttle control and its application fields on different machines
- ▶ Fundamentals of mobile hydraulics in mobile working machines
- ▶ Basic principles of hydraulics, throttle control and their operation, as well as explanation of special symbols
- ▶ Structure and function of a 6/3 directional control valve, load holding valve, primary and secondary valve and pilot controller

Before carrying out the project exercises, general aspects of safety and safety information indicate potential hazards.



Numbers of the project exercises and the respective topic			
01	Flow control and velocity control	06	Secondary valves
02	Pressure control and power control	07	Parallel operation
03	Hydraulic pilot control	08	Control characteristics
04	Speed with different loads	09	Boom lowering and force structure
05	Load holding valves		

Trainer's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainer's manual "Mobile hydraulics - throttle control" DE	DE	R961004608	Projekthandbuch Mobilhydraulik Drosselsteuerung 3SM-12	MANUAL TW-HY-LH 303DE	RD 09968
Trainer's manual "Mobile hydraulics - throttle control" EN	EN	R961005094	Project manual: Mobile hydraulics throttle control 3SM-12	MANUAL TW-HY-LH 303EN	RE 09968

Trainee's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainee's manual "Mobile hydraulics - throttle control" DE	DE	R961004614	Projekthandbuch Mobilhydraulik Drosselsteuerung 3SM-12	MANUAL TW-HY-SH 303DE	RD 09969
Trainee's manual "Mobile hydraulics - throttle control" EN	EN	R961005093	Project manual: Mobile hydraulics throttle control 3SM-12	MANUAL TW-HY-SH 303EN	RE 09969

Device set for WS290 Mobile hydraulics - throttle control, complete

Material number R961009462





Type short description DEVICE SET TS-HS 303-1X

This device set is used to impart practical applications of mobile control technology. Only components which meet industry standards and which are specially prepared for use in the training exercises are used.

The set is aligned matched to the "Mobile Hydraulics - Throttle Control" manual.

The exercises with the listed components can be performed at the WS290 workstation.



Item	Components of device set R961009462	Mat. no.	Quantity	Image	Page
1	Mobile hydraulics - throttle control 3 SM12	R961005970	1		130
2	Hydraulic pilot controller with 2 hand levers 2-2TH6	R961005967	1		129
3	Planetary motor	R961008748	1		128
4	Load unit 80 kg stationary	R961004005	1		125

Item	Components of device set R961009462	Mat. no.	Quantity	Image	Page
5	Pressure relief valve DBDH6G1X/	R961002520	1		113
6	Pressure reducing valve, directly operated DR6DP1-5X/	R961002544	1		113
7	Pressure shut-off valve, directly operated DZ6DP1-5X/	R961002558	1		114
8	Non-return valve S6A1.X	R961002489	1		121
9	Accumulator module	R961002503	1		132
10	Hydraulic distributor 4x	R961002485	6		134
11	Pressure gauge 0-100 bar with measuring hose	R961002715	3		159
12	Hose line 630 mm	R961002474	11		135
13	Hose line 700 mm with 90° fitting and mini gauge port	R961004329	3		138
14	Hose line 1000 mm with 90° fitting	R961004331	6		137

The recommended accessories can be found on page 54.

Mobile hydraulics - load sensing control

In preparation for their future careers, students should work practically and largely independently and they should learn how to act in a professional context. This means that core and technical skills are taught in an integrated manner including independent planning, execution and monitoring of all practical project tasks

Delivery range:

- ▶ Project manual “Mobile hydraulics load sensing 2M4-12” for teachers and for trainees
- ▶ Device sets for WS290 mobile hydraulics - load sensing with the components

Project manuals for instructors and trainees

The projects are based on practical examples from mobile control technology. Project exercises are performed at the WS290 workstation.

It is recommended to complete each project in sequence. Trainees are expected to have a basic knowledge of hydraulics. Before the projects are executed, the previous project manuals up to “On/off hydraulics - Manual operation” should have been completed.

Structure of the project manual:

- ▶ Overview of the historical development of mobile hydraulics
- ▶ Technological classifications of load sensing control and their application fields on different machines
- ▶ Fundamentals of mobile hydraulics in mobile working machines
- ▶ Basic principles of hydraulics, load sensing control and their operation, as well as explanation of special symbols
- ▶ Structure and function of an LS control block 2M4-12, a stroke limiter, primary and secondary valves and a pilot control 2-2TH6



Numbers of the project exercises and the respective topic			
01	Primary pressure limitation	07	Secondary valves
02	Actuator volumes and stroke limitations	08	Load sensing pressure limitation
03	Load pressure compensation	09	Parallel operation with sufficient delivery volume
04	Pressure loss in the P line	10	Parallel operation with insufficient delivery volume
05	Hydraulic pilot control	11	Stroke cylinders with alternating directions of force
06	External power unit		

Trainer's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainer's manual "Mobile hydraulics - load sensing control" DE	DE	R961004565	Projekthandbuch Mobilhydraulik Load Sensing 2M4-12	MANUAL TW-HY-LH 304DE	RD 09970
Trainer's manual "Mobile hydraulics - load sensing control" EN	EN	R961005147	Project manual Mobile hydraulics load sensing 2M4-12	MANUAL TW-HY-LH 304EN	RE 09970

Trainee's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainee's manual "Mobile hydraulics - load sensing control" DE	DE	R961004564	Projekthandbuch Mobilhydraulik Load Sensing 2M4-12	MANUAL TW-HY-SH 304DE	RD 09971
Trainee's manual "Mobile hydraulics - load sensing control" EN	EN	R961005146	Project manual Mobile hydraulics load sensing 2M4-12	MANUAL TW-HY-SH 304EN	RE 09971

Device set for WS290 Mobile hydraulics - load sensing control, complete

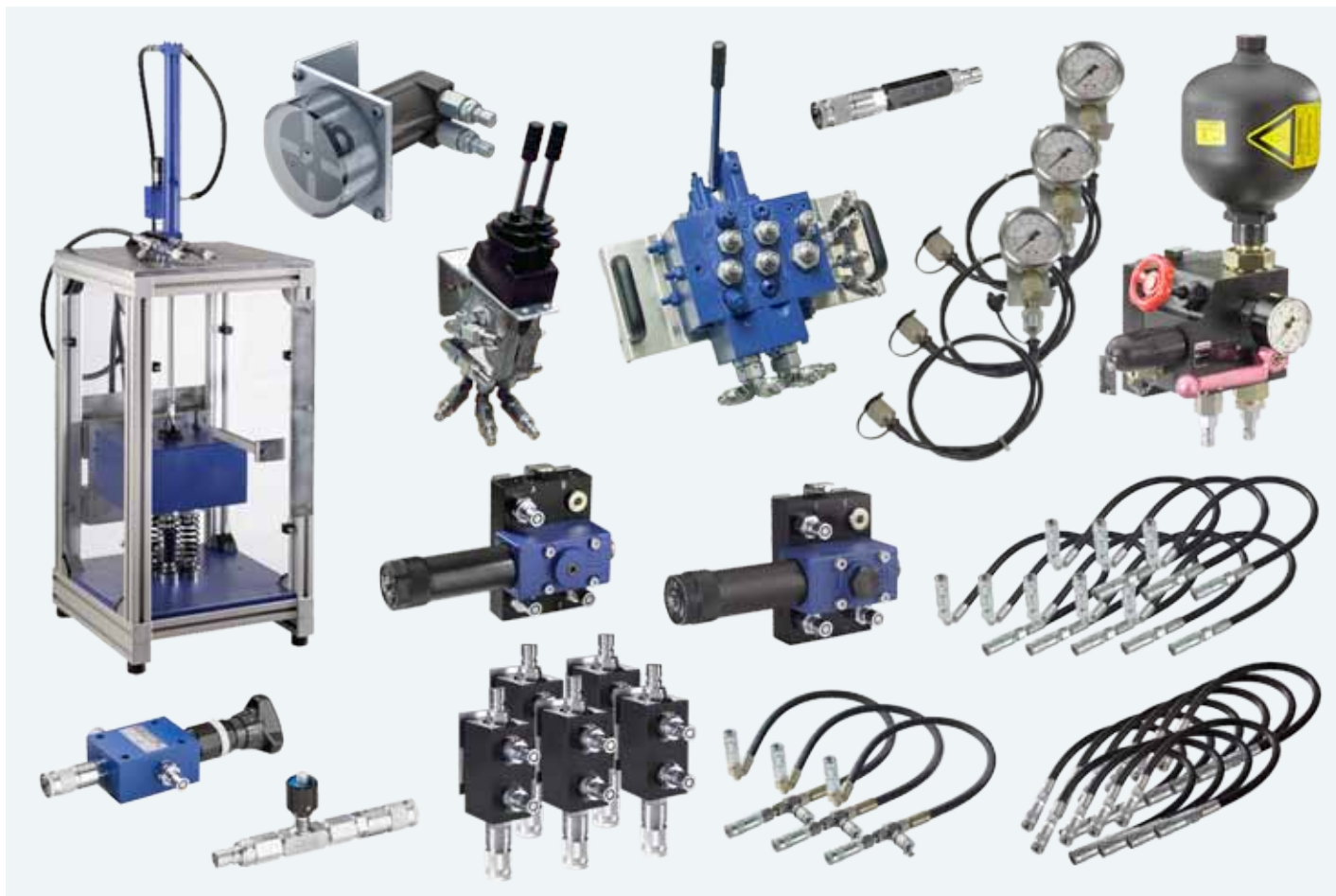
Material number R961009463





Type short description DEVICE SET TS-HS 304-1X

This device set is used to impart practical applications of mobile control technology. Only components which meet industry standards and which are specially prepared for use in the training exercises are used.

The device set is matched to the "Mobile Hydraulics - load sensing control" manual.

The exercises with the listed components can be performed at the WS290 workstation.



Item	Components of device set R961009463	Mat. no.	Quantity	Image	Page
1	Mobile hydraulics - load sensing 2M4-12	R961005969	1		131
2	Hydraulic pilot controller with 2 hand levers 2-2TH6	R961005967	1		129
3	Planetary motor	R961008748	1		128
4	Load unit 80 kg stationary	R961004005	1		125

Item	Components of device set R961009463	Mat. no.	Quantity	Image	Page
5	Pressure relief valve DBDH6G1X/	R961002520	1		113
6	Pressure reducing valve, directly operated DR6DP1-5X/	R961002544	1		113
7	Pressure shut-off valve, directly operated DZ6DP1-5X/	R961002558	1		114
8	Throttle valve DRV06-1-1X/V	R961002539	1		117
9	Non-return valve S6A1.X	R961002489	1		121
10	Accumulator module	R961002503	1		132
11	Hydraulic distributor 4x	R961002485	5		134
12	Pressure gauge 0-100 bar with measuring hose	R961002715	3		159
13	Hose line 630 mm	R961002474	10		135
14	Hose line 700 mm with 90° fitting and mini gauge port	R961004329	3		138
15	Hose line 1000 mm with 90° fitting	R961004331	8		137

The recommended accessories can be found on page 54.

Mobile hydraulics - LIFD control

In preparation for their future careers, students should work practically and largely independently and they should learn how to act in a professional context. This means that core and technical skills are taught in an integrated manner including independent planning, execution and monitoring of all practical project tasks

Delivery range:

- ▶ Project manual “Mobile hydraulics LIFD 2SX-12” for teachers and for trainees
- ▶ Device sets for WS290 mobile hydraulics - LIFD control with the components

Project manuals for instructors and trainees

The projects are based on practical examples from mobile control technology. Project exercises are performed at the WS290 workstation.

It is recommended to complete each project in sequence. Trainees are expected to have a basic knowledge of hydraulics. Before the projects are executed, the previous project manuals up to “On/off hydraulics - Manual operation” should have been completed.

Structure of the project manual:

- ▶ Overview of the historical development of mobile hydraulics
- ▶ Technological classifications of load pressure-independent flow distribution (LIFD) and its application fields on different machines
- ▶ Fundamentals of mobile hydraulics in mobile working machines
- ▶ Basic principles of hydraulics, load pressure-independent flow distribution (LIFD) and its operation, as well as explanation of special symbols
- ▶ Structure and function of an LIFD control block 2SX-12, load pressure signal, pressure balances, consumer flow and hydraulic pilot control



Numbers of the project exercises and the respective topic			
01	Pressure adjustment and hydraulic pilot control	05	Stroke cylinders with alternating directions of force
02	Adjust actuator volumes and stroke limitations	06	Boom cylinders with external force effects
03	Effects of piping	07	Functional principle of an LIFD system
04	Effects of loads		

Trainer's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainer's manual "Mobile hydraulics - LIFD control" DE	DE	R961004654	Projekthandbuch Mobilhydraulik LUDV 2SX-12	MANUAL TW-HY-LH 305DE	RD 09972
Trainer's manual "Mobile hydraulics - LIFD control" EN	EN	R961005149	Project manual Mobile hydraulics LIFD 2SX-12	MANUAL TW-HY-LH 305EN	RE 09972

Trainee's manuals	Language	Mat. no.	Book title	Type short description	Edition no.
Trainee's manual "Mobile hydraulics - LIFD control" DE	DE	R961004749	Projekthandbuch Mobilhydraulik LUDV 2SX-12	MANUAL TW-HY-SH 305DE	RD 09973
Trainee's manual "Mobile hydraulics - LIFD control" EN	EN	R961005148	Project manual Mobile hydraulics LIFD 2SX-12	MANUAL TW-HY-SH 305EN	RE 09973

Device set for WS290 Mobile hydraulics - LIFD control, complete

Material number R961009464





Type short description DEVICE SET TS-HS 305-1X

This device set is used to impart practical applications of mobile control technology. Only components which meet industry standards and which are specially prepared for use in the training exercises are used.

The set is matched to the “Mobile Hydraulics - LIFD control” manual.

The exercises with the listed components can be performed at the WS290 workstation.



Item	Device set R961009464	Mat. no.	Quantity	Image	Page
1	Mobile hydraulics - LUDV 2SX-12	R961005966	1		130
2	Hydraulic pilot controller with 2 hand levers 2-2TH6	R961005967	1		129
3	Planetary motor	R961008748	1		128
4	Load unit 80 kg stationary	R961004005	1		125

Item	Device set R961009464	Mat. no.	Quantity	Image	Page
5	Pressure relief valve DBDH6G1X/	R961002520	1		113
6	Pressure reducing valve, directly operated DR6DP1-5X/	R961002544	1		113
7	Pressure shut-off valve, directly operated DZ6DP1-5X/	R961002558	1		114
8	Throttle valve DRV06-1-1X/V	R961002539	1		117
9	Non-return valve S6A1.X	R961002489	1		121
10	Accumulator module	R961002503	1		132
11	Hydraulic distributor 4x	R961002485	6		134
12	Pressure gauge 0-100 bar with measuring hose	R961002715	4		159
13	Hose line 630 mm	R961002474	11		135
14	Hose line 700 mm with 90° fitting and mini gauge port	R961004329	2		138
15	Hose line 1000 mm with 90° fitting	R961004331	8		137

The recommended accessories can be found on page 54.

Mobile hydraulics - Accessories

Measuring equipment is needed for the exercises in mobile hydraulics to measure the flow, speed and pressure. Further accessories can be found on page 64.













We recommend:






Item	Components	Mat. no.	Quantity	Image	Page
1	Basic measuring device set	R961009563	1		155
and	Measuring glass 2.5l for WS290	R961002564	1		166
2	Gear volumetric flow sensor	R961002508	1		157
and	Measurement cable for ISDS	R900733207	1		157
and	Measuring device set 3020	R913038909	1		154
3	Filling and test equipment for hydraulic accumulators	0538103012	1		132
4	Pressure relief coupling	R961002927	1		138

Expansion device sets

As an inexpensive complement to study topics, Bosch Rexroth offers appropriate supplementary device sets (overview on page 10). Supplementary device sets provide the perfect way to move to the next study topic using the device set from the previous one.

Expanded device set for WS200/WS290 from “On/off hydraulics - getting started” to “On/off hydraulics - manual operation” (according to BIBB, A-H)	
Material number	R961009465
Type short description	DEVICE SET TS-HS 402-1X

Item	Expansion device set R961009465	Mat. no.	Quantity	Image	Page
1	Planetary motor	R961008748	1		128
2	4/2-way directional control valve 4WMM6C5X	R961002552	1		106
3	4/3-way directional control valve 4WMM6J5X	R961002510	1		107
4	4/3-way directional control valve 4WMM6E5X/	R961002551	1		107
5	Pressure relief valve DBDH6G1X/	R961002520	2		113
6	Pressure relief valve, pilot-operated DB6K1-4X/50	R961002545	1		114
7	2-way flow control valve 2FRM6B36-3X/	R961002546	1		118
8	Throttle valve DRV06-1-1X/V	R961002539	1		117
9	Non-return valve S6A1.X	R961002489	1		121
10	Non-return valve, hydraulically pilot-operated SV 6 PB1-6X/	R961002513	1		122
11	Accumulator module	R961002503	1		132
12	Hydraulic distributor 4x	R961002485	2		134

Item	Expansion device set R961009465	Mat. no.	Quantity	Image	Page
13	Shut-off valve	R961002491	1		120
14	Pressure gauge 0-100 bar with measuring hose	R961002715	1		159
15	Hose line 630 mm	R961002474	3		135
16	Hose line 1000 mm with 90° fitting and mini gauge port	R961004330	4		138
17	Hose line 1500 mm with mini gauge port	R961002482	2		136




Expansion device set for WS200/WS290 from “On/off hydraulics - manual operation” to “On/off hydraulics - electrical operation” (according to BIBB, A-H)










Material number	R961009466
Type short description	DEVICE SET TS-HS 404-1X

Item	Expansion device set R961009466	Mat. no.	Quantity	Image	Page
1	4/2-way directional control valve 4WE6C6X/	R961002547	2		109
2	4/3-way directional control valve 4WE6G6X/	R961002548	1		109
3	4/3-way directional control valve 4WE6J6X/	R961002554	1		110
4	4/3-way directional control valve 4WE6E6X/	R961002549	1		110

Expansion device set for WS290 from “On/off hydraulics - electrical operation” (BIBB, A-H) to “Continuous valve technology - proportional hydraulics”



Material number	R961009468
Type short description	DEVICE SET TS-HS 406-1X

Item	Expansion device set R961009468	Mat. no.	Quantity	Image	Page
1	Differential cylinder CD70F25/16-400 with protective housing	R961003495	1		124
2	4/3-way proportional directional control valve 4WREE6E08-2X/ with int. elec. and load simulation	R961003533	1		111
3	Proportional pressure relief valve DBEE6-1X/50	R961003924	1		116

Expansion electrical device set for WS290 from “On/off hydraulics - electrical operation” (BIBB, A-H) to “Continuous valve technology - proportional hydraulics”					
Material number	R901386161				
Type short description	DEVICE SET TS-HS 505-1X				
Item	Expansion electrical device set R901386161	Mat. no.	Quantity	Image	Page
1	Switching element 19" version - 1 switch + 2 push buttons, 3 NO contacts, 3 NC contacts	R961009617	1		139
2	Display unit 19" version - 2 displays, max. display range 0-20 V	R961009623	1		141
3	Adapter plate 19" version - circular connector / lab jack	R961009630	1		142
4	Command value encoder 19" version - with ramp	R961009631	1		141
5	Command value encoder 19" version - +/- 10 V	R961009632	1		141
6	Cable, 7-pin for integrated electronics	R961003550	1		151
7	Cable set for setpoint measurement	R961009488	1		151
8	Proximity switch, inductive	R961003106	1		151
9	Measurement cable set, small	R900029597	1		150

Expansion device set for WS290 from “On/off hydraulics - Electrical operation” (according to BIBB, A-H) + Continuous valve technology - proportional hydraulics” to “Continuous valve technology - control hydraulics”










Material number	R961009474
Type short description	DEVICE SET TS-HS 411-1X

Item	Expansion device set R961009474	Mat. no.	Quantity	Image	Page
1	Load unit, controllable, for dynamic load simulation	R961004486	1		126
2	4/4-way closed loop control valve 4WRPEH6 with integrated electronics	R961002509	1		112

Expansion device set for WS290 from “Continuous valve technology - proportional hydraulics” to “Continuous valve technology - control hydraulics”



Material number	R961009470
Type short description	DEVICE SET TS-HS 408-1X

Item	Expansion device set R961009470	Mat. no.	Quantity	Image	Page
1	Load unit, controllable, for dynamic load simulation	R961004486	1		126
2	4/4-way closed loop control valve 4WRPEH6 with integrated electronics	R961002509	1		112
3	4/2-way directional control valve 4WE6C6X/	R961002547	1		109
4	Pressure reducing valve, directly operated DR6DP1-5X/	R961002544	1		113
5	Pressure gauge 0-100 bar with measuring hose	R961002715	1		159
6	Hydraulic distributor 4x	R961002485	2		134
7	Hose line 630 mm	R961002474	3		135
8	Hose line 1000 mm with 90° fitting and mini gauge port	R961004330	2		138









Expansion electrical device set for WS290 from “On/off hydraulics - electrical operation” (BIBB, A-H) to “Continuous valve technology - control hydraulics”					
Material number	R901386163				
Type short description	DEVICE SET TS-HS 507-1X				
Item	Expanded electrical device set R901386163	Mat. no.	Quantity	Image	Page
1	Operating module TS-BPS 30.0, analog controller module, 30DU	R961004782	1		142
2	Switching element 19" version - 1 switch + 2 push buttons, 3 NO contacts, 3 NC contacts	R961009617	1		139
3	Display unit 19" version - 2 displays, max. display range 0-20 V	R961009623	1		141
4	Adapter plate 19" version - circular connector / lab jack	R961009630	1		142
5	Command value encoder 19" version - with ramp	R961009631	1		141
6	Command value encoder 19" version - +/- 10 V	R961009632	1		141
7	Cable, 7-pin for integrated electronics	R961003550	1		151
8	Cable set for setpoint measurement	R961009488	2		151
9	Measurement cable set, small	R900029597	1		150

Expansion device set for WS290 from “Continuous valve technology - proportional hydraulics” to “Continuous valve technology - control hydraulics”




Material number R901386164
 Type short description DEVICE SET TS-HS 508-1X

Item	Expansion electrical device set R901386164	Mat. no.	Quantity	Image	Page
1	Operating module TS-BPS 30.0, analog controller module, 30DU	R961004782	1		142
2	Cable set for setpoint measurement	R961009488	1		151

Expansion device set from “On/off hydraulics - manual operation” (according to BIBB, A-H) to “Mobile hydraulics - throttle control”	
Material number	R961009467
Type short description	DEVICE SET TS-HS 405-1X

Item	Expansion device set R961009467	Mat. no.	Quantity	Image	Page
1	Mobile hydraulics - throttle control 3 SM12	R961005970	1		130
2	Hydraulic pilot controller with 2 manual levers 2-2TH6	R961005967	1		129
3	Load unit 80 kg stationary	R961004005	1		125
4	Pressure shut-off valve, directly operated DZ6DP1-5X/	R961002558	1		114
5	Hydraulic distributor 4x	R961002485	3		134
6	Hose line 630 mm	R961002474	3		135
7	Hose line 700 mm with 90° fitting and mini gauge port	R961004329	3		138
8	Hose line 1000 mm with 90° fitting	R961004331	2		137

Expansion device set for WS290 from “Mobile hydraulics - throttle control” to “Mobile hydraulics - load sensing control”	
Material number	R961009471
Type short description	DEVICE SET TS-HS 409-1X










Item	Expansion device set R961009471	Mat. no.	Quantity	Image	Page
1	Mobile hydraulics - load sensing 2M4-12	R961005969	1		131
2	Throttle valve DRV06-1-1X/V	R961002539	1		117
3	Hose line 1000 mm with 90° fitting	R961004331	2		137

Expansion device set for WS290 from “Mobile hydraulics - throttle control” to “Mobile hydraulics - LIFD control”	
Material number	R961009472
Type short description	DEVICE SET TS-HS 410-1X




Item	Expansion device set R961009472	Mat. no.	Quantity	Image	Page
1	Mobile hydraulics - LUDV 2SX-12	R961005966	1		130
2	Throttle valve DRV06-1-1X/V	R961002539	1		117
3	Pressure gauge 0-100 bar with measuring hose	R961002715	1		159
4	Hose line 1000 mm with 90° fitting	R961004331	2		137

Accessories



Flowmeters

Item	Components	Mat. no.	Quantity	Image	Page
1	Stopwatch, digital	R900061256	1		155
and	Measuring glass for WS201	R961009485	1		161
or	Measuring glass 2.5 l for WS290	R961002564	1		166
2	Volumetric flow rate sensor 1.0 to 7.5 l/min	R961002561	1		158
3	Gear volumetric flow sensor	R961002508	1		157
and	Temperature sensor with ISDS	R900749653	1		157
and	Measurement cable for ISDS	R900733207	1		157
and	Measuring device set 3020	R913038909	1		154
or	Measuring device set 5060	R913038907	1		155

Speed measurement

Item	Components	Mat. no.	Quantity	Image	Page
1	Tachometer visual	R961008893	1		156
2	Speed sensor	R900892375	1		156
and	Measuring device set 5060	R913038907	1		155


Pressure measurement

Item	Components	Mat. no.	Quantity	Image	Page
1	Digital pressure gauge	R961009534	1		158
2	Pressure transmitter 0-200 bar with ISDS	R900738915	1		156




Multimeter

Item	Components	Mat. no.	Quantity	Image	Page
1	Multimeter VC175	R913038027	1		154

For filling the hydraulic accumulator

Item	Components	Mat. no.	Quantity	Image	Page
1	Filling and test equipment for hydraulic accumulators	0538103012	1		132

Measuring sets

Item	Components	Mat. no.	Quantity	Image	Page
1	Basic measuring device set	R961009563	1		155
2	Measuring device set 3020	R913038909	1		154
3	Measuring device set 5060	R913038907	1		155

Workstations



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WS200 Workstation

Your ideal entry into the world of knowledge.

The WS200 workstation features a convincing combination of modular and compact design and practical equipment. Users benefit from the low price combined with a wide range of expansion options depending on the application.

The New WS200 System for Beginners

With the new WS200 workstation, Bosch Rexroth offers ideal and cost-effective access to the comprehensive Rexroth knowledge base. The WS200 workstation is a compact, basic solution in the fields of hydraulics, pneumatics and automation technology which makes it extremely versatile.

The WS200 can be tailored perfectly to fit a comprehensive range of accessories to meet the individual needs of companies and educational institutions as well as a variety of learning topics. In conjunction with the teaching and learning aids, the workstation allows for customized instruction and skills training – from novices to professionals.

Modular

The WS200 is extremely versatile. Its modular design makes possible customized training of professionals in the fields of hydraulics, pneumatics and automation. Six standard models of the WS200 workstation are available.

Robust, Compact and Expandable

The rugged, durable construction is in accordance with industrial quality standards (CE label) and designed for heavy-duty industrial components. Thanks to its compact structure and adaptation to standard door sizes, as well as its maneuverability on wheels, the WS200 is extremely flexible and can be used wherever it is needed. The WS200 workstation is unique and easy to expand. All the

modules can connect easily with one other using simple fastening technology.

Equipped for Practical Application

The WS200 workstation is equipped with industry-proven products and standard components which students will come across in plant and machinery later in their professional careers.

For example, the “On/Off Hydraulics - Getting Started” basic device set:

- ▶ differential cylinder with protective housing
- ▶ direct-control pressure reduction valve
- ▶ 4/3-way directional control valve 4WMM6G5X
- ▶ throttle check valve
- ▶ pressure gauge with measuring hose
- ▶ hydraulic distributor
- ▶ Hose lines
- ▶ hose line with mini gauge port

Single- and Double-Operation

The clear set-up of the WS200 workstation makes it easy to enter the world of know-how. Step by step, students gather experience in handling industrially tried and tested components. The workstation can be used either from only one side or from both sides. It consists of a base frame and grids for industrial components and grooved plates for pneumatics and automation elements.

The extensive range of accessories – from tube holders to drive units to control units – can be tailored exactly to your



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requirements In addition to the various device sets and components, this complete training system includes appropriate training and project manuals on technologies such as on/off hydraulics, pneumatics, sensors, etc. for teachers and students. This means that students are ideally prepared for the professional tasks and challenges that they will face later.



WS290 Workstation

A comprehensive package for your project ideas.

The WS290 workstation offers unlimited options for creating practical and demanding tasks in the fields of on/off hydraulics, proportional servo valve technology, mobile hydraulics and pneumatics.

Rexroth Training Systems

Bosch Rexroth's training systems are based on standard components from Rexroth's various product ranges. A single training system consists of a workstation, the components contained in the device sets and project manuals. Based on the project manuals for teachers and students, interrelated topics can be explored. With the help of our training systems, beginners and advanced students develop hands-on and technical expertise on a step-by-step basis. The standard components used on the workstation are the same ones which students will find later in their careers in plant and machinery. In addition to the training systems for hydraulics described here in the catalog, Bosch Rexroth offers training systems in the fields of pneumatics, sensor technology, PLCs and mechatronics. For information on the appropriate teachware of the Drive & Control Academy, please visit the Bosch Rexroth website at:
www.boschrexroth.com

WS290 Workstation

The WS290 workstation is used to provide instruction in industrial and mobile hydraulics. By upgrading the unit with a grooved plate, it can also be used for pneumatics and automation technology. It provides the basis to provide instruction on how modern hydraulic circuits perform and prepares students in an optimum way for use in their companies. The preferred models of the WS290 workstation offer appropriate designs for training each topic and can be extended if necessary. By using a load-sensing unit, the

WS290 is ideally suited for mobile hydraulics training. The special characteristics of mobile applications are practically illustrated in this way. The device sets related to the different learning topics, together with the included project manuals, prepare students for the professional tasks and challenges that they will face in the future.

Equipment

The WS290 workstation is divided into 10 preferred types, which are based on the technology of the tried and tested DS4 workstations. The main components are:

- ▶ a basic frame with grid for holding components
- ▶ a hydraulics unit with TÜV-tested safety valves and control box
- ▶ a rack for holding electrical components
- ▶ an integrated container for stowage of components and accessories
- ▶ a measuring glass with scale
- ▶ a hose tray to accommodate up to 50 hoses
- ▶ a 15 kg swiveling load simulator.

The WS290 workstation is delivered fully assembled.

Training Environment

The WS290 workstation comes equipped according to the intended use:

- ▶ Hydraulics: Choose the right single- or double-sided model for your purposes from our 10 standard types, for up to 6 students with independent workstations separated by a grid on each side.



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- ▶ Pneumatics: Replace both grids with grooved panels to create independent workstations for up to 6 students.
- ▶ Hydraulics/Pneumatics Combined: Replace both grids with grooved panels to create independent workstations for up to 6 students; grid for hydraulics on one side and grooved plate for pneumatics on the other side (grooved plates are not included in the standard types but are available as an accessory).

Tailored to Lessons Through Extensions

To achieve your objectives, you can customize your training system to the needs of your company.

- ▶ On/off hydraulics
- ▶ Proportional servo valve technology
- ▶ Mobile hydraulics

Practical Exercises with Appropriate Teachware

Employees' specialist knowledge and expertise provide a crucial advantage for their company on a competitive global market.

- ▶ Teacher and student project manuals
- ▶ Technical books
- ▶ Teaching aids

Safety

The WS290 workstation is designed and tested according to the guidelines of Machinery Directive 2006/42/EC. A CE certificate is included in the operating instructions.

Choosing the Right Standard Type

Select the standard type of WS290 workstation to meet your needs. We will happily assist you in making the right choice. Just get in touch with us!

Order examples

Components and Spare Parts

Range of Applications of Workstations

The technical know-how of Bosch Rexroth combined with comprehensive expertise in industrial applications have gone into the design these modular workstations – this ensures that they meet to the fullest the qualification levels required in industry.

Quality that's tried and tested

All Bosch Rexroth workstations are based on standard components from the drive and control specialist's various product ranges. In particular, the core competencies in hydraulics have been incorporated into the workstations. The secure, robust, durable and easy-to-use series-produced components, which they will encounter in their future careers, allow students a smooth transition to the requirements of everyday life in industrial firms. Thanks to their versatility, the workstations can always be adapted precisely to the respective training topic. Appropriate teaching and learning tools, including project manuals for teachers and students, round off the package.

With the WS200 workstation, a very cost-effective system for practical apprenticeship and in-service training has been developed. Working with the modular workstation is a clear and practical way to impart fundamental knowledge in hydraulics, pneumatics and automation.

This means that the WS200 complements the existing range of starter systems, with the WS290 bringing advanced students all the elements of a focused training system. The larger work area with optimum use of space provides plenty of room for more complex tasks and more demanding examples in the areas of on/off hydraulics, proportional servo valve technology and mobile hydraulics.

Which workstation do I need?

The WS200 workstation has the advantage of a low introductory price and being compact. On/off hydraulics,

pneumatics and automation can all be covered on the easily expandable WS200 workstation. Topics such as proportional servo valve technology and mobile hydraulics can be taught using our tried and tested WS290 workstation. The following table provides an overview of the possible topics that can be covered:

Topics	WS200	WS290
On/off hydraulics – getting started	X	X
On/off hydraulics – manual operation (according to BIBB)	X	X
On/off hydraulics – electrical operation (according to BIBB)	X	X
Proportional servo valve technology – proportional hydraulics		X
Proportional servo valve technology – control hydraulics		X
Mobile hydraulics – throttle control		X
Mobile hydraulics – load sensing control		X
Mobile hydraulics – LIFD control		X
Pneumatics – fundamentals (according to BIBB)	X	X
Pneumatics – fundamentals of electropneumatics (according to BIBB)	X	X
Pneumatics – fundamentals (according to PAL)	X	X
Pneumatics – fundamentals of electropneumatics (according to PAL)	X	X
Pneumatics – control technology	X	X
Pneumatics – handling technology	X	X

WS200 workstation

WS201 Hydraulic work station, single-sided for 1 - 2 trainees - assembled, including packaging

Material number	R961008850
Type short description	WORKSTATION TS-WS200-1X/ NOG1A1T1&

This workstation is ideal for training the basics of hydraulics according to BIBB A-Z3.

The WS200 mobile workstation has a grid onto which the hydraulic components can be securely mounted. It can be operated from one side and used by one or two students at the same time.

The built-in hydraulic power unit is equipped with a low-noise external gear pump and a single-phase asynchronous motor. The switch box contains one ON and one OFF button, as well as an EMERGENCY STOP button. The workstation is powered by means of an electrical cable (length approximately 1.8 m) with a Euro standard mains connector.

The simple and safe supply of pressurized fluid is ensured by low-leakage, self-sealing coupling connectors on the P/T-distributor. With a simple twist, you can transform the included storage trays from an oil pan to a practical writing support.

Delivery includes:	<ul style="list-style-type: none"> ▶ Base frame ▶ 1 grid ▶ 1 hydraulic power unit, 230 V/50 Hz with pump, hose set, switch box, and P/T distributor ▶ Storage set
--------------------	---

Dimensions	mm (L x W x H)	800 x 806 x 1772
Number of workstations		1 - 2
Weight	kg	63
Supply voltage	V AC	230
Rated current	A	1.6
Mains frequency	Hz	50 - 60
Power	kW	0.37
Operating pressure (hydraulics)	bar	60
Maximum flow	l/min	3.2 (at 870 l/min)



WS200 Hydraulic workstation, double-sided for 2 - 4 trainees - assembled, including packaging		
Material number	R961008852	
Type short description	WORKSTATION TS-WS200-1X/ N0G2A2T1&	
<p>This workstation is the same as its predecessor (R961008850), but is of double-sided design, which allows two to four students to work in two groups at the same time.</p>		
Delivery includes:	<ul style="list-style-type: none"> ▶ Base frame ▶ 2 grids ▶ 2 hydraulic power units, 230 V/50 Hz with pump, hose set, switch box, and P/T distributor ▶ Storage set 	
Dimensions	mm (L x W x H)	800 x 806 x 1772
Number of workstations		2 - 4
Weight	kg	89
Supply voltage	V AC	230
Rated current	A	1.6
Mains frequency	Hz	50 - 60
Power	kW	0.37
Operating pressure (hydraulics)	bar	60
Maximum flow	l/min	3.2 (at 870 l/min)



WS200 Hydraulic workstation, single-sided and pneumatics for 1 - 2 trainees - assembled, including packaging

Material number	R961009258
Type short description	WORKSTATION TS-WS200-1X/ N1G1A1T1

This workstation is ideal for training the basics of hydraulics according to BIBB A-Z3, as well as of pneumatics and automation. It has a grooved plate onto which the components of pneumatic and automation technology can be fixed. The SnapIN quick fastening system ensures easy installation and a secure fit.

The mobile work station has a grid onto which the required hydraulic components can be securely mounted. It can be operated from one side and used by one or two students at the same time. The built-in hydraulic power unit is equipped with a low-noise external gear pump and a single-phase asynchronous motor. The switch box contains one ON and one OFF button, as well as an EMERGENCY STOP button. The workstation is powered by means of an electrical cable (length approximately 1.8 m) with a Euro standard mains connector.

The simple and safe supply of pressurized fluid is ensured through a self-sealing coupling connector on the P/T distributor. With a simple twist, you can transform the included storage trays from an oil pan to a practical writing support.

Delivery includes:	<ul style="list-style-type: none"> ▶ Base frame ▶ 1 grooved plate ▶ 1 grid ▶ 1 hydraulic power unit, 230 V/50 Hz with pump, hose set, switch box, and P/T distributor ▶ Storage set
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Dimensions	mm (L x W x H)	800 x 806 x 1772
Number of workstations		1 - 2
Weight	kg	75
Supply voltage	V AC	230
Rated current	A	1.6
Mains frequency	Hz	50 - 60
Power	kW	0.37
Operating pressure (hydraulics)	bar	60
Maximum flow	l/min	3.2 (at 870 l/min)

Accessories

Designation	Material number	Quantity
Compressor*	1827008426	1

* To order pneumatic accessories, please see the Training System Pneumatics R999000217 sales catalog.



WS200 Hydraulic workstation, double-sided for 2 - 4 trainees and pneumatics - assembled, including packaging

Material number	R901392535
Type short description	WORKSTATION TS-WS200-1X/ N1G2A2T1&

This workstation is the same as its predecessor (R961009258), but is of double-sided design, which allows two to four students to work in two groups at the same time.

Delivery includes:	<ul style="list-style-type: none"> ▶ Base frame ▶ 1 grooved plate ▶ 2 grids ▶ 2 hydraulic power units, 230 V/50 Hz with pump, hose set, switch box, and P/T distributor ▶ Storage set
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Dimensions	mm (L x W x H)	800 x 806 x 1772
Number of workstations		2 - 4
Weight	kg	75
Supply voltage	V AC	230
Rated current	A	1.6
Mains frequency	Hz	50 - 60
Power	kW	0.37
Operating pressure (hydraulics)	bar	60
Maximum flow	l/min	3.2 (at 870 l/min)

Accessories

Designation	Material number	Quantity
Compressor*	1827008426	1

* To order pneumatic accessories, please see the Training System Pneumatics R999000217 sales catalog.



WS201 Pneumatic workstation, double-sided for 2 - 4 trainees - assembled, including packaging

Material number	R961008854
Type short description	WORKSTATION TS-WS200-1X/ N1G0A0T1

This workstation is ideal for training in pneumatics and automation techniques.

It has a grooved plate onto which the components of pneumatic and automation technology can be fixed. The SnapIN quick fastening system ensures easy installation and a secure fit.

The double-sided version is designed to allow two to four students to work simultaneously at the workstation in two groups.

With a simple twist, you can transform the included storage trays from an oil pan to a practical writing support.

Delivery includes:	<ul style="list-style-type: none"> ▶ Base frame ▶ 1 grooved plate ▶ Storage set
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Dimensions	mm (L x W x H)	800 x 806 x 1772
Number of workstations		2 - 4
Weight	kg	47

Accessories

Designation	Material number	Quantity
Compressor*	1827008426	1

* To order pneumatic accessories, please see the Training System Pneumatics R999000217 sales catalog.



WS200 workstation, double sided component carrier - assembled, including packaging

Material number	R961008856
Type short description	WORKSTATION TS-WS200-1X/ NOG6A0T0

Space-saving and clearly-arranged, all hydraulic components which are not needed can be stored on the component rack. It has a total of four 50 mm grids and an oil pan, it is also mobile and can be outfitted with equipment on both sides.

Delivery includes:	<ul style="list-style-type: none"> ▶ WS200 base frame ▶ 4 grids
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Dimensions	mm (L x W x H)	800 x 758 x 1772
Weight	kg	48



Extensions to the WS200 Workstation

WS201 Hydraulic workstation, load unit measuring glass, single-sided for 1 - 2 trainees - assembled, including packaging

Material number	R961009584
Type short description	WORKSTATION TS-WS201-1X/M1L1B0

The WS201 workstation is required for project exercises in on/off hydraulics according to BIBB in which a load unit and measuring glass are required. One load unit and a measuring glass are fixed to the base frame of the WS201.

Delivery includes:	<ul style="list-style-type: none"> ▶ Base frame ▶ 1 load unit ▶ 1 measuring glass
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Dimensions	mm (L x W x H)	800 x 758 x 1772
Number of workstations		1 - 2



WS201 Hydraulic workstation, load unit measuring glass, double-sided for 2 - 4 trainees - assembled, including packaging

Material number	R961009585
Type short description	WORKSTATION TS-WS201-1X/M2L2B0

This workstation is the same as its predecessor (R961009584), but is of double-sided design, which allows two to four students to work in two groups at the same time.

Delivery includes:	<ul style="list-style-type: none"> ▶ Base frame ▶ 2 load units ▶ 2 measuring glasses
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Dimensions	mm (L x W x H)	800 x 758 x 1772
Number of workstations		2 - 4



WS201 Hydraulic workstation, load unit, single-sided for 1 - 2 trainees - assembled, including packaging

Material number	R961009588
Type short description	WORKSTATION TS-WS201-1X/MOL1B0

The WS201 workstation is required for project exercises in on/off hydraulics according to BIBB in which only a load unit is needed but not a measuring glass. One load unit is fixed to the base frame of the WS201.

Delivery includes:	<ul style="list-style-type: none"> ▶ Base frame ▶ 1 load unit
Dimensions	mm (L x W x H) 800 x 758 x 1772
Number of workstations	1 - 2



WS201 Hydraulic workstation, load unit, double-sided for 2 - 4 trainees - assembled, including packaging

Material number	R961009589
Type short description	WORKSTATION TS-WS201-1X/MOL2B0

This workstation is the same as its predecessor (R961009588), but is of double-sided design, which allows two to four students to work in two groups at the same time.

Delivery includes:	<ul style="list-style-type: none"> ▶ Base frame ▶ 2 load units
Dimensions	mm (L x W x H) 800 x 758 x 1772
Number of workstations	2 - 4



WS290 Workstation

WS290 Hydraulic workstation with single pump and pressure regulator, one-sided for 2 - 3 trainees

The WS290 workstation is suitable for training the topics of on/off, proportional and control hydraulics.

On one side of the WS290 mobile work station there is a grating on which the hydraulic components can be securely mounted. The single-sided WS290 is designed for 2 - 3 students.

The hydraulic power unit has a vane pump with a pressure controller. The WS290 has a built-in control box with an ON button, a protective motor switch and two outlets. The workstation is powered by means of a power cable (length 1.8 m approximately) with CEE three-phase current plug. An emergency stop button is mounted on the workstation side. Self-sealing coupling connectors on the P/T distributor make it possible to supply the workplace with hydraulic fluid due to easy handling with extremely low oil leakage.

The integrated container made of powder-coated sheet steel has 5 fully extensible drawers. An acrylic measuring glass with scale is equipped with a bleeding/venting valve, an overflow line and a stopcock. This provides safe use of the station and protects against overflow and overpressure. The hose tray can accommodate up to 50 hydraulic hoses. The arrangement of the hoses prevents the hydraulic fluid from leaking. The integrated oil pan is suitable for storing small parts or tools.

The side-mounted hinged load unit is equipped with a weight of 15 kg. When using this load unit it is possible to carry out exercises for applying loads to cylinders. All moving parts are safely housed in a Plexiglas protective housing.



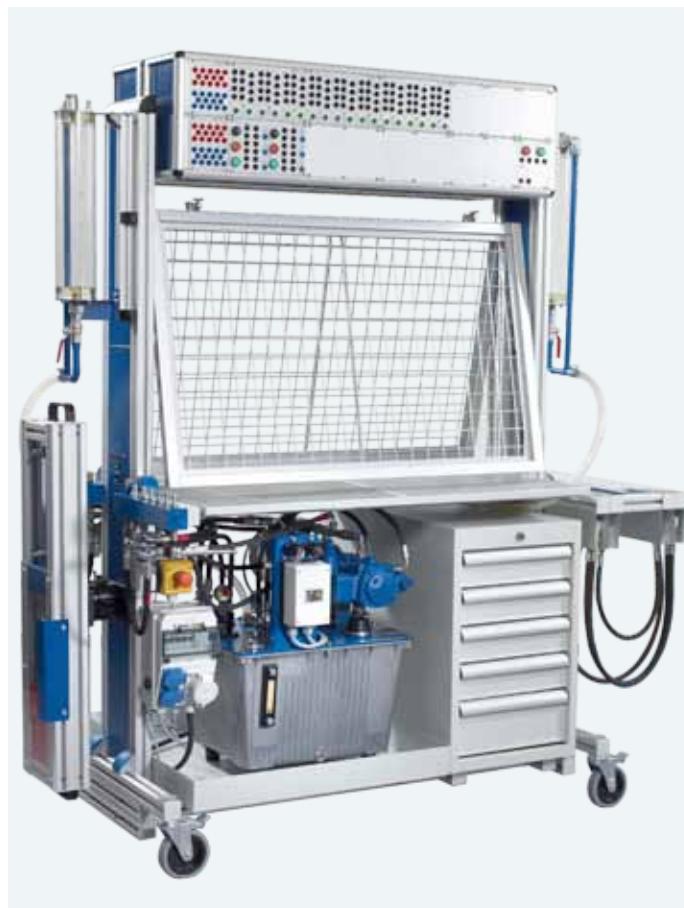
Delivery includes:	<ul style="list-style-type: none"> ▶ WS290 base frame ▶ 1 grid with reinforcement for suspended attachment ▶ 1 integrated container ▶ 1 measuring glass ▶ 1 hose tray for 50 hoses ▶ 1 15 kg swiveling load unit. ▶ 4 oil drip trays ▶ completely assembled
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Dimensions	mm (L x W x H)	1810 x 800 x 1950
Number of workstations		2 - 3
Weight	kg	315
Max. operating pressure	bar	50
Safety pressure of the hydraulic power unit	bar	70
Maximum flow	l/min	8
Container	l	40

	With rack	Without rack
Supply voltage 230 V, single-phase mains frequency 50 Hz Power 1.5 kW Protective motor switch 9 - 12 A	Material number R961009454 Material short text WORKSTATION TS-WS290-1X/G1A4B1C1M1S1L1T2-M1	Material number R961009862 Material short text WORKSTATION TS-WS290-1X/G1A4B0C1M1S1L1T2-M1
Supply voltage 400 V, three-phase mains frequency 50 Hz Power 2.2 kW Protective motor switch 4.5 - 6.3 A	Material number R961009453 Type short description WORKSTATION TS-WS290-1X/G1A5B1C1M1S1L1T2-M1	Material number R961009863 Type short description WORKSTATION TS-WS290-1X/G1A5B0C1M1S1L1T2-M1

WS290 Hydraulic workstation with double pump and pressure regulator, double-sided for 4 - 6 trainees

The WS290 workstation is suitable for training courses in on/off, proportional, control and mobile hydraulics. On both sides of the WS290 mobile work station, there is a grating on which the hydraulic components can be securely mounted. The double-sided WS290 is designed for 4 - 6 students. The built-in hydraulic power unit has two pumps with flow-pressure controller (load sensing) which make it possible to carry out independent exercises on both sides. The WS290 has a built-in control box with an ON button, a protective motor switch and two outlets. The workstation is powered by means of a power cable (length 1.8 m approximately) with a CEE three-phase current plug. In addition, there is an emergency stop button on both sides of the workstation. Self-sealing coupling connectors on the P/T distributor make possible the supply of the workplaces with hydraulic fluid due to easy handling with extremely low oil leakage. The Integrated container made of powder-coated sheet steel has 5 fully extensible drawers. An acrylic measuring glass with scale is equipped with a bleed valve, an overflow line and a shut-off cock. This makes it possible to safely use the station and protects against overflow and overpressure. The hose tray can accommodate up to 50 hydraulic hoses. The arrangement of the hoses prevents the hydraulic fluid from leaking. The integrated oil pan is suitable for storing small parts or tools. The side-mounted hinged load unit is equipped with a weight of 15 kg. When using this load unit it is possible to carry out exercises for applying loads to cylinders. All moving parts are safely housed in a Plexiglas protective housing.



- Delivery includes:
- ▶ WS290 base frame
 - ▶ 2 grids with reinforcement
 - ▶ 1 integrated container
 - ▶ 2 measuring glasses
 - ▶ 1 hose tray for 50 hoses
 - ▶ 1 15 kg swiveling load unit.
 - ▶ 4 oil drip trays
 - ▶ completely assembled

Dimensions	mm (L x W x H)	1810 x 800 x 1950
Number of workstations		4 - 6
Weight	kg	415
Max. operating pressure	bar	50
Safety pressure of the hydraulic power unit	bar	70
Maximum flow	l/min	2 x 8
Container	l	40

	With rack	Without rack
Supply voltage 230 V, single-phase mains frequency 50 Hz Power 1.5 kW Protective motor switch 9 - 12 A	Material number R961009457 Type short description WORKSTATION TS-WS290-1X/G2A1B2C1M2S1L1T2-M1	Material number R961009864 Type short description WORKSTATION TS-WS290-1X/G2A1B0C1M2S1L1T2-M1
Supply voltage 230 V, single-phase mains frequency 60 Hz Power 1.5 kW Protective motor switch 9 - 12 A	Material number R961009456 Type short description WORKSTATION TS-WS290-1X/G2A2B2C1M2S1L1T2-M1	Material number R961009865 Type short description WORKSTATION TS-WS290-1X/G2A2B0C1M2S1L1T2-M1
Supply voltage 3x400 V, three-phase mains frequency 50 Hz Power 2.2 kW Protective motor switch 4.5 - 6.3 A	Material number R961009455 Type short description WORKSTATION TS-WS290-1X/G2A3B2C1M2S1L1T2-M1	Material number R961009866 Type short description WORKSTATION TS-WS290-1X/G2A3B0C1M2S1L1T2-M1

General accessories

PLC holder		
Material number	R961007600	
Type short description	MOUNTING FRAME TS-MC-DS4-SPS-365X136X30 MM	
The PLC holder can be mounted on the base frame of the WS290 workstation. The PLC with SnapIN quick fastening system can be securely attached.		
Dimensions	mm (L x W x H)	365 x 136 x 30



Roller container		
Material number	R961000287	
Type short description	CABINET TS-MC-5S-ROLL	
Roller container for holding tools, measuring tools, components and small parts. It is needed to achieve rapid overall availability of parts at the workplace.		
Design details	<ul style="list-style-type: none"> ▶ Drawers with easy running tracks ▶ Central cylinder lock ▶ Each drawer individually locked in position ▶ Housing and drawers of coated sheet steel ▶ 2 lockable casters, 2 rigid casters ▶ Top with frame and rubber pad ▶ Front with sliding rods 	
Dimensions	mm (L x W x H)	411 x 725 x 825
Weight	kg	78
Type of fastening	Mobile, locking casters	
Material	Sheet steel, coated	
Number of drawers	mm	4 x 100 high 1 x 150 high
Load per drawer	N	500



Accessories		
Name	Material number	Quantity
Drawer divider assortment H = 100 mm	R961000563	
Drawer divider assortment H = 150 mm	R961000564	
Anti-skid mat	R961000568	

Drawer divider assortment 100 mm

Material number	R961000563
Type short description	DRAWER MODULE TS-MC-DS100

The 100 mm height of the container allows flexible division of drawers and systematic arrangement of the stored parts. Version for drawers of the WS290's built-in container and the roller container (R961000287).

- ▶ Dividers made of galvanized sheet steel
- ▶ Sub-division is possible by means of tiered grid slots in the middle rail.
- ▶ Six transverse division components can be attached suspended in the middle rail

Type of mounting	Inserted / screwed-in optional	
Single compartments	Units	8


Drawer divider assortment 150 mm

Material number	R961000564
Type short description	DRAWER MODULE TS-MC-DS150

The 150 mm height of the container allows flexible division of drawers and systematic arrangement of the stored parts. Version for drawers of the WS290's built-in container and the roller container (R961000287).

- ▶ Dividers made of galvanized sheet steel
- ▶ Sub-division is possible by means of tiered grid slots in the middle rail.
- ▶ Six transverse division components can be attached suspended in the middle rail

Type of mounting	Inserted / screwed-in optional	
Single compartments	Units	8


Anti-skid mat

Material number	R961000568
Type short description	INLAY MAT TS-MC-ANTISKID-18X36MM

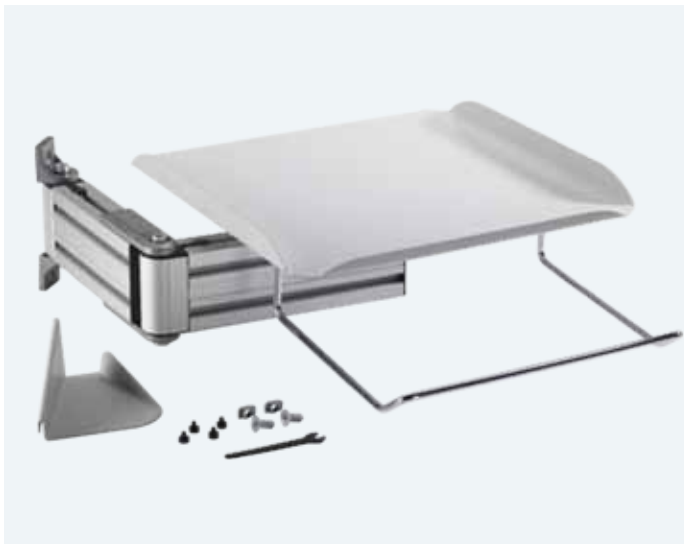
Prevents slippage of stored parts such as tools and components in the drawer of the WS290's built-in container and the roll container (R961000287). Can also be used with range of 100 mm or 150 mm drawer dividers.

Dimensions	mm (L x W x H)	600 x 300 x 5
Weight	kg	0.086
Material	Neoprene, black	



Screen support arm

Material number	1827003725	
Type short description	SUPPORT ARM TS-MC-DS3/DS4	
The flexible support arm with a swiveling mounting plate supports ergonomic set up of the workstation with a monitor/laptop and keyboard. The support arm consists of a two-jointed support profile with a mounting plate and a fastening plate to allow height-adjustable attachment on the side of the base frame.		
Dimensions	mm (L x W x H)	710 x 415 x 350
Weight	kg	8.3
Load-bearing capacity	N	250
Type of delivery	pre-assembled unit	
Type of fastening	screws with sliding blocks	
Table area	mm (L x W)	400 x 400



Rag holder

Material number	1827003722	
Type short description	RAG HOLDER TS-MC-2ST	
Rag holder for quick access to wipes at the workstation; can also be used to route cables and hoses. Can be easily fixed in the groove profiles of workstations.		
Type of fastening	Fitted into 10 mm groove	
Material	Plastic, black	
Delivery unit	Units	2



Cable holder for 50 measuring lines

Material number	R961004144	
Type short description	CABLE HOLDER TS-MC-50F-MITBEF	
Cable holder for holding measuring leads, ergonomic workstation with availability of the required measuring leads for training exercises. The measuring lead is hooked into the cable holder.		
Dimensions	mm (L x W x H)	210 x 65 x 35
Weight	kg	0.14
Type of delivery	pre-assembled unit	
Type of fastening	screw-fastened	
Receiving capacity	Units	50



Info panel	
Material number	1827003721
Type short description	INFOPANEL TS-MC-DINA4-GELENK

To show information in an ergonomic way that is needed to conduct the training exercise at the workstation, e.g. wiring diagrams, device descriptions or work instructions. This makes it possible to access this information directly at the workstation. Double-jointed support profile with fixing kit for mounting on the base frame using head nuts in the aluminum groove profile or grooved plate, height-adjustable, cover with acrylic protective screen.

Dimensions	mm (L x W x H)	370 x 280 x 80
Weight	kg	4.11
Load-bearing capacity	N	250
Type of fastening	screws with sliding blocks	
Panel size	Format	A4

10 l Hydraulic oil RSL22	
Material number	R913035362
Type short description	HYDRAULIC OIL AVIA FLUID RSL 22 (10 L CANISTER)

10 liters of hydraulic fluid, suitable for all WS200/WS290 power units, see safety data sheet: www.avia.de

Product name	AVIA Fluid RSL 22	
Contents	l	10

20 l Hydraulic oil RSL22	
Material number	R900019287
Type short description	HYDRAULIC OIL AVIA FLUID RSL 22 (20 L CANISTER)

20 liters of hydraulic fluid, suitable for all WS200/WS290 power units, see safety data sheet: www.avia.de

Product name	AVIA Fluid RSL 22	
Contents	l	20

Filling funnel with hose	
Material number	R961009591
Type short description	FUNNEL160 + HOSE

Funnel for filling the power units of WS200 and WS290 workstations with hydraulic fluid



Tool bag for hydraulics

Material number	R900865138	
Type short description	TOOL BAG TS-MC-HY-TASCHE	
Composed of:	<ul style="list-style-type: none"> ▶ open-ended wrenches 10 x 11; 12 x 13; 14 x 17; 18 x 19 ▶ screwdrivers 0.7 x 4.0; 0.95 x 5.5 ▶ Phillips screwdriver ▶ hexagon socket wrenches 2.5, 3.0, 4.0, 6.0 	
Dimensions	mm (L x W x H)	300 x 90 x 90
Weight	kg	1



Wiper roll dispenser

Material number	R900833872	
Type short description	DISPOSAL TS-HC-OEL_PAPROL-SACK_GESTELL	
Composed of:	<ul style="list-style-type: none"> ▶ Mobile wiper roll dispenser ▶ 40 L litter bin with lid ▶ Binding agents ▶ Wipes ▶ Garbage bags 	
Dimensions	mm (L x W x H)	700 x 500 x 450
Weight	kg	35



Accessories for WS200

Mounting kit for connecting WS 200 workstations

Material number	R961008677
Type short description	CONNECTION SET TS-MC-GN851-160-T2

The mounting kit can be easily installed on the WS200 /WS201 workstations. The stainless steel latch clamp safely connects the workstations together.



Hose holder for 9 hoses

Material number	R961009234
Type short description	HOSE HOLDER TS-MC-9F

The hose holder can be optionally attached to the WS200 workstation. The hose holder can be used to accommodate up to 9 hydraulic hoses. The hoses are hung between the two racks.

Dimensions	mm (L x W x H)	280 x 210 x 105
Weight	kg	1.5



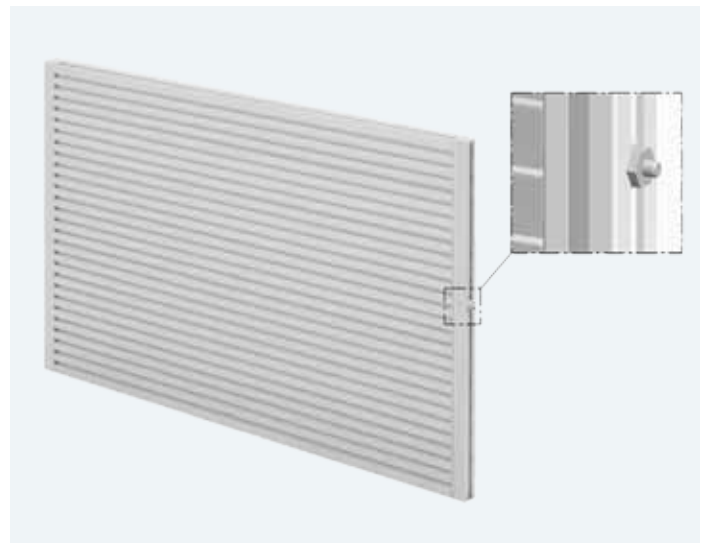
Accessories for WS290

Mountable grooved plate

Material number	R961000169
Type short description	GROOVED PLATE TS-MC-DS4-1130X700X30-MIT-BOLZEN

Grooved plate with 25 mm groove intervals For mounting components with SnapIN quick fastening system from the fields of pneumatics and automation technology. The grooved plate can be mounted quickly and easily on either side of the WS290 workstation and fastened securely.

Dimensions	mm (L x W x H)	1130 x 700 x 30
Weight	kg	24
Material	Aluminum body	
Groove intervals	mm	25



Order examples



Drive & Control Academy

Study topics

Workstations

Order examples

Components and Spare Parts

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Proportional servo valve technology 98

Mobile hydraulics 100

On/Off Hydraulics

We recommend the equipment below for teaching hydraulics from basic knowledge to on/off hydraulics, from manual and electric operation to troubleshooting:

Selection of equipment sets suitable for the study topics:

Mat. no.	Designation	Description	Pieces
R961009458	DEVICE SET TS-HS 201-1X	Device set for WS200/WS290 On/off hydraulics – manual control (according to BIBB, A-H), complete	2
R961009466	DEVICE SET TS-HS 404-1X	Expanded device set for WS200/WS290 from On/off hydraulics – manual control to On/off hydraulics – electrical control (according to BIBB, A-H)	2
R901386157	DEVICE SET TS-HS 501-1X	Electrical device set for WS200, On-off hydraulics – electrical operation (BIBB A-H), excluding I/O module	2
R961006620	DEVICE SET TS-HS 204-1X	Device set for WS200/WS290 On/off hydraulics – troubleshooting, electrical control	2

Workstations suitable for the study topics:

Mat. no.	Designation	Description	Pieces
R961008852	WORKSTATION TS-WS200-1X/N0G2A2T1&	WS200 Hydraulic workstation, double-sided for 2 - 4 trainees – assembled, including packaging	1
R961009585	WORKSTATION TS-WS201-1X/M2L2B0	WS201 Hydraulic work station, load unit measuring glass, double-sided for 2 - 4 trainees – assembled, including packaging	1
R961008856	WORKSTATION TS-WS200-1X/N0G6A0T0	WS200 workstation, double-sided component carrier – assembled, including packaging	1

Selection of project manuals suitable for the study topics:

Mat. no.	Designation	Description	Pieces
R901385282	HANDBOOK TW-HY-LH 201EN	Trainer's manual "On/off hydraulics – manual control (according to BIBB, A to H)", EN	1
R901385283	HANDBOOK TW-HY-SH 201EN	Trainee's manual "On/off hydraulics – manual control (according to BIBB, A to H)", EN	2
R901385284	HANDBOOK TW-HY-LH 202EN	Trainer's manual "On/off hydraulics – electrical control (according to BIBB, A to Z3)", EN	1
R901385285	HANDBOOK TW-HY-SH 202EN	Trainee's manual "On/off hydraulics – electrical control (according to BIBB, A to Z3)", EN	2
R961003805	HANDBOOK TW-HY-AL 204EN	Trainer's/trainee's manual "On/off hydraulics – troubleshooting", EN	3

In addition, the accessories below are required:

Mat. no.	Designation	Description	Pieces
R961009563	MEASURING DEVICE SET TS-HY BASIC	Basic measuring device set	2
R961002927	COUPLING SOCKET TS-HC-1-15-005-9-XX008	Pressure relief coupling	2
R961008698	HOSE HOLDER TS-MC-9F	Hose holder for 9 hoses	4
R913035362	HYDRAULIC OIL AVIA FLUID RSL 22 (10 L CANISTER)	Hydraulic oil RSL22 – packaging unit 9 kg	1
R961009591	FUNNEL 160 + HOSE	Filling funnel with hose	1
0538103012	TEST AND FILLING EQUIPMENT FOR DIAPHRAGM ACCUMULATOR	Filling and test equipment for hydraulic accumulator	1
R961008677	CONNECTION SET TS-MC-GN851-160-T2	Mounting kit for connecting WS 200 workstations	2

The appropriate books, e-learning media, resources, posters, cutaway models, multimedia and software can be found in our media catalog:

www.boschrexroth.com/trainingmedia

These resources completely cover the desired study topics for 2 - 4 trainees so that no additional materials are required.

Proportional Servo Valve Technology

We recommend the following resources for teaching hydraulics from basic knowledge of on/off hydraulics (manual and electrical operation) through troubleshooting and proportional hydraulics to hydraulic control:

Selection of device sets suitable for the study topics:

Mat. no.	Designation	Description	Pieces
R961009458	DEVICE SET TS-HS 201-1X	Device set for WS200/WS290 On/off hydraulics – manual control (according to BIBB, A-H), complete	2
R961009466	DEVICE SET TS-HS 404-1X	Expanded device set for WS200/WS290 from On/off hydraulics – manual control to On/off hydraulics – electrical control (according to BIBB, A-H)	2
R901386159	DEVICE SET TS-HS 503-1X	Electrical device set for WS290, On-off hydraulics – electrical control (BIBB A-H), excluding I/O module	2
R961006620	DEVICE SET TS-HS 204-1X	Device set for WS200/WS290 On/off hydraulics – troubleshooting, electrical control	2
R961009468	DEVICE SET TS-HS 406-1X	Expanded device set for WS290 from On/off hydraulics – electrical operation (BIBB, A-H) to Continuous control valve technology - proportional hydraulics	2
R901386161	DEVICE SET TS-HS 505-1X	Expanded electrical device set for WS290 from On/off hydraulics – electrical operation (BIBB, A-H) to Proportional servo valve technology - proportional hydraulics	2
R961009474	DEVICE SET TS-HS 411-1X	Expanded device set for WS290 from On/off hydraulics – electrical operation (according to BIBB, A-H) + Proportional servo valve technology – proportional hydraulics to Proportional servo valve technology – control hydraulics	2
R901386164	DEVICE SET TS-HS 508-1X	Expanded device set for WS290 from Proportional servo valve technology – proportional hydraulics to Proportional servo valve technology – control hydraulics	2

Workstations suitable for the study topics:

Mat. no.	Designation	Description	Pieces
R961009457	WORKSTATION TS-WS290-1X/G2A1B2C1&	WS290 work station, hydraulics, 230 V/50 Hz, double sided for 4 - 6 trainees, complete – assembled, including packaging	1
R961008856	WORKSTATION TS-WS200-1X/N0G6A0T0	WS200 workstation, double-sided component carrier – assembled, including packaging	1

Selection of project manuals suitable for the study topics:

Mat. no.	Designation	Description	Pieces
R901385282	HANDBOOK TW-HY-LH 201EN	Trainer's manual “On/off hydraulics – manual control (according to BIBB, A to H)”, EN	1
R901385283	HANDBOOK TW-HY-SH 201EN	Trainee's manual “On/off hydraulics – manual control (according to BIBB, A to H)”, EN	2
R901385284	HANDBOOK TW-HY-LH 202EN	Trainer's manual “On/off hydraulics – electrical control (according to BIBB, A to Z3)”, EN	1
R901385285	HANDBOOK TW-HY-SH 202EN	Trainee's manual “On/off hydraulics – electrical control (according to BIBB, A to Z3)”, EN	2
R961003805	HANDBOOK TW-HY-AL 204EN	Trainer's/trainee's manual “On/off hydraulics – troubleshooting”, EN	3

Mat. no.	Designation	Description	Pieces
R961003873	HANDBOOK TW-HY-LH 301EN	Trainer's manual "Continuous control valve technology – proportional hydraulics", EN	1
R961003875	HANDBOOK TW-HY-SH 301EN	Trainee's manual "Continuous control valve technology – proportional hydraulics", EN	2
R961005091	HANDBOOK TW-HY-LH 302EN	Trainer's manual "Continuous control valve technology – control hydraulics", EN	1
R961005092	HANDBOOK TW-HY-SH 302EN	Trainee's manual "Continuous control valve technology – control hydraulics", EN	2

In addition, the accessories below are required:

Mat. no.	Designation	Description	Pieces
R961009563	MEASURING DEVICE SET TS-HY BASIC	Basic measuring device set	2
R961002927	COUPLING SOCKET TS-HC-1-15-005-9-XX008	Pressure relief coupling	2
R900019287	HYDRAULIC OIL AVIA FLUID RSL 22 (20 L CANISTER)	Hydraulic oil RSL22 – packaging unit 18 kg	1
R961009591	FUNNEL 160 + HOSE	Filling funnel with hose	1
0538103012	TEST AND FILLING EQUIPMENT FOR DIAPHRAGM ACCUMULATOR	Filling and test equipment for hydraulic accumulator	1

To obtain continuous measurements of the flow rate, we recommend using the following optional accessories:

Mat. no.	Designation	Description	Pieces
R913002273	MEASURING DEVICE SET TS-EC-3020P/P-10-10	MEASURING DEVICE SET 3020P/P-10-1 The supplied case contains cables, a power supply unit, and measuring connections Two pressures can be measured Completely ready to use with 2 x ISDS pressure transducers 200 bar and full version of software	2
R961002508	FLOW METER TS-HC-GFM 3843-03-S-3	Gear volumetric flow sensor	2
R900733207	CONNECTION CABLE TS-EC-ISDS-2500MM	Measuring cable for ISDS	2

The appropriate books, e-learning media, resources, posters, cutaway models, multimedia and software can be found in our media catalog:

www.boschrexroth.com/trainingmedia

These resources completely cover the desired study topics for 2 - 4 trainees so that no additional materials are required.

Mobile Hydraulics

We recommend the following resources for teaching hydraulics from basic knowledge of on/off hydraulics (manual and electrical operation) through troubleshooting to mobile hydraulics (LUDV control system):

Selection of device sets suitable for the study topics:

Mat. no.	Designation	Description	Pieces
R961009458	DEVICE SET TS-HS 201-1X	Device set for WS200/WS290 On/off hydraulics – manual control (according to BIBB, A-H), complete	2
R961006619	DEVICE SET TS-HS 203-1X	Device set for WS200/WS290 On/off hydraulics – troubleshooting, manual control	2
R961009467	DEVICE SET TS-HS 405-1X	Expanded device set from On/off hydraulics – manual operation (according to BIBB, A-H) to Mobile hydraulics – throttle control	2
R961009471	DEVICE SET TS-HS 409-1X	Expanded device set for WS290 from Mobile hydraulics – throttle control to Mobile hydraulics – load sensing control	2
R961009472	DEVICE SET TS-HS 410-1X	Expanded device set for WS290 from Mobile hydraulics – throttle control to Mobile hydraulics – LIFD control	2

Workstations suitable for the study topics:

Mat. no.	Designation	Description	Pieces
R961009864	WORKSTATION TS-WS290-1X/G2A1B0C1&	WS290 workstation, hydraulics, 230 V/50 Hz, double-sided for 4 - 6 trainees, without module frame – assembled, including packaging	1
R961008856	WORKSTATION TS-WS200-1X/N0G6A0T0	WS200 workstation, double-sided component carrier – assembled, including packaging	1

Selection of project manuals suitable for the study topics:

Mat. no.	Designation	Description	Pieces
R901385282	HANDBOOK TW-HY-LH 201EN	Trainer's manual "On/off hydraulics – manual control (according to BIBB, A to H)", EN	1
R901385283	HANDBOOK TW-HY-SH 201EN	Trainee's manual "On/off hydraulics – manual control (according to BIBB, A to H)", EN	2
R961003805	HANDBOOK TW-HY-AL 204EN	Trainer's/trainee's manual "On/off hydraulics – troubleshooting", EN	3
R961005094	HANDBOOK TW-HY-LH 303EN	Trainer's manual "Mobile hydraulics – throttle control", EN	1
R961005093	HANDBOOK TW-HY-SH 303EN	Trainee's manual "Mobile hydraulics – throttle control", EN	2
R961005147	HANDBOOK TW-HY-LH 304EN	Trainer's manual "Mobile hydraulics – load sensing control", EN	1
R961005146	HANDBOOK TW-HY-SH 304EN	Trainee's manual "Mobile hydraulics – load sensing control", EN	2
R961005149	HANDBOOK TW-HY-LH 305EN	Trainer's manual "Mobile hydraulics – LUDV control", EN	1
R961005148	HANDBOOK TW-HY-SH 305EN	Trainee's manual "Mobile hydraulics – LUDV control", EN	2

In addition, the accessories below are required:

Mat. no.	Designation	Description	Pieces
R961009563	MEASURING DEVICE SET TS-HY BASIC	Basic measuring device set	2
R961002927	COUPLING SOCKET TS-HC-1-15-005-9-XX008	Pressure relief coupling	2
R900019287	HYDRAULIC OIL AVIA FLUID RSL 22 (20 L CANISTER)	Hydraulic oil RSL22 – packaging unit 18 kg	1
R961009591	FUNNEL 160 + HOSE	Filling funnel with hose	1
R913002273	MEASURING DEVICE SET TS-EC-3020P/P-10-10	MEASURING DEVICE SET 3020P/P-10-10 The supplied case contains cables, a power supply unit, and measuring connections Completely ready to use with 2 x ISDS pressure transducers 200 bar and full version of software	2
R961002508	FLOW METER TS-HC-GFM 3843-03-S-3	Gear volumetric flow sensor	2
R900733207	CONNECTION CABLE TS-EC-ISDS-2500 MM	Measuring cable for ISDS	2
0538103012	TEST AND FILLING EQUIPMENT FOR DIAPHRAGM ACCUMULATOR	Filling and test equipment for hydraulic accumulator	1

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These resources completely cover the desired study topics for 2 - 4 trainees so that no additional materials are required.

We will gladly send you an offer for these order examples. If you have further questions or need information, please contact us.

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Components and Spare Parts



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Components - Valves

Directional control valves - manual control

4/2-way directional control valve 4WMM6C5X		
Material no.:	R961002552	
Type short description	DIRECTIONAL VALVE TS-HC-4WMM 6 C5X/	
Directional spool valve; 4 connection points; manual operation via hand lever; spring reset; direct actuation control spool; type "C" control spool; P-A & B-T open during standby; mounted on component plate; connections via self-sealing coupling connectors		
Dimensions	mm (L x W x H)	137 x 125 x 182
Weight	kg	2
Max. operating pressure	bar	120
Industrial type	4WMM6C5X	
Plug-in connector	Low oil leakage	Type W



4/3-way directional control valve 4WMM6G5X		
Material no.:	R961002550	
Type short description	DIRECTIONAL VALVE TS-HC-4WMM 6 G5X/	
Directional spool valve; 4 connection points; 3 spool positions; manual operation via hand lever; direct actuation control spool; type "G" control spool; P-T open & A,B blocked during standby; mounted on component plate; connections via self-sealing coupling connectors		
Dimensions	mm (L x W x H)	137 x 125 x 182
Weight	kg	2
Max. operating pressure	bar	120
Industrial type	4WMM6G5X	
Plug-in connector	Low oil leakage	Type W



4/3-way directional control valve 4WMM6G5X manipulated		
Material no.:	R961006553	
Type short description	DIRECTIONAL VALVE TS-HC-4WMM 6 G5X/-MANIP	
Manipulated 4/3-way directional valve 4WMM6G5X; the typical features of aging and wear are simulated; connections via self-sealing coupling connectors		

Directional control valves - manual control

4/3-way directional control valve 4WMM6E5X/

Material no.:	R961002551	
Type short description	DIRECTIONAL VALVE TS-HC-4WMM 6 E5X/F	
Directional spool valve; 4 connection points; 3 spool positions; manual operation via detent; direct actuation control spool; type "E" control spool; P, T, A, B blocked during standby; mounted on component plate; connections via self-sealing coupling connectors		
Dimensions	mm (L x W x H)	137 x 125 x 182
Weight	kg	2
Max. operating pressure	bar	120
Industrial type	4WMM6E5X/F	
Plug-in connector	Low oil leakage	Type W



4/3-way directional control valve 4WMM6J5X

Material no.:	R961002510	
Type short description	DIRECTIONAL VALVE TS-HC-4WMM 6 J5X/	
Directional spool valve; 4 connection points; 3 spool positions; manual operation via hand lever; spring centering; direct actuation control spool; type "J" control spool; P blocked & T-A-B open during standby; mounted on component plate; connections via self-sealing coupling connectors		
Dimensions	mm (L x W x H)	137 x 125 x 182
Weight	kg	2
Operating pressure	bar	120
Industrial type	4WMM6J5X/F	
Plug-in connector	Low oil leakage	Type W



Directional control valves - manual control

4/3-way directional control valve 4WMM6H5X		
Material no.:	R961002511	
Type short description	DIRECTIONAL VALVE TS-HC-4WMM 6 H5X/	
Directional spool valve; 4 connection points; 3 spool positions; manual operation via hand lever; spring centering; direct actuation control spool; type "H" control spool; P-T-A-B open during standby; mounted on component plate; connections via self-sealing coupling connectors		
Dimensions	mm (L x W x H)	137 x 125 x 182
Weight	kg	2
Operating pressure	bar	120
Industrial type	4WMM6H5X	
Plug-in connector	Low oil leakage	Type W



Directional control valves - electronically controlled
4/2-way directional control valve 4WE6C6X/

Material no.:	R961002547
Type short description	DIRECTIONAL VALVE TS-HC-4WE 6 C6X/EG 24N9K4

Directional spool valve; 4 connection points; 2 spool positions; electronic operation; concealed manual override; direct actuation control spool; type "C" control spool; P-A open during standby; B-T open; mounted on component plate; connections via self-sealing coupling connectors

Dimensions	mm (L x W x H)	146 x 125 x 98
Weight	kg	2.35
Operating voltage	V DC	24
Max. operating pressure	bar	120
Industrial type	4WE6C6X/EG24N9K4	
Plug-in connector	Low oil leakage	Type W

Accessories

Designation	Material no.:	Quantity
Solenoid cable with LED, shape A, gray	R900846808	1


4/3-way directional control valve 4WE6G6X/

Material no.:	R961002548
Type short description	DIRECTIONAL VALVE TS-HC-4WE 6 G6X/EG 24N9K4

Directional spool valve; 4 connection points; 3 spool positions; electronic operation; spring centering; concealed manual override; direct actuation control spool; type "G" control spool; P-T open during standby; A-B blocked; mounted on component plate; connections via self-sealing coupling connectors

Dimensions	mm (L x W x H)	206 x 125 x 98
Weight	kg	2.9
Operating voltage	V DC	24
Max. operating pressure	bar	120
Industrial type	4WE6G6X/EN24N9K4	
Plug-in connector	Low oil leakage	Type W

Accessories

Designation	Material no.:	Quantity
Solenoid cable with LED, shape A, gray	R900846808	1
Solenoid cable with LED, shape A, black	R900846807	1



Directional control valves - electronically controlled

4/3-way directional control valve 4WE6E6X/		
Material no.:	R961002549	
Type short description	DIRECTIONAL VALVE TS-HC-4WE 6 E6X/EG 24N9K4	
Directional spool valve; 4 connection points; 3 spool positions; electronic operation; spring centering; concealed manual override; direct actuation control spool; type "E" control spool; P-T-A-B blocked during standby; mounted on component plate; connections via self-sealing coupling connectors		
Dimensions	mm (L x W x H)	206 x 125 x 98
Weight	kg	2.9
Operating voltage	V DC	24
Max. operating pressure	bar	120
Industrial type	4WE6E6X/EG24N9K4	
Plug-in connector	Low oil leakage	Type W
Accessories		
Designation	Material no.:	Quantity
Solenoid cable with LED, shape A, gray	R900846808	1
Solenoid cable with LED, shape A, black	R900846807	1



4/3-way directional control valve 4WE6J6X/		
Material no.:	R961002554	
Type short description	DIRECTIONAL VALVE TS-HC-4WE 6 J6X/EG 24N9K4	
Directional spool valve; 4 connection points; 3 spool positions; electronic operation; spring centering; concealed manual override; direct actuation control spool; type "J" control spool; P blocked & T-A-B open during standby; mounted on component plate; connections via self-sealing coupling connectors		
Dimensions	mm (L x W x H)	206 x 125 x 98
Weight	kg	2.9
Operating voltage	V DC	24
Max. operating pressure	bar	120
Industrial type	4WE6J6X/EG24N9K4	
Plug-in connector	Low oil leakage	Type W
Accessories		
Designation	Material no.:	Quantity
Solenoid cable with LED, shape A, gray	R900846808	1
Solenoid cable with LED, shape A, black	R900846807	1



Directional valves - proportional servo valves with feedback

**4/3-way proportional directional control valve 4WREE6E08-2X/
 with int. elec. and load simulation**

Material no.:	R961003533
Type short description	PROP-DIRECTIONAL-VALVE TS-HC-4WREE 6 E08-2X+DBDH 6 K1X/

Direct-operated proportional directional valve with electronic position feedback and integrated OBE electronics; flow direction and volume control; actuation via proportional solenoid with central thread and detachable coil; spring-centered control spool; control electronics with voltage input; load simulation via pressure relief valve at connection B in reverse flow; manually adjustable; check valve; free flow in the feed direction; mounted on component plate; connections via self-sealing coupling connectors

Dimensions	mm (L x W x H)	350 x 125 x 210
Weight	kg	5.9
Supply voltage	V DC	24
Max. operating pressure	bar	120
Industrial type	4WREE6E08-2X/G24K31/A1V + HSZ 06 A218	
Plug-in connector	Low oil leakage	Type W
Max. current consumption	A	2
Command value input	V DC	± 10 V

Accessories

Designation	Material no.:	Quantity
Cable, 7-pin for integrated electronics	R961003550	1



Directional valves - proportional servo valves with feedback

4/4-way closed loop control valve 4WRPEH6 with integrated electronics		
Material no.:	R961009234	
Type short description	PROP-DIRECTIONAL-VALVE TS-HC-4WRPEH 6 C3 B04L-2X/G24K0/A1M	
Directly-actuated directional control valve; servo quality control spool and sleeve; single-sided operation with 4/4 failsafe position when turned off (P blocked, T-A-B open); electrical position feedback and integrated electronics (OBE); calibrated at factory; signal input differential amplifier with voltage input; mounted on component plate; connections via self-sealing coupling connectors		
Dimensions	mm (L x W x H)	199 x 125 x 150
Weight	kg	4
Max. operating pressure	bar	120
Supply pressure	V DC	24
Command value input	V DC	± 10
Industrial type	4WRPEH6C3B04L-2X/G24K0/A1M	
Plug-in connector	Low oil leakage	Type W
Max. power consumption	W	40
Connector plug	according to E DIN 43563-AM6	
Accessories		
Designation	Material no.:	Quantity
Cable, 7-pin for integrated electronics	R961003550	1



Pressure control valves - manual control

Pressure relief valve DBDH6G1X/

Material no.:	R961002520
Type short description	PRESSURE-RELIEF-VALVE TS-HC-DBDH 6 G1X/100 SO127

The pressure relief valve is for limiting the system pressure. The settings are steplessly-adjustable using the rotary knob. Connections via self-sealing coupling connectors and sockets

Dimensions	mm (L x W x H)	233 x 126 x 52
Weight	kg	1.8
Max. operating pressure	bar	120
Set pressure	bar	Up to 100
Actuation		Manual
Industrial type		DBDH6G1X/100
Plug-in connector	Low oil leakage	Type W
Max. flow	l/min	Approx. 15



Pressure reducing valve, directly operated DR6DP1-5X/

Material no.:	R961002544
Type short description	PRESSURE-REDUCING-VALVE TS-HC-DR 6 DP1-5X/75YM

The directly actuated pressure reducing valve is used to reduce the system pressure and is adjusted using a hand wheel. Internal pilot oil supply, external pilot oil drain, mounted on component plate, without check valve.

Connections via self-sealing coupling connectors

Dimensions	mm (L x W x H)	194 x 125 x 84
Weight	kg	2.45
Max. operating pressure	bar	120
Max. secondary pressure	bar	75
Actuation		Manual
Industrial type		DR6DP1-5X/75YM
Plug-in connector	Low oil leakage	Type W
Max. flow	l/min	15



Pressure control valves - manual control

Pressure shut-off valve, directly operated DZ6DP1-5X/		
Material no.:	R961002558	
Type short description	PRESSURE-SHUT-OFF -VALVE TS-HC-DZ 6 DP1-5X/75Y	
<p>The direct-operated pressure shut-off valve is used to connect a second system on a pressure-dependent basis, which is regulated by means of a hand wheel. Internal pilot oil supply, external leakage oil discharge, with check valve, mounted on the component plate Connections via self-sealing coupling connectors</p>		
Dimensions	mm (L x W x H)	197 x 125 x 86
Weight	kg	2.47
Max. operating pressure	bar	120
Cut-in pressure	bar	75
Actuation	Manual	
Industrial type	DZ6DP1-5X/75Y	
Plug-in connector	Low oil leakage	Type W
Max. flow	l/min	15



Pressure reducing valve, pilot operated DB6K1-4X/		
Material no.:	R961002545	
Type short description	PRESSURE-REDUCING-VA TS-HC-DB 6 K1-4X/50YV	
<p>The pilot-operated pressure relief valve is used to limit system pressure and is regulated by means of a hand wheel. internal pilot oil supply, external pilot oil drain, mounted on the worktop. Connections via self-sealing coupling connectors</p>		
Dimensions	mm (L x W x H)	155 x 125 x 79
Weight	kg	1.5
Max. operating pressure	bar	120
Set pressure	bar	50
Actuation	Manual	
Industrial type	DB6K1-4X/50YV	
Plug-in connector	Low oil leakage	Type W
Max. flow	l/min	15



Pressure control valves - manual control

Lowering brake valve A-VBSO-SE78-14-35		
Material no.:	R961002540	
Type short description	LOWERING-BRAKE-VALVE TS-HC-A-VBSO-SE-78-14-35	
The lowering brake valve controls the motion with leading loads. In the opposite direction, unimpeded movement is provided for.		
Dimensions	mm (L x W x H)	120 x 155 x 25
Weight	kg	1.23
Operating pressure	bar	100
Actuation	Manual	
Industrial type	A-VBSO-SE-78-14-35	
Plug-in connector	Low oil leakage	Type W



Pressure control valves - electrical control

Proportional pressure relief valve DBEE6-1X/50		
Material no.:	R961003924	
Type short description	PRESSURE-RELIEF-VA HC-DBEE 6-2X/50YG24K31A1M	
<p>The pressure relief valve with integrated electronics (OBE) is used to limit the system pressure. The system pressure can be continuously adjusted depending on the electrical command value. Internal pilot oil supply, external pilot oil drain, mounted on the component plate. Connections via self-sealing coupling connectors.</p>		
Dimensions	mm (L x W x H)	213 x 125 x 123
Weight	kg	3.45
Setting range	bar	50
Operating pressure	bar	120
Hysteresis	%	1.5
Industrial type	DBEE6-1X/50	
Plug-in connector	Low oil leakage	Type W
Electrical connection	K31	
Max. contact load	mA	1600
Accessories		
Designation	Material no.:	Quantity
Cable, 7-pin for integrated electronics	R961003550	1



Pressure relief valve pilot-operated DBW10A1-5X/		
Material no.:	R961002553	
Type short description	PRESSURE-RELIEF-VA TS-HC-DBW 10 A1-5X/50	
<p>The pilot-operated pressure relief valve is used to limit and provide solenoid-actuated relief to the operating pressure. For subplate mounting; with rotary knob; with directional spool valve; with concealed manual override; without mating connector</p>		
Dimensions	mm (L x W x H)	182 x 190 x 230
Weight	kg	7.45
Operating voltage	VDC	24
Max. operating pressure	bar	120
Set pressure	bar	50
Actuation	Clamping mechanism	
Industrial type	DBW10A1-5X/50-6EG24N9K4	
Plug-in connector	Low oil leakage	Type W
Max. flow	l/min	15
Accessories		
Designation	Material no.:	Quantity
Solenoid cable with LED, shape A, gray	R900846808	1



Flow control valves - manual control

Throttle valve DRV06-1-1X/V		
Material no.:	R961002539	
Type short description	THROTTLE-VALVE TS-HC-DV 06 -1- 1X/V	
The throttle valve is used to easily and precisely regulate and block flow in both directions. Connections via self-sealing coupling connectors and coupling sockets.		
Dimensions	mm (L x W x H)	174 x 65 x 24
Weight	kg	0.33
Operating pressure	bar	120
Actuation	Manual	
Industrial type	DV06-1-1X/V	
Plug-in connector	Low oil leakage	Type W
Max. flow	l/min	15
Control area	l/min	0 - 15



Throttle check valve DRV06-1-1X/V		
Material no.:	R961002495	
Type short description	THROTTLE-CHECK-VA TS-HC-DRV 06 -1-1X/V	
The throttle check valve makes possible throttling in one direction only (A to B). In the opposite direction, the throttle check valve allows unrestricted flow. Connections via self-sealing coupling connectors and coupling sockets		
Dimensions	mm (L x W x H)	180 x 65 x 24
Weight	kg	0.35
Operating pressure	bar	120
Cracking pressure	bar	0.5
Actuation	Manual	
Industrial type	DRV06-1-1X/V	
Plug-in connector	Low oil leakage	Type W
Flow	l/min	15
Control area	l/min	0 - 15



Flow control valves - manual control

2-way flow control valve 2FRM6B36-3X/		
Material no.:	R961002546	
Type short description	FLOW-CONTROL-VA TS-HC-2FRM 6 B36-3X/10QRV	
The 2-way flow control valve has the task of keeping flow constant regardless of the pressure and temperature. Setting by means of a lockable rotary knob with scale, without closing of the compensator devices, mounted on worktop. Connections via self-sealing coupling connectors.		
Dimensions	mm (L x W x H)	80 x 125 x 145
Weight	kg	1.86
Max. operating pressure	bar	120
Check valve	bar	0.7
Actuation	Manual	
Industrial type	2FRM6B36-3X/10QRV	
Plug-in connector	Low oil leakage	Type W



Flow divider		
Material no.:	R961002537	
Type short description	FLOW-DIVIDER TS-HC-DRF-38-11-A	
The flow divider divides an input current into two identical (50% - 50%) volume flows.		
Dimensions	mm (L x W x H)	143 x 40 x 225
Weight	kg	1.62
Operating pressure	bar	100
Industrial type	DRF-38-11-A	
Plug-in connector	Low oil leakage	Type W
Dividing ratio	50 - 50	
Max. pitch error	± 3	



Flow control valves - electrical control

Proportional flow control valve 2FRE6B-2X/

Material no.:	R961002557
Type short description	FLOW-CONTROL-VA TS-HC 2FRE6B-2x/10QK4RV

The proportional flow control valve has a double function, it can regulate flow, determined by an electrical setpoint, with pressure and temperature compensation.

With inductive position transducer, mounted on worktop

Dimensions	mm (L x W x H)	108 x 125 x 267
Weight	kg	3.91
Ambient temperature	°C	-20 to +50
Operating pressure	bar	100
Actuation	Via proportional solenoid	
Industrial type	2FRE6B-2X/10Q K4 RV	
Control area	l/min	0.05 - 10
Max. flow	l/min	10
Cracking pressure	bar	0.7
Voltage type	DC voltage	
Max. current per solenoid	A	1.5

Accessories

Designation	Material no.:	Quantity
Position transducer cable for proportional valve	R900844180	1
Solenoid cable with LED, shape A, gray	R900846808	1
Operating module VT-VRPA1 proportional amplifier, 4 rack units	R901057058	1



Isolator valves - manual control

Shut-off valve		
Material no.:	R961002491	
Type short description	BALL-VALVE TS-HC-AB21-20/G 1/4-500	
Shut-off valves are used to shut off the flow of hydraulic fluid. Connections via self-sealing coupling connectors and coupling sockets.		
Dimensions	mm (L x W x H)	202 x 26 x 76
Weight	kg	0.53
Operating pressure	bar	120
Plug-in connector	Low oil leakage	Type W



Isolator valve - hydraulic control

Non-return valve S6A1.X

Material no.:	R961002489	
Type short description	NON-RETURN-VALVE TS-HC-S6A1.0	
The non-return valve blocks flow in one direction, in the opposite direction it opens the spring at 1 bar. Connections via self-sealing coupling connectors and coupling sockets		
Dimensions	mm (L x W)	150 x 22
Weight	kg	0.25
Operating pressure	bar	120
Cracking pressure	bar	1
Industrial type	S6A1.0	
Plug-in connector	Low oil leakage	Type W
Flow	l/min	approx. 18 at p = 7 bar



Non-return valve S6A1.X with hose 630 mm

Material no.:	R961002471	
Type short description	HOSE-LINE TS-HC-ZN10031-08-W00R1-630	
The non-return valve with hose blocks flow in one direction, in the opposite direction it opens the spring at 1 bar. connections via self-sealing coupling sockets		
Dimensions	mm (L x W)	1000 x 22
Weight	kg	0.83
Operating pressure	bar	120
Cracking pressure	bar	1
Industrial type	S6A1.0	
Plug-in connector	Low oil leakage	Type W
Flow	l/min	approx. 18 at p = 7 bar



Non-return valve S6A3.X

Material no.:	R961002522	
Type short description	NON-RETURN-VALVE TS-HC-S 6 A3.0	
The non-return valve blocks flow in one direction, in the opposite direction it opens the spring at 3 bar. Connections via self-sealing coupling connectors and coupling sockets.		
Dimensions	mm (L x W)	150 x 22
Weight	kg	0.26
Operating pressure	bar	120
Cracking pressure	bar	3
Industrial type	S6A3.0	
Plug-in connector	Low oil leakage	Type W
Max. flow	l/min	approx. 18 at p = 7 bar



Isolator valve - hydraulic control

Non-return valve S6A3.X with hose 630 mm		
Material no.:	R961002472	
Type short description	HOSE-LINE TS-HC- ZN10031-08-W00R3-630	
The non-return valve with hose blocks the flow in one direction, in the opposite direction it opens the spring at 3 bar. Connections via self-sealing coupling sockets		
Dimensions	mm (L x W)	1000 x 22
Weight	kg	0.83
Operating pressure	bar	120
Cracking pressure	bar	3
Industrial type	S6A3.0	
Plug-in connector	Low oil leakage	Type W
Flow	l/min	approx. 18 at p = 7 bar



Non-return valve, hydraulic pilot controlled SV 6 PB1-6X/		
Material no.:	R961002513	
Type short description	HY-NON-RETURN-VA TS-HC-SV 6 PB1-6X/	
The hydr. releasable check valve is used for leakage-free blocking of the flow direction from B to A. The flow direction can be opened using a sufficiently high pilot pressure on X, . The seat valve allows flow in the direction A to B without external pilot pressure. Connections via self-sealing coupling connectors.		
Dimensions	mm (L x W x H)	85 x 125 x 81
Weight	kg	1.73
Operating pressure	bar	120
Cracking pressure	bar	1.5
Actuation	hydraulic	
Industrial type	SV6PB1-6X	
Plug-in connector	Low oil leakage	Type W
Max. flow	l/min	15



Cylinders, Load Units, Motors

Cylinders

Differential cylinder CD70F25/16-200 with protective housing and connection facility for load unit in WS201

Material no.:	R961009526
Type short description	CYLINDER TS-HC-CD 70F 25/ 16-.200Z11
Hydraulic cylinder of tie rod design with mounting system for grid, mounted on the base plate for mounting of sensors. Cover with scale, piston rod with bolts for optimal attachment of load unit. Connections via self-sealing coupling connectors.	

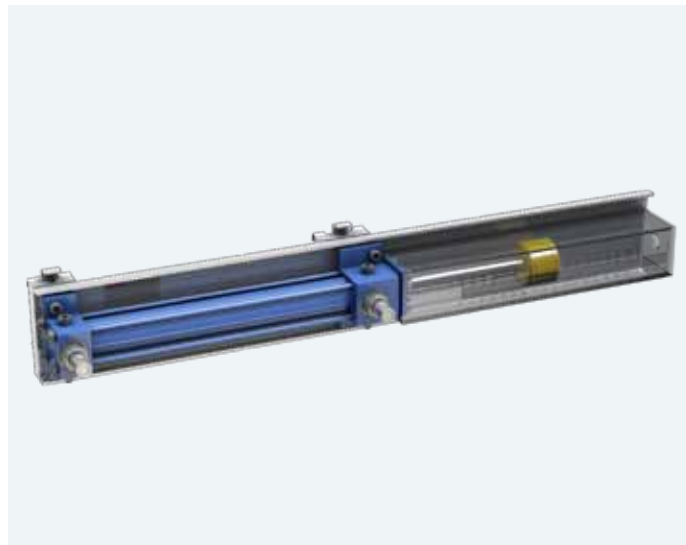
Dimensions	mm (L x W x H)	560 x 90 x 100
Weight	kg	3.9
Operating pressure	bar	105
Industrial type	CD70F25/16-200Z11/01HCUM11T	
Plug-in connector	Low oil leakage	Type W
Stroke	mm	200
Piston diameter	mm	25
Piston rod diameter	mm	16
Piston ratio		1,6 : 1

Differential cylinder CD70F25/16-200 with protective housing and end cushioning

Material no.:	R961007508
Type short description	CYLINDER TS-HC-CD 70F 25/ 16-.200Z11-ENDAE

Hydraulic cylinder in tie rod design with end position cushioning with mounting system for grids, mounted on base plate for attachment of sensors cover with scale, piston rod with bolts. Connections via self-sealing coupling connectors.

Dimensions	mm (L x W x H)	560 x 90 x 100
Weight	kg	3.9
Operating pressure	bar	105
Industrial type	CD70F25/16-200Z11/01HCUM11T	
Plug-in connector	Low oil leakage	Type W
Stroke	mm	200
Piston diameter	mm	25
Piston rod diameter	mm	16
Piston ratio		1,6 : 1



Cylinders

Differential cylinder CD70F25/16-400 with protective housing		
Material no.:	R961003495	
Type short description	CYLINDER TS-HC-CD 70F 25/ 16-.400Z11	
Hydraulic cylinder of tie rod design with mounting system for grid, mounted on the base plate for mounting of sensors. cover with scale.		
Connections via self-sealing coupling connectors.		
Dimensions	mm (L x W x H)	960 x 90 x 100
Weight	kg	5.55
Max. operating pressure	bar	105
Industrial type	CD70F25/16-400Z11/01HCUM11T	
Plug-in connector	Low oil leakage	Type W
Stroke	mm	400
Piston diameter	mm	25
Piston rod diameter	mm	16
Piston ratio	1,6 : 1	

Load Units

Load unit 80 kg stationary

Material no.:	R961004005
Type short description	LOAD UNIT TS-HC-CD 70H 25/ 16-400Z11-80KG

To mediate the dynamic properties of hydraulic systems with positive and negative mass forces. Heavy vertical load unit, detached, mass is attached suspended on the cylinder. It can be run against a load spring.

Four-quadrant operation is possible. A load cycle occurs when the mass is placed on the spring load. Mounting rail for proximity switches, protective screens, roller bearings for absorbing radial forces.

Dimensions	mm (L x W x H)	445 x 445 x 1400
Weight	kg	150
Load mass	kg	80
Max. operating pressure	bar	105
Industrial type	CD70H25/16+DBDS6G1X/50	
Type of installation	free-standing	
Plug-in connector	Low oil leakage	Type W
Cylinder stroke	mm	400
Load force 50 bar	kN	2.45
Load spring	kN	2.5
Load stroke opp. load spring	mm	80
Piston diameter	mm	25
Piston rod diameter	mm	16
Piston ratio	1,6 : 1	



Load Units

Load unit, controllable, for dynamic load simulation		
Material no.:	R961004486	
Type short description	LOAD UNIT TS-HC-2ZYL-25X14X200+25X14X50	
<p>For teaching the basic properties of open- and closed loop-controlled positioning systems. A position regulated cylinder is moved against a load cylinder with damping cushion. The force can be regulated by means of a pressure reducing valve. The cushion prevents the metal from impacting. Position recirculation is carried out with a standardized measuring transducer cable. Mounting rail for proximity switches, scaled ruler, POM plastic runners for absorbing radial forces.</p>		
Dimensions	mm (L x W x H)	703 x 120 x 120
Weight	kg	6.3
Operating pressure	bar	120
Industrial type	CYL1MF3/25/14/200 + CYL1MF3/25/14/50	
Plug-in connector	Low oil leakage	Type W
Regulated stroke	mm	200
Load stroke	mm	50
Position-controlled cylinders	25/14/200	
Load cylinders	25/14/50	
Measurement distance input, output	normalized	600 mm = 10 V
Load force at 50 bar, max.	kN	2.45 (hydr. adjustable)



Motors
Gear motor

Material no.:	R961004259
Type short description	GEAR-MOTOR TS-HC-AZMF-12-008UCN20MX-S0077

If hydraulic fluid is supplied to the external gear motor, a moment of force can be taken off the protruding shaft; Output shaft with disc and 4 reflective film strips; suitable for clockwise/counterclockwise rotation; with leakage oil connection; plexiglass hood as intrusion protection - also for attaching a speed sensor (mat. no. R900892375); connections via self-sealing coupling connectors.

Dimensions	mm (L x W x H)	250 x 220 x 160
Weight	kg	5.9
Operating pressure	bar	120
Displacement	cm ³ /rev	8
Industrial type	AZMF-12-008	
Plug-in connector	Low oil leakage	Type W
Max. oil flow	l/min	8
Max. speed	1/min	1000

Axial piston motor

Material no.:	R961002811
Type short description	AXIALPISTONMOTOR TS-HC-A2F5/60W-C3

If hydraulic fluid is supplied to the axial piston motor of bent axis design, a moment of force can be drawn off the protruding shaft; Output shaft with disc and 4 reflective film strips; constantly changing direction of rotation; mounted on component plate; plexiglass screen as engagement protection - also for attaching a speed sensor (mat. no.. R900892375); connections via self-sealing coupling connectors.

Dimensions	mm (L x W x H)	130 x 230 x 205
Weight	kg	5.2
Max. operating pressure	bar	120
Displacement	cm ³ /rev	4.93
Industrial type	A2F5/60W-C3	
Plug-in connector	Low oil leakage	Type W
Max. oil flow	l/min	49
Max. speed	1/min	10 000



Motors

Planetary motor		
Material no.:	R961009234	
Type short description	DRIVEMOTOR TS-HC-EPMM-S 8 C	
If hydraulic fluid is supplied to the planetary motor, a moment of force can be taken off the protruding shaft; output shaft with disc and 4 reflective film strips, suitable for right or left rotation, no leakage oil connection necessary, plexiglass hood as engagement protection - also serves for the attachment of a speed sensor (mat. no. R900892375); connections via self-sealing coupling connectors		
Dimensions	mm (L x W x H)	156 x 115 x 155
Operating pressure	bar	140
Max. speed	1/min	1950
Oil flow	l/min	16
Displacement	cm ³ /rev	8.2



Mobile hydraulics

Hydraulic pilot controller with 2 hand levers 2-2TH6

Material no.:	R961005967
Type short description	HANDCONTROLTRANS TS-HC-2-2 TH6 L70-10/L70-M 01

With the deflection of the lever, the control pressure is regulated at the output. For example, with the hydraulic pilot pressure, directional valve spools are actuated. The pilot control unit is comprised of 2 elements with 2 hydraulic pressure reducing valves each.

Control curve 70; 2 hand levers without detent locking; connections via self-sealing coupling connectors.

Dimensions	mm (L x W x H)	363 x 200 x 192
Weight	kg	4.5
Max. inlet pressure	bar	50
Max. pilot pressure	bar	35
Max. pilot volume	l/min	16

Hydraulic pilot controller with joystick 4TH6

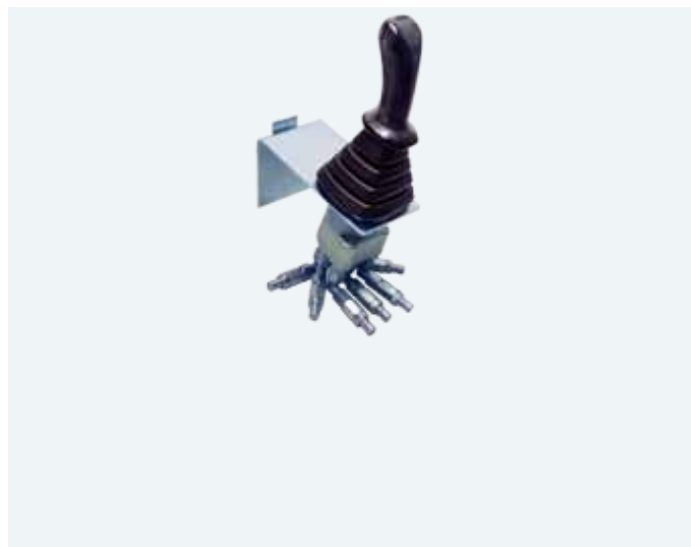
Material no.:	R961005968
Type short description	HANDCONTROLTRANS TS-HC-4 TH6E 97-14/TT 03 M01

With the deflection of the lever, the output pilot pressure is regulated according to a characteristic curve. For example, with the hydraulic pilot pressure, directional valve spools are actuated.

Allows parallel control of two actuators using a hand lever.

The pilot control unit is composed of 1 element with 4 hydraulic pressure reducing valves. Control curve 97; 1 hand lever; connections via self-sealing coupling connectors.

Dimensions	mm (L x W x H)	405 x 213 x 184
Weight	kg	5
Max. inlet pressure	bar	50
Max. pilot pressure	bar	35
Max. pilot volume	l/min	16



Mobile hydraulics

Mobile hydraulics - throttle control 3 SM12		
Material no.:	R961005970	
Type short description	HY-MANIFOLD TS-HC-SM12 3EL RR LOHR	
<p>The directional valve spools are actuated by means of hydraulic pilot pressure or manual lever movement. The actuator movement depends on the load pressure and the pressure differential at the opening cross-section. The pressure differential is load pressure-dependent and not pressure-compensated.</p> <p>The manifold is composed of an input and end element, three-way directional valve elements with 2 hydraulic controls and manual actuation. Input element with P connection; end element with T connection and P3 pressure lines; 2 secondary pressure limitation mechanisms;</p> <p>connections via self-sealing coupling connectors</p>		
Dimensions	mm (L x W x H)	366 x 275 x 344
Weight	kg	14
Operating pressure	bar	120



Mobile hydraulics - LIFD 2SX-12		
Material no.:	R961005966	
Type short description	HY-MANIFOLD TS-HC-SX12 2EL RR LOHR	
<p>The directional valve spools are actuated by means of hydraulic pilot pressure. The actuator movement depends on the load pressure and the pressure differential at the opening cross-section. The lowest pressure differential is regulated by the pump control, the greatest pressure differential by the downstream pressure compensators. The greatest load pressure is sent to the pump control as an LS signal. In case of undersupply (requested flow rate greater than maximum possible quantity supplied by the pump) the downstream pressure balances can be operated in the closing direction. This guarantees that no actuator will stall in the event of undersupply.</p> <p>The manifold is composed of an input and end element and 2 hydraulically controlled directional valve elements.</p> <p>LS pressure limitation and unloading take place within the input element. Each directional valve element is equipped with secondary pressure valves. The flow capacity can be set by means of stroke limitation mechanisms.</p> <p>Connections via self-sealing coupling connectors</p>		
Dimensions	mm (L x W x H)	366 x 195 x 374
Weight	kg	17
Max. operating pressure	bar	120



Mobile hydraulics

Mobile hydraulics - load sensing 2M4-12

Material no.:	R961005969
Type short description	HY MANIFOLD TS-HC-M4-7283-20/2M4-12JHLSYV01

The directional valve spools are actuated by means of hydraulic pilot pressure or manual lever movement. The actuator movement depends on the load pressure and the pressure differential at the opening cross-section. Input element with pilot oil supply

The pressure differential is regulated by the upstream pressure compensators. The highest load pressure is sent to the pump control as an LS signal via a shuttle valve chain.

The manifold is composed of an input and end element, 2 directional valve elements with 2 hydraulic controls and manual actuation. LS unloading in the end element. 4 secondary pressure limitation mechanisms, 2 of which are adjustable A directional valve element is equipped with an LS pressure valve. The flow capacity can be set by means of stroke limitation mechanisms. Connections via self-sealing coupling connectors

Dimensions	mm (L x W x H)	366 x 280 x 391
Weight	kg	19
Max. operating pressure	bar	120



Hydraulics Accessories

Hydraulic accumulator, pressure filter, inspection glass

Accumulator module		
Material no.:	R961002503	
Type short description	DIAPHRAGM ACCUMULATOR TS-HC-HAD0,7-210-1X/0G04E-1N111-BA	
<p>The accumulation station receives a certain volume of pressurized fluid and if required releases it again. The accumulator shut-off block with pressure relief valve and pressure gauge is used for manual safeguarding, blocking of the membrane hydraulic accumulator and providing relief to it. Connections via self-sealing coupling connectors. The accumulator station is delivered unfilled. Prior to operation, fill with nitrogen according to the operating instructions.</p>		
Dimensions	mm (L x W x H)	225 x 165 x 350
Weight	kg	9.9
Nominal volume	l	0.75
Nominal pressure	bar	100
Pressure rating	bar	100
Industrial type	Accumulator HAD 0,7-210-1X Accumulator shut-off block ABZSS10M-2X/100B/S30V	
Plug-in connector	Low oil leakage	Type W

Accessories		
Name	Material no.:	Quantity
Filling and test equipment for hydraulic accumulator	0538103012	1

Filling and test equipment for hydraulic accumulators		
Material no.:	0538103012	
Type short description	FILLING AND TEST EQUIP FOR HYDRAULICACC	
<p>With the help of the filling and testing equipment, the hydraulic accumulator is filled with nitrogen and the existing pre-filling pressure checked and changed.</p>		
Dimensions	mm (L x W x H)	450 x 350 x 100
Pressure gauge display	bar	0-250



Hydraulic accumulator, pressure filter, inspection glass

In-line filter for snapping into grid		
Material no.:	R961004334	
Type short description	PRESSUREFILTER TS-HC-ABZFD-S0040-10N-100-1X/M-A	
Inline filter for installing in pressure lines, with bypass valve and visual contamination indicator		
Dimensions	mm (L x W x H)	167 x 108 x 218
Weight	kg	2.1
Nominal pressure	bar	100
Series		40
Industrial type	ABZFD-S0040-10N-100-1X/M-A	
Plug-in connector	Low oil leakage	Type W
Filter unit	μ	10
Flow	l/min	350



Inspection glass		
Material no.:	R961006596	
Type short description	INSPECTION GLASS TS-HC-120BAR-178X55	
The inspection glass can be universally used to make air bubbles in fluids visible. Connections via self-sealing coupling connectors and coupling sockets.		
Dimensions	mm (L x W)	178 x 55
Max. operating pressure allowed	bar	120
Material	Aluminum, transparent plastic	



Distributors

Hydraulic distributor 4x on component plate		
Material no.:	R961002563	
Type short description	DISTRIBUTOR TS-HC-4F-4M-P	
4x hydraulic distributor on component plate Connections via self-sealing coupling connectors		
Dimensions	mm (L x W x H)	80 x 125 x 64
Weight	kg	0.97
Max. operating pressure	bar	120
Plug-in connector	Low oil leakage	Type W



Hydraulic distributor 4x		
Material no.:	R961002485	
Type short description	DISTRIBUTOR TS-HC-4F-3M1W	
4x hydraulic distributor Connections via self-sealing coupling connectors and coupling sockets		
Dimensions	mm (L x W x H)	168 x 45 x 80
Weight	kg	0.63
Operating pressure	bar	120
Plug-in connector	Low oil leakage	Type W



Pressure gauge 0 to 100 bar with 4x distributor on component plate		
Material no.:	R961002530	
Type short description	PRESSURE GAUGE TS-HC-VERT4M	
4x hydraulic distributor mounted on component plate with pressure gauge, connections via self-sealing coupling connectors		
Dimensions	mm (L x W x H)	80 x 125 x 91
Weight	kg	1.15
Operating pressure	bar	120
Plug-in connector	Low oil leakage	Type W



Hoses with Couplings

Hose line 630 mm		
Material no.:	R961002474	
Type short description	HOSELINE TS-HC-ZN10031-08-W00NN-630	
Hose length	mm	630
Weight	kg	0.64
Operating pressure	bar	120
Quick couplings	R96100481	Coupling socket M16 x 1.5
Bending radius	mm	85

Hose line 1000 mm		
Material no.:	R961002475	
Type short description	HOSELINE TS-HC-ZN10031-08-W00NN-1000	
Hose length	mm	1000
Weight	kg	0.74
Operating pressure	bar	120
Quick couplings	R96100481	Coupling socket M16 x 1.5
Bending radius	mm	85

Hose line 1500 mm		
Material no.:	R961002473	
Type short description	HOSELINE TS-HC-ZN10031-08-W00NN-1500	
Hose length	mm	1500
Weight	kg	0.86
Operating pressure	bar	120
Displacement	20	l
Quick couplings	R96100481	Coupling socket M16 x 1.5
Bending radius	mm	85

Hose line 2000 mm		
Material no.:	R961002480	
Type short description	HOSELINE TS-HC-ZN10031-08-W00NN-2000	
Hose length	mm	2000
Weight	kg	0.95
Operating pressure	bar	120
Quick couplings	R96100481	Coupling socket M16 x 1.5
Bending radius	mm	85



Hose line 2500 mm		
Material no.:	R961002479	
Type short description	HOSELINE TS-HC-ZN10031-08-W00NN-2500	
Hose length	mm	2500
Weight	kg	1.12
Operating pressure	bar	120
Quick couplings	R96100481	Coupling socket M16 x 1.5
Bending radius	mm	85

Hoses with Couplings

Hose line 630 mm with mini gauge port		
Material no.:	R961002481	
Type short description	HOSE LINE TS-HC-ZN10031-08-W00MM-630	
Hose length	mm	630
Weight	kg	0.83
Operating pressure	bar	120
Quick couplings	R96100481	Coupling socket M16 x 1.5
Bending radius	mm	85
Mini gauge port	Threaded coupling	AB20-11/K1G1/4
Hose line 1000 mm with mini gauge port		
Material no.:	R961002476	
Type short description	HOSELINE TS-HC-ZN10031-08-W00MM-1000	
Hose length	mm	1000
Weight	kg	0.93
Operating pressure	bar	120
Quick couplings	R96100481	Coupling socket M16 x 1.5
Bending radius	mm	85
Mini gauge port	threaded coupling	AB20-11/K1G1/4
Hose line 1500 mm with mini gauge port		
Material no.:	R961002482	
Type short description	HOSELINE TS-HC-ZN10031-08-W00MM-1500	
Hose length	mm	1500
Weight	kg	1.05
Operating pressure	bar	120
Quick couplings	R96100481	Coupling socket M16 x 1.5
Bending radius	mm	85
Mini gauge port	threaded coupling	AB20-11/K1G1/4
Hose line 2000 mm with mini gauge port		
Material no.:	R961002478	
Type short description	HOSE LINE TS-HC-ZN10031-08-W00MM-2000	
Hose length	mm	2000
Weight	kg	1.18
Operating pressure	bar	120
Quick couplings	R96100481	Coupling socket M16 x 1.5
Bending radius	mm	85



Hoses with Couplings

Hose line 700 mm with 90° fitting		
Material no.:	R961004332	
Type short description	HOSELINE TS-HC-ZN10031-08-W90NN-700	
Hose length	mm	700
Weight	kg	0.68
Max. operating pressure	bar	120
Quick couplings	R961000481	Coupling socket M16 x 1.5
Bending radius	mm	85

Hose line 1000 mm with 90° fitting		
Material no.:	R961004331	
Type short description	HOSELINE TS-HC-ZN10031-08-W90NN-1000	
Hose length	mm	1000
Weight	kg	0.85
Max. operating pressure	bar	120
Quick couplings	R961000481	Coupling socket M16 x 1.5
Bending radius	mm	85

Hose line 2000 mm with 90° fitting		
Material no.:	R961002477	
Type short description	HOSE LINE TS-HC-ZN10031-08-W90NN-2000	
Hose length	mm	2000
Weight	kg	1.08
Operating pressure	bar	120
Quick couplings	R96100481	Coupling socket M16 x 1.5
Bending radius	mm	85



Hoses with Couplings

Hose line 700 mm with 90° fitting and mini gauge port		
Material no.:	R961004329	
Type short description	HOSE LINE TS-HC-ZN10031-08-W90MM-700	
Hose length	mm	700
Weight	kg	0.68
Max. operating pressure	bar	120
Quick couplings	R961000481	Coupling socket M16 x 1.5
Bending radius	mm	85
Mini gauge port	threaded coupling	AB20-11K1 G1/4

Hose line 1000 mm with 90° fitting and mini gauge port		
Material no.:	R961004330	
Type short description	HOSE LINE TS-HC-ZN10031-08-W90MM-1000	
Hose length	mm	1000
Weight	kg	0.75
Max. operating pressure	bar	120
Quick couplings	R961000481	Coupling socket M16 x 1.5
Bending radius	mm	85
Mini gauge port	threaded coupling	AB20-11K1 G1/4

Pressure relief coupling		
Material no.:	R961002927	
Type short description	COUPLING SOCKET TS-HC-1-15-005-9-XX008	
To relieve pressure arising from clamping		
Dimensions	mm (L x W)	79 x 50



Electrical

Distributor 19" version - 10x

Material no.:	R961009613
Type short description	DISTRIBUTOR TS-EC-E-VER-NN-NN-B10
distributor 10x, red sockets for 24 V and blue sockets for 0 V are hooked up, contact-protected 4 mm laboratory jacks	

Dimensions	mm (L x W x H)	76 x 36 x 129
Weight	g	136
Protection class		IP50
Operating voltage	V DC	24
Max. current per socket	A	4
Connected red (+) sockets	pieces	10
Connected blue (-) sockets	pieces	10

Switching element 19" version - 1 switch + 2 push buttons, 3 normally closed contacts, 3 normally open contacts

Material no.:	R961009617
Type short description	SWITCHING ELEMENT TS-EC-E-SST-S3-S3O3

1 switch with detent locking, 1 normally closed and 1 normally open contact, actuation by means of turning the knob switch; 2 push buttons with spring return, 1 normally closed and 1 normally open contact each, actuation by pressing the button
Aluminum front plate with scratch-resistant labels, can be mounted in a 19" frame, contact-protected 4 mm laboratory jacks

Dimensions	mm (L x W x H)	76 x 36 x 129
Weight	g	136
Protection class		IP50
Operating voltage	V DC	24
Contact load	A	4

Display unit 19" version - display 4x visual, 1x audible

Material no.:	R961009615
Type short description	DISPLAY UNIT TS-EC-E-AZE-NN-O4A1

Optical and audible signal display; 4x red LED display, 1x buzzer, indicators are activated when 24 V is connected to the sockets
Aluminum front plate with scratch-resistant labels, can be mounted in a 19" frame, contact-protected 4 mm laboratory jacks

Dimensions	mm (L x W x H)	76 x 36 x 129
Weight	g	136
Protection class		IP50
Operating voltage	V DC	24
LED current consumption	mA	20
Total current consumption	mA	10



Electrical

Relay 19" version - 4 changeover contacts		
Material no.:	R961009538	
Type short description	RELAY TS-EC-E-REL-NN-W4-NN	
1 relay with 4 changeover contacts; direct control; control lamp lit when running; aluminum front plate; contact-protected 4 mm laboratory jacks; can be mounted in a 19" frame		
Dimensions	mm (L x W x H)	76 x 42 x 129
Weight	g	145
Protection class	IP50	
Operating voltage	V DC	24
Drop-out voltage	V DC	1.2
Response voltage	V DC	18
Contact load	A	4



Relay 19" version - pickup delay, 1 NO contact, 1 NC contact		
Material no.:	R961009600	
Type short description	RELAY TS-EC-E-RAN-NN-S1O1	
Relay with 1 normally open contact, on delayed switching, delay time up to 15 sec. freely-adjustable, indicator lamp lit when in operation, aluminum front plate; scratch-resistant labels; can be mounted in a 19" frame; contact-protected 4 mm laboratory jacks		
Dimensions	mm (L x W x H)	76 x 53 x 129
Weight	g	136
Protection class	IEC 60529	IP 50
Operating voltage	V DC	24
Current consumption	mA	80
Contact load	A	4
Delay time	sec.	0.5..15



Relay 19" version - dropout delay, 1 NO contact, 1 NC contact		
Material no.:	R961009601	
Type short description	RELAY TS-EC-E-RAB-NN-S1O1	
Relay with 1 normally open and 1 normally closed contact, off delayed switching, delay time up to 15 sec. freely-adjustable, indicator lamp lit when in operation, aluminum front plate; scratch-resistant labels; can be mounted in a 19" frame; contact-protected 4 mm laboratory jacks		
Dimensions	mm (L x W x H)	76 x 53 x 129
Weight	g	137
Protection class	IEC 60529	IP 50
Operating voltage	V DC	24
Current consumption	mA	80
Contact load	A	4
Delay time	sec.	0.5..15



Electrical

Setpoint sensor 19" version - +/- 10 V

Material no.:	R961009632
Type short description	SETPOINT SENSOR TS-EC-E-SGM-NN-NN-NN

10-gear potentiometer; 1 rotary knob with 3 positions; visual display of the selected polarity; contact-protected 4 mm laboratory jacks for the voltage supply; 2 mm laboratory jacks for the command value; aluminum front plate; scratch-resistant labels; can be mounted in a 19" frame Output voltage

Dimensions	mm (L x W x H)	153 x 55 x 129
Weight	g	221
Protection class		IP50
Operating voltage	V DC	24
Output voltage	V	± 10



Display unit 19" version - 2 displays, max. display range 0-20 V

Material no.:	R961009623
Type short description	DISPLAY UNIT TS-EC-E-AZE-A2-A20V

2 digital voltmeters, display 3 ½ digits; digit height 13 mm; aluminum front plate; contact-protected 4 mm laboratory jacks for the voltage supply; measuring ports with 2 mm and 4 mm laboratory jacks; can be mounted in a 19" frame

Dimensions	mm (L x W x H)	153 x 82 x 129
Weight	g	325
Protection class	IEC 60529	IP50
Operating voltage	V DC	24
Measuring voltage	V DC	± 20
Internal resistance	MΩ	1



Setpoint sensor 19" version - with ramp

Material no.:	R961009631
Type short description	SETPOINT SENSOR TS-EC-E-SGG-NN-NN-NN

Setpoint sensor for 4 retrievable command values and 5 ramps per command value; aluminum front plate; can be mounted in a 19" frame; contact-protected 4 mm laboratory sockets; setpoint connections with 2 mm laboratory jacks

Dimensions	mm (L x W x H)	153 x 90 x 129
Weight	g	350
Protection class	IEC 60529	IP50
Operating voltage	V DC	24
Output voltage	V DC	± 10
Current consumption	mA	500



Electrical

Adapter plate 19" version - circular connector / lab socket		
Material no.:	R961009630	
Type short description	ADAPTER PLATE TS-EC-E-ADA-NN-NN-NN	
Adapter for connecting a 7-pole connector plug to laboratory jacks; aluminum front plate; scratch-resistant labels; can be mounted in a 19" frame; 4 mm laboratory jacks for DC24V; contact-protected; 2 mm laboratory jacks for setpoint and actual values; gold-plated contact surfaces		
Dimensions	mm (L x W x H)	76 x 53 x 129
Weight	g	130
Protection class	IEC 60529	IP50
Operating voltage	V DC	24



Operating module TS-BPS 30,0, analog controller module, 30DU		
Material no.:	R961004782	
Type short description	CONTROLLER TS-EC-E-RPM-NN-NN-MACAS	
For setting up simple position control using an analog position measurement system. For controlling valves with built-in electronics. The controller module is equipped with only the most necessary features for the setting up a control system. All signals are processed on an analog basis. The setpoint and actual values are compared and the resulting actuating signal is transmitted based on the control parameters. Cable break detection for feedback signal; interfaces short circuit-protected; test points on front panel; compensation step can be switched off;		
Location: PT1 control; area adjustment cylinder		
<ul style="list-style-type: none"> ▶ Command value (2 x 2 mm socket, yellow) ▶ Output, actuating signal (2 x 2 mm socket, yellow) ▶ Actual value (5-pole socket M12) ▶ Enable signal (4 mm socket, black) ▶ In-position signal (4 mm socket, black) ▶ "Zero gain" actual value adjustment ▶ "zero valve" zero-point valve 		
Dimensions	mm (L x W x H)	153 x 82 x 129
Weight	g	492
Protection class	IEC 60529	IP50
Operating voltage	V DC	24
Current consumption	mA	500
External command value	V DC	0-10
Ramp time	sec.	0.1-10
Controller (prop. component)	Kp	1-16
Controller (reset time)	KT1	1-16
Controller (integral component)	KI	1-16
Area adjustment	cylinders	1-16
Output signal Control output	V	± 10



Electrical

Operating module BPS 2.1 adapter for analog control amplifier VT-VRPA1, 34DU

Material no.:	R900711658	
Type short description	ADAPTER TS-EC-E-ADA-NN-NN-NN	
Adapter for VT-VRPA1 amplifier; for connecting to laboratory jacks from connector strips, setting the command value signals, connecting the position transducer on the valve and forwarding it to the amplifier; can be mounted in a 19" frame		
<ul style="list-style-type: none"> ▶ Voltage supply ▶ 10-gear potentiometer for presetting command values (3 x yellow) ▶ Control of the solenoids (2 x black) ▶ Connection for valve position transducer (3-pole plug) ▶ - 9 V supply for command value specification (2 x blue) ▶ + 9 V supply for command value specification (2 x red) ▶ Measurement of the set ramp (2 x white) ▶ Command value presetting (2 x yellow) ▶ External command value input via PLC or CNC (2 x yellow) ▶ "Ramp off" switching input (1 x green) 		
Dimensions	mm (L x W x H)	172 x 200 x 129
Weight	g	420
Protection class		IP50
Supply voltage	V DC	24



Operating module VT-VRPA1 proportional amplifier, 4 rack units

Material no.:	R901057058	
Type short description	AMPLIFIER VT-VRPA1-150-1X/V0/0	
For controlling directly operated proportional valves with a solenoid as the actuating element and electrical position feedback, suitable for directional, pressure and flow control valves; can be mounted in a 19" frame		
<ul style="list-style-type: none"> ▶ Command value signal input 0 to + 6 V; 0 to + 9 V; 0 to + 10 V; 0 to 20 mA; 4 to 20 mA (jumpers) ▶ Potentiometer setting on the front plate for zero point and amplitude attenuation ▶ Measuring sockets for the ramp time ▶ Enable input and "ramp off" input ▶ Jumpers for switching the maximum ramp time 0.02 to 5 sec. or 0.2 to 50 sec. ▶ Outputs for command values (0 to + 6 V) and actual value (0 to - 6 V) ▶ LED display "ready for operation" ▶ Reverse polarity protection 		
Supply voltage	V DC	24
Operating current	max. A	1.5
Industrial type	VT-VRPA1-150-1X/V0/0	



Electrical

Operating module, power supply unit, 230 V/50 HZ, 42TE		
Material no.:	R900703147	
Type short description	POWER SUPPLY UNIT TS-EC-230VAC/50HZ	
Power supply unit for mounting in 19" frame; short-circuit-proof; stabilized; illuminated mains switch; power cable; 4 safety sockets for 24 V DC output voltage		
Length, power cable	mm	2000
Weight	kg	2.5
Protection class	IP50	
Operating voltage	V DC	24
Output current	A	5
Input voltage	VAC	230
Microfuse	1.6 Type C slow-blow	



Blanking plate 3HE/21TE		
Material no.:	R900309347	
Type short description	BLANKING PLATE TS-MC-3HE/21TE	
Front plate for covering the unused surface area in the 19" frame; aluminum; clear anodized; thickness 2.5 mm; 4 non-detachable screws		
Dimensions	mm (L x W x H)	107 x 14 x 129
Weight	kg	0.05
Dividing grid	3HE, 21TE	



Electrical

Blanking plate 3HE/8TE		
Material no.:	1827008409	
Type short description	FRONT PLATE TS-MC-3HE-8TE	
Front plate for covering the unused surface area in the 19" frame; aluminum; clear anodized; thickness 2.5 mm; 4 non-detachable screws		
Dimensions	mm (L x W x H)	40 x 14 x 129
Weight	kg	0.038
Dividing grid	3HE, 8TE	

Blanking plate 3HU/7DU		
Material no.:	1827008410	
Type short description	FRONT PLATE TS-MC-3HE-7TE	
Front plate for covering the unused surface area in the 19" frame; aluminum; clear anodized; thickness 2.5 mm; 2 non-detachable screws		
Dimensions	mm (L x W x H)	36 x 14 x 129
Weight	kg	0.028
Dividing grid	3HE, 7TE	

Blanking plate 3HE/6TE		
Material no.:	R913004345	
Type short description	FRONT PLATE TS-MC-3HE6TE	
Front plate for covering the unused surface area in the 19" frame; aluminum; clear anodized; thickness 2.5 mm; 2 non-detachable screws		
Dimensions	mm (L x W x H)	30 x 12 x 129
Weight	kg	0.027
Dividing grid	3HE, 6TE	

Blanking plate 3HU/4DU		
Material no.:	R961001336	
Type short description	FRONT PLATE TS-MC-3HE4TE	
Front plate for covering the unused surface area in the 19" frame; aluminum; clear anodized; thickness 2.5 mm; 2 non-detachable screws		
Dimensions	mm (L x W x H)	21 x 14 x 129
Weight	kg	0.025
Dividing grid	3HE, 4TE	



Electrical

Control unit housing version - BIBB module + I/O module

Material no.:	R961009675
Type short description	CONTROL UNIT TS-EC-G-CR-SVAI

The control unit is used for establishing electrical connections on the WS200. It can control electro-hydraulic, pneumatic electrical, and automation functions. The number of electrical components makes it possible to carry out all the exercises as prescribed by BIBB from A to Z. A connection to the PC is possible via the I/O module. With the appropriate software (e.g. Automation Studio) electrical valves and limit switches can be controlled.

control unit 1 switch and 2 buttons with 1 normally open and 1 normally closed contact each, 2 buttons with normally open contact, 6 relays, on delay relay, off delay relay, 12 x 24 V distributor and 8 x 0 V distributor, 8 sensor connections, 6 valve connections, 8 analog inputs 0 - 10 V, 4 analog inputs 4 - 20 mA, power pack 24 V 10 A, power switch, USB port, housing and power cable, contact-protected 4 mm laboratory sockets, 25 pole Sub D plugs for connecting to valve island, mounting system

Operating voltage	V DC	24
Supply voltage	V AC	230
Delay time	sec.	1 - 15



Control unit housing version BIBB module

Material no.:	R961009678
Type short description	CONTROL UNIT TS-EC-G-CR

The control unit is used to make electrical connections on the WS200. It can control electro-hydraulic, pneumatic electrical, and automation functions. The number of electrical components makes it possible to carry out all the exercises as prescribed by BIBB from A to Z.

Control module 1 switch and 2 buttons with 1 normally open and 1 normally closed contact each, 2 buttons with normally open contact, 6 relays, on delay relay, off delay relay, 8 x 24 V distributor and 6 x 0 V distributor, 2 LED displays, 1 acoustic signal, power pack 24 V 10 A, housing and power cable, contact-protected 4 mm laboratory jacks, mounting system

Operating voltage	V DC	24
Supply voltage	V AC	230
Delay time	sec.	1 - 15



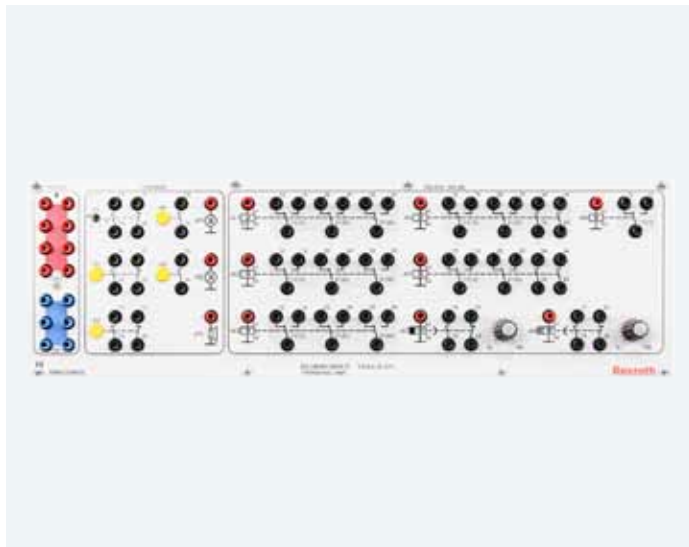
Electrical

Control unit 19" version - BIBB module

Material no.:	R961009676
Type short description	CONTROL UNIT TS-EC-E-CR

This control unit corresponds to its predecessor with housing (R961009678). It is designed as a 19" version and can be installed in the rack of the WS290 workstation.

Operating voltage	V DC	24
Supply voltage	V AC	230
Delay time	sec.	1 - 15

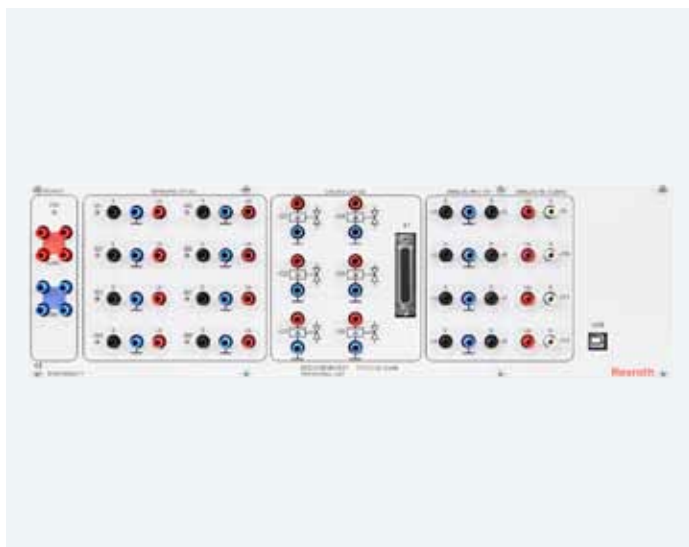


Control unit 19" version - I/O module

Material no.:	R961009677
Type short description	CONTROL UNIT TS-EC-E-SVAI

It is designed as a 19" version and can be installed in the rack of the WS290 workstation. A connection to the PC is possible via the I/O module. With the appropriate software (e.g. Automation Studio), it is possible to control electrical valves and limit switches. Control module for 19" frame, 8 sensor connections with switching characteristics, 8 analog inputs 0 - 10 V, 4 analog inputs 4 - 20 mA, 6 valve connections, 25 pole Sub D plugs for connecting to valve island, contact-protected 4 mm laboratory jacks, USB port

Operating voltage	V DC	24
Supply voltage	V AC	230
Delay time	sec.	1 - 15



Electrical

Adapter plate 19" version - 1 switch, IEC socket, power supply cable

Material no.: R901384795

Type short description ADAPTER PLATE TS-EC-E-ADA-S1-NN-NN

Adapter plate for feeding the power supply in the control unit 19" version - BIBB module, IEC socket with 2 poles Power switch illuminated, power cable 0.5 m in length Aluminum front plate, scratch-resistant labels, for mounting in 19" frames

Dimensions mm (L x W x H) 76 x 36 x 129

Operating voltage V AC 230



Input/output unit for Automation Studio, complete with housing, snap-in, USB connecting cable and software

Material no.: R961008946

Type short description CONTROL UNIT TS-AT-FT-DIV-15055 &

The FAMIC I/O box allows you to connect and control real functioning models using Automation Studio. Control of the I/O box is carried out via Automation Studio.

8 digital inputs and outputs each (24 V DC) are available.

The functioning model is connected via 4 mm safety sockets.

The connection to the PC is via a USB cable.

Dimensions mm (L x W x H) 150 x 85 x 71

Supply voltage V DC 24



Electrical

Solenoid cable with LED, shape A, black

Material no.:	R900846807	
Type short description	CONNECTION CABLE TS-EC-VEN-SW-MIT-LED	
With LED, form A DIN 43650, 2-wire, black plug		
Dimensions	mm (L)	3000
Weight	kg	0.3



Solenoid cable with LED, shape A, gray

Material no.:	R900846808	
Type short description	CONNECTION CABLE TS-EC-VEN-GRAU-MIT-LED	
With LED, form A DIN 43650, 2-wire, gray plug		
Dimensions	mm (L)	3000
Weight	kg	0.3



Solenoid cable without LED, shape A, gray

Material no.:	R900846809	
Type short description	CONNECTION CABLE TS-EC-VEN-GRAY	
Without LED, form A DIN 43650, 2-wire, gray plug		
Dimensions	mm (L)	3000
Weight	kg	0.3



Solenoid cable without LED, shape A, black

Material no.:	R900846812	
Type short description	CONNECTION CABLE TS-EC-VEN-SW	
Without LED, form A DIN 43650, 2-wire, black plug		
Dimensions	mm (L)	3000
Weight	kg	0.3



Cable set for setpoint measurement

Material no.:	R900826555	
Type short description	CABLE SET TS-EC-2MM-4MM	
For measuring actual and setpoint values, 2 adapter cores each (from 2 to 4 mm), black and red pug		
Dimensions	mm (L)	240
Weight	kg	0.27



Electrical

Pressure switch cable		
Material no.:	R900846817	
Type short description	CONNECTION CABLE TS-EC-HED-4F	
With plug, shape A DIN 43650, 4-wire		
Dimensions	mm (L)	3000
Weight	kg	0.3



Measuring line set, small		
Material no.:	R900029597	
Type short description	CABLE SET TS-EC-SMALL-BIBB	
Including:		
39 touch-proof measuring lines		
▶ 10 pieces 250 mm long, red		
▶ 5 pieces each 250 mm long, blue and green		
▶ 3 pieces each 500 mm long, blue and black		
▶ 2 pieces 500 mm long, green		
▶ 5 pieces 500 mm long, red		
▶ 2 pieces each 1000 mm long, red and black		
▶ 1 piece each 2000 mm long, red and blue		
Weight	kg	1.1



Measuring line set, large		
Material no.:	R900021502	
Type short description	CABLE SET TS-EC-LARGE-BIBB	
Including:		
64 touch-proof measuring lines		
▶ 5 pieces each 250 mm long, green and blue		
▶ 10 pieces each 250 mm long, red and black		
▶ 5 pieces each 500 mm long, red and black		
▶ 2 pieces 500 mm long, green		
▶ 3 pieces 500 mm long, blue		
▶ 2 pieces 1000 mm long, green		
▶ 3 pieces 1000 mm long, blue		
▶ 6 pieces each 1000 mm long, red and black		
▶ 1 piece each 2000 mm long, red and blue		
Weight	kg	1.78



Electrical

Cable, 7-pin for integrated electronics

Material no.:	R961003550	
Type short description	CONNECTION CABLE TS-EC-7POL-VTL-OBE	
7-pole connection cable (6 + PE) for integrated electronics (OBE); for connecting to K31 connector with mating connector according to DIN EN 175201-804 (OBE side); CA 6LS line connector (for subplate R961001630); cable: LiYC 7 x 0.75 mm ²		
Dimensions	mm (L)	1500
Weight	kg	0.45
Protection class	IP50	

Cable set for setpoint measurement, 2 mm/2 mm

Material no.:	R961009488	
Type short description	CABLE SET TS-EC-ST/ST-2MM-RT/SW-2X450MM	
Measuring cable for measuring actual and setpoint values, 2 mm connector, 2 measuring cables each in red and black, length 450 mm		
Length	mm	450
Weight	kg	0.27

Position transducer cable for proportional valve

Material no.:	R900844180	
Type short description	SENSOR CABLE TS-EC-FOR-2FRE6B-2X	
Connection cable for proportional valves with analog control; 3-pole and 3-wire		
Length	mm	3000
Weight	kg	0.23

Proximity switch, inductive

Material no.:	R961003106	
Type short description	PROXIMITY SWITCH TS-EC-NBN8-18GM50-E2-MITBEF	
Inductive proximity switch with adjustable switching distance, with holding plate and knurled screw for stable mounting onto attachment plates. 24 V signal generation by metallic objects; Switching state can be read on LED; 24 V power supply; 24 V signal; 4 mm safety plugs; red 24 V; blue 0 V; black 24 V signal		
Dimensions	mm (L)	3000
Weight	kg	0.2
Supply voltage	V DC	24
Max. coverage	mm	8



Electrical

Electrical pressure switch		
Material no.:	R961003488	
Type short description	PRESSURE SWITCH TS-HC-HED 80A-2X/100K14	
With mounting, including cable		
Dimensions	mm (L x W x H)	100 x 45 x 170
Max. operating pressure	bar	120
Industrial type	HED80A1X/100K14	
Plug-in connector	Plug-in connection DIN 43650	Design A, 3-pole + PE
Switching accuracy	%	< ± 1 v adj.
Contact load	VAC:250 V-5 A	VDC: 50 - 1 A; 125 V - 0.03 A
Switching cycles	admissible/h	4800
Pressure range	bar	0 - 60
Setting range	bar	4 - 100



Electronic pressure switch, programmable		
Material no.:	R961003555	
Type short description	PRESSURE SWITCH TS-HC-HEDE10A1-2X/100/	
With mounting, including cable		
Dimensions	mm (L x W x H)	72 x 44 x 157
Weight	kg	0.75
Setting range	bar	0 - 100
Max. operating pressure	bar	120
Switching accuracy	%	0.5
Industrial type	HEDE10	
Max. contact load	mA	250
Electrical connection	K41 (M12)	
Switching cycles	Hz	170



Electrical

Proximity switch, inductive, with NC and NO contact

Material no.:	R961008585
Type short description	PROXIMITY SWITCH TS-EC-NBB8-18GM60-A2

Inductive proximity switch with 8 mm adjustable switching distance, with holding plate and knurled screw for stable mounting onto attachment plates, signal generation by metallic objects, switching state can be read on LED 24 V power supply; 24 V signal; 4 mm safety plugs; red 24 V; blue 0 V; signal NO contact black, signal NC contact green

Dimensions	mm (L)	3000
Weight	kg	0.2
Supply voltage	V DC	24
Switching distance	mm	8
Max. coverage	mm	8
Reverse polarity protection		yes



Measuring technology

Multimeter VC175		
Material no.:	R913038027	
Type short description	MULTIMETER VC 175	
VC175 digital multimeter Robust beginners' device with automatic range selection incl. measuring leads		
Equipped with:		
<ul style="list-style-type: none"> ▶ Standard measuring ranges V/DC, V/AC, A/DC, A/AC ▶ Resistance ▶ Diode test ▶ Acoustic continuity tester ▶ Contactless AC voltage tester ▶ hFE transistor test (with optional adapter) ▶ Frequency meter and duty cycle ▶ Hold function ▶ Low battery indicator ▶ Sturdy housing with soft rubber protection 		
Dimensions	mm (L x W x H)	137 x 72 x 40
Weight	g	200
Current	A	10
Measurement category	CAT III 250 V	
Display	Counts	4000



Measuring device set 3020		
Material no.:	R913038909	
Type short description	MEASURING DEVICE SET 3020A-PP-10-10	
Two analog inputs; 1 frequency input memory for 1 million analog measured values; LCD display		
The 3020 measuring device set consists of:		
<ul style="list-style-type: none"> ▶ 1 measuring device Multi-Handy 3020 ▶ 1 power supply 24 V DC with country adapter ▶ 1 USB data cable ▶ 2 mini gauge port direct connections 1620 ▶ 1 software HYDROcomsys ▶ 2 pressure sensors HAT-PD with freely selectable measurement range ▶ 1 transport case ▶ 2 measuring cables 		
Measurement range	bar	0 - 200



Measuring technology

Measuring device set 5060

Material no.: R913038907
Type short description MEASURING DEVICE SET 5060C-PP-10-10

With 24 channels; up to 1 GB of data storage; color display;
CAN-bus technology

The measuring device set 5060 consists of:

- ▶ 1 measuring device Multi-Handy 5060
- ▶ 1 power supply 24 VDC with country adapter
- ▶ 1 USB data cable
- ▶ 2 mini gauge port direct connections 1620
- ▶ 1 software CD
- ▶ 2 pressure sensors PR 15 with freely selectable measurement range
- ▶ 1 transport case
- ▶ 2 measuring cables

Measurement range bar 0 - 200



Basic measuring device set

Material no.: R961009563
Type short description MEASURING DEVICE SET TS-HY BASIC

The basic measuring device set contains the following devices:

- ▶ 1 digital pressure gauge with mini gauge port connection (R961009534)
- ▶ 1 contactless tachometer with digital display (R961008893)
- ▶ 1 digital stopwatch
- ▶ 1 transport case (not pictured)



Stopwatch, digital

Material no.: R900061256
Type short description STOPWATCH TS-MC-DIG-TIME-STOP
Digital quartz stopwatch, 1/100 sec, time and date



Measuring technology

Tachometer visual		
Material no.:	R961008893	
Type short description	Tachometer TS-EC-CEM AT-6	
Contactless laser tachometer 2-99999 rev/min; hand-held meter for easy measurement of the speed; 5-digit LCD display in rev/min or as an event-counting function		
Dimensions	mm (L x W x H)	160 x 58 x 39
Weight	g	150
Operating voltage	9 V block	
Measuring distance	cm	5 - 50



Speed sensor		
Material no.:	R900892375	
Type short description	SPEED SENSOR TS-EC-OPTICAL DS 03	
Visual reference mark identification; pulsating red light; measuring cable		
Dimensions	mm (L)	3000
Weight	kg	0.43
Supply voltage	V DC	7.5 - 30
Switching current	mA	200
Response time	ms	1
Burst frequency	Hz	5



Pressure transducer 0 - 200 bar with ISDS		
Material no.:	R900738915	
Type short description	PRESSURE SENSOR TS-HC-3403-10-S-E5.33	
Dimensions	mm (L x W)	180 x 40
Weight	kg	0.17
Output current	mA	0 - 20
Measurement range	bar	0 - 200



Measuring technology

Temperature sensor with ISDS

Material no.:	R900749653
Type short description	TEMPERATURE SENSOR TS-EC-P/T1003973-04-S-01.00

Dimensions	mm (L x W)	100 x 40
Weight	kg	0.46
Supply voltage	V (DC)	10 - 30
Measurement range	°C	-50 - 200
Measurement signal output	mA	0 - 20

Accessories

Name	Material no.:	Quantity
Measurement cable with ISDS	R900733207	1

Measurement cable for ISDS

Material no.:	R900733207
Type short description	CONNECTION CABLE TS-EC-ISDS-2500MM

Length	mm	2500
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Gear volumetric flow sensor

Material no.:	R961002508
Type short description	FLOW METER TS-HC-GFM 3843-03-S-3

Mounted on component plate; connections via self-sealing coupling connectors

Dimensions	mm (L x W x H)	230 x 180 x 115
Weight	kg	3.38
Measurement range	l/min	0.2 - 30
Pulses	dm ³	Approx. 1640

Accessories

Name	Material no.:	Quantity
Measurement cable for ISDS	R900733207	1



Measuring technology

Volumetric flow rate sensor 1.0 to 7.5 l/min		
Material no.:	R961002561	
Type short description	FLOW METER TS-HC-HP202A020 G1/4-245BAR	
FM-222-112		
Dimensions	mm (L x W)	160 x 60
Weight	kg	0.66
Max. operating pressure	bar	100
Measurement range	l/min	1.0 - 7.5



Digital pressure gauge 0 to 100 bar		
Material no.:	R961009534	
Type short description	PRESSURE GAUGE DIM 20 0/100 BAR KPL.	
Compact microprocessor controlled pressure gauge 0 - 100 bar. The signal from the pressure sensor is processed by the microprocessor, converted and displayed in the desired unit. Functions: Unit switching, min./ max. value memory, zero point and end point calibration, adjustable automatic switch-off, adjustable decimal point, battery indication		
Dimensions	mm (L x W x H)	133 x 75 x 43
Pressure range	bar	0 - 160



Measuring technology

Pressure gauge 0 to 60 bar with measuring hose		
Material no.:	R961003403	
Type short description	PRESSURE GAUGE TS-HC-ABZMM-63-60BAR/	
With glycerin filling and mounting, diameter 63 mm, scaling 5 bar		
Dimensions	mm (L x W x H)	63 x 56 x 147
Weight	kg	0.45
Pressure range	bar	0 - 60

Pressure gauge 0-100 bar with measuring hose		
Material no.:	R961002715	
Type short description	PRESSURE GAUGE TS-HC-ABZMM 63-100 BAR	
With glycerin filling and mounting, diameter 63 mm, scaling 5 bar		
Dimensions	mm (L x W x H)	63 x 56 x 147
Weight	kg	0.45
Pressure range	bar	0 - 100

Pressure gauge 0 to 160 bar with measuring hose		
Material no.:	R961002720	
Type short description	PRESSURE GAUGE TS-HC-ABZMM 63-160 BAR	
With glycerin filling and mounting, diameter 63 mm, scaling 5 bar		
Dimensions	mm (L x W x H)	63 x 56 x 147
Weight	kg	0.45
Pressure range	bar	0 - 160



Spare Parts for Workstations

Grooved plate for WS200

Material no.:	R961008637
Type short description	GROOVED PLATE TS-MC-710X700X30MM *BG

The grooved plate for the WS200 workstation is used for accommodating the components from the device sets of pneumatics and automation technology. Pneumatic and automation components can be fixed onto the grooved plate with the SnapIN quick mounting system. Both sides of the grooved plate can be used.

Dimensions	mm (L x W x H)	710 x 700 x 30
Weight	kg	14
Groove spacing	mm	25

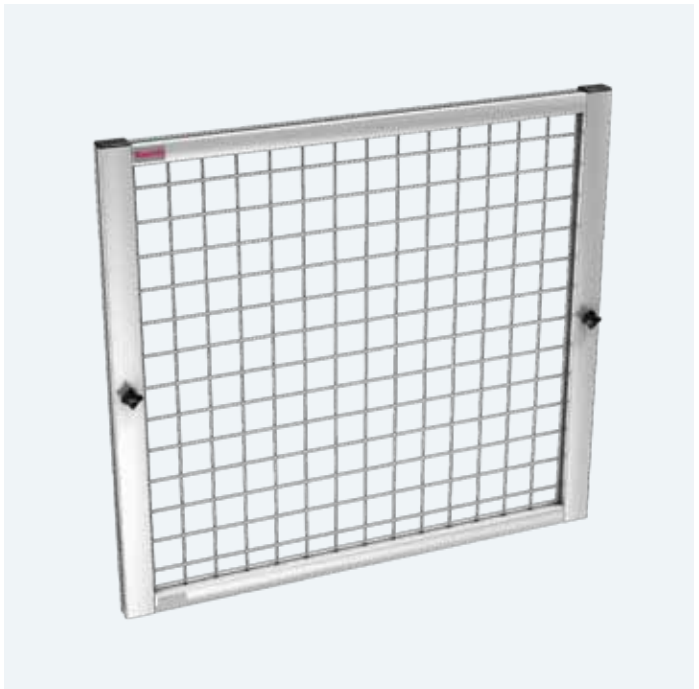


Grid for WS200

Material no.:	R961009533
Type short description	GRID TS-HC-800X733X30

The grid for the WS200 workstation is used for the safe connection of the components of the hydraulic equipment sets. The grid can be hooked onto and unhooked from the base frame of the WS200 workstation. The grid mounting set is attached to provide vertical protection.

Ordering code	▶ 1 grids
	▶ 1 grid mounting set



Spare Parts for Workstations

Measuring glass for WS201

Material no.:	R961009485	
Type short description	MEASURING GLASS TS-HC-WS200-1.5L	
<p>The measuring glass for the WS201 workstation is required for project exercises in On/off Hydraulics according to BIBB.</p> <p>The measuring glass with its sturdy transparent plastic casing and scale with a measuring range of up to 1.6 liters can be used in conjunction with a stopwatch to measure flow.</p> <p>The measuring glass is equipped with a ball valve, overflow protection and a bleeding/venting valve.</p> <p>The bleeding/venting valve is constructed such that when the measuring glass is being filled with hydraulic liquid, excess air can escape without causing oil leakage.</p> <p>When emptying, the bleeding/venting valve ensures that sufficient air is supplied to allow the hydraulic fluid to quickly drain into the container.</p> <p>The measuring glass is filled with hydraulic fluid via two ergonomically arranged, low-leakage, self-sealing coupling connectors in conjunction with an anti-turbulence inlet.</p> <p>The steady inflow prevents an excessive amount of air bubbles in the fluid pressure during filling.</p> <p>A drain hose is supplied already assembled. It has a connection length of about 1 meter and is bolted securely to the reservoir of the hydraulic unit of the WS200 workstation.</p>		
Dimensions	mm (L x W x H)	142 x 242 x 590
Measurement range	l	1.6

Load unit for WS201

Material no.:	R961009507	
Type short description	EXERCISE UNIT TS-HC-30KG-25/16	
<p>The load unit for the WS201 workstation is required for project exercises in On/off hydraulics according to BIBB.</p> <p>The load unit is used to generate mechanical tension and compression forces acting on the piston rod of a hydraulic cylinder. The differential cylinder (R961009526) contained in the equipment sets "On/off hydraulics - getting started" and "On/off hydraulics - manual and electric operation" is used in the load unit.</p> <p>The differential cylinder is attached via an easy-to-use clamp technique securely onto the load unit. A rod with mounted clevis connects the piston rod of the differential cylinder directly with the weights.</p> <p>The load unit has 4 weights, each with 4 kg, which can be incorporated into the lower part or upper part of the load unit to simulate tensile or compressive forces.</p> <p>The differential cylinder must be swiveled in order to change from tensile to compressive forces. It must be dismantled to do so.</p> <p>To prevent injury, the load unit is housed, access is via two easy-to-open transparent plastic doors.</p>		
Dimensions	mm (L x W x H)	413 x 206 x 1338
Weight	kg	30



Spare Parts for Workstations

Power unit 220 V/50 HZ 3X for expansion of WS200 for double sided use, without cross strut		
Material no.:	R961009539	
Type short description	POWER GROUP TS-HC-WS200 220 V/50 HZ Single OP	
Power unit 220 V/50 HZ 3X for expansion of WS200 for double sided use		
Delivery contents	<ul style="list-style-type: none"> ▶ 1 power unit, 230 V/50 Hz with pump, hose set, switch box, and P/T distributor ▶ 1 mounting set ▶ 1 damping set 	
Dimensions	mm (L x W x H)	710 x 340 x 646
Supply voltage	V AC	230
Nominal flow	A	16
Power frequency	Hz	50 - 60
Power	kW	0.37
Operating pressure	bar	60
Maximum flow	l/min	3.2 (at 870 l/min)
Spare part for		
Name	Material no.:	Quantity
WS200 Hydraulics, 1-sided	R961008850	1
WS200 Hydraulics, 1-sided and pneumatics	R961009258	1



Spare Parts for Workstations

Power unit 220 V/50 HZ 5X for expansion of WS200 for double sided use, with cross strut		
Material no.:	R961009540	
Type short description	POWER GROUP TS-HC-WS200-220/50HZ Single	
Power unit 220 V/50 HZ 4X for expansion of WS200 for double sided use, with cross strut		
Delivery contents	<ul style="list-style-type: none"> ▶ 1 power unit, 230 V/50 Hz with pump, hose set, switch box, and P/T distributor ▶ 1 mounting strut ▶ 1 mounting set ▶ 1 damping set 	
Dimensions	mm (L x W x H)	710 x 340 x 646
Supply voltage	V AC	230
Nominal flow	A	16
Power frequency	Hz	50 - 60
Power	kW	0.37
Operating pressure	bar	60
Maximum flow	l/min	3.2 (at 870 l/min)
Spare part for		
Designation	Material no.:	Quantity
WS200 Pneumatics, double-sided	R961008854	1



Spare Parts for Workstations

Power unit 220 V/50 HZ 5X for expansion of WS200 for double sided use, with cross strut		
Material no.:	R961009541	
Type short description	POWER GROUP TS-WS200 220 V/50 HZ 2fach	
Power unit 220 V/50 HZ 5X for expansion of WS200 for double sided use, with cross strut		
Delivery contents	<ul style="list-style-type: none"> ▶ 2 power units, 230 V/50 Hz with pump, hose set, switch box, and P/T distributor ▶ 1 mounting strut ▶ 2 mounting sets ▶ 2 damping sets 	
Dimensions	mm (L x W x H)	710 x 340 x 646
Supply voltage	V AC	230
Nominal flow	A	16
Power frequency	Hz	50 - 60
Power	kW	0.37
Operating pressure	bar	60
Maximum flow	l/min	3,2 (at 870 l/min)
Spare part for		
Designation	Material no.:	Quantity
WS200 Pneumatics, double-sided	R961008854	1



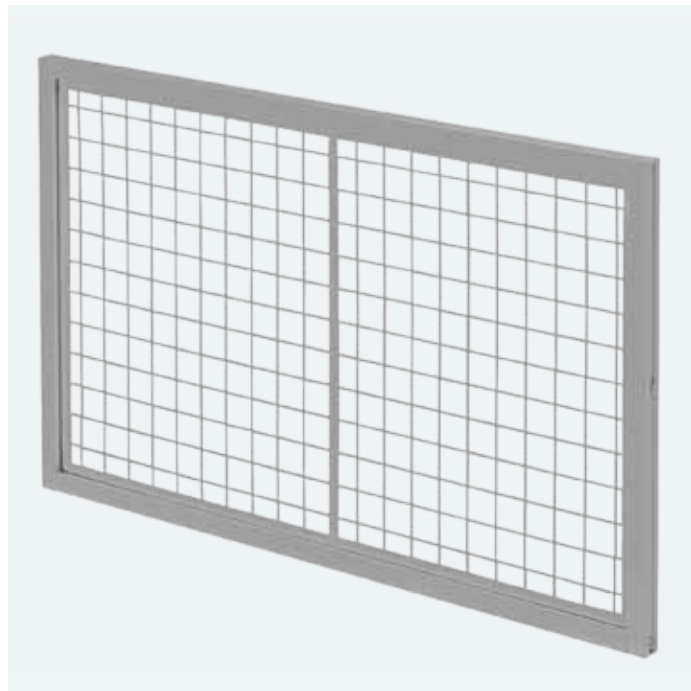
Spare Parts for Workstations

Reinforced grid for snapping into WS290

Material no.:	R961000210
Type short description	GRID TS-MC-1130X700X30

The grid for the WS290 workstation is used for the safe connection of the components of the hydraulic equipment sets and can be quickly and easily mounted and securely attached to both sides of the WS290.

Dimensions	mm (L x W x H)	1130 x 700 x 30
Weight	kg	11.75
Material	steel, aluminum body	
Grid	mm	50 x 50



Module frame for WS290, double-row

Material no.:	R961000166
Type short description	MODULE FRAME TS-MC-DS4-2R-1130X197X306

The double row rack can be mounted on the upper part of the WS290 workstation. Being 19", the rack is able to hold both elements developed by Rexroth for didactic purposes, as well as standard 19" components.

Dimensions	mm (L x W x H)	1130 x 197 x 306
Weight	kg	11.6
Material	aluminum body powder coated sheet steel	
Size of grid	210TE; 3HE	



Spare Parts for Workstations

Measuring glass 2.5l for WS290

Material no.: R961002564

Type short description MEASURING GLASS AS TS-HC-2.5 L

The measuring glass for the WS290 workstation is required for training in the fundamentals of hydraulics (BIBB A-Z3). The measuring glass with sturdy transparent plastic casing and up to 2.5 liter scaled measuring range can be used in conjunction with a stopwatch to measure a flow rate. The measuring glass is equipped with ball valve, overflow protection and ventilation valve. The ventilation valve is constructed so that when filling the measuring glass with hydraulic liquid, excess air can escape without causing oil leakage. When emptying, the bleeding/venting valve ensures that sufficient air is supplied to allow the hydraulic fluid to drain quickly into the container. The measuring glass is filled with hydraulic fluid via two low oil leakage, self-sealing coupling connectors. A drain hose connects the measuring glass with the container of the hydraulic power unit. The measuring glass is not a pressure vessel.

Dimensions	mm (L x W x H)	160 x 200 x 700
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Weight	kg	6.5
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Material	<ul style="list-style-type: none"> ▶ Acrylic glass ▶ Aluminum body ▶ Copper pipe ▶ PVC hose with nylon lining length 1.5 m
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Capacity	l	2.5
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Hose tray of WS290 for 50 hoses

Material no.: R961002634

Type short description HOSE TRAY TS-MC-50

The hose tray can be mounted on one side of the WS290 workstation. The hose tray can be used to hold up to 50 hydraulic hoses, hose lines are simply suspended in the tray. The oil pan is used to store small parts.

Dimensions	mm (L x W x H)	708 x 320 x 191
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Weight	kg	11
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Spare Parts for Workstations

Load unit for attachment to WS290, 15 kg, pivoting

Material no.:	R961000187
Type short description	LOAD UNIT TS-HC-CD 70P 25/16-200Z1-15 KG

The pivoting load unit can be used for training purposes in the Fundamentals of Hydraulics (BIBB A-Z3) in which a load unit is required.

The load unit can be fixed to the base frame of the WS290. Pivoting the load unit by 180° generates tensile and compressive forces on the piston rod of a hydraulic cylinder. The load unit is protected by a safety mechanism that prevents uncontrolled pivoting.

The red-painted steel weight has a mass of 15 kg. To prevent injury, all moving parts are enclosed. Proximity switches can be attached to the mounting plate.

Connections via self-sealing coupling connectors.

Delivery incl. 2 x 2 m hose lines with 90° fitting.

Dimensions	mm (L x W x H)	1000 x 250 x 250
Weight	kg	31
Operating pressure	bar	105
Industrial type	CD70P25/16-200Z11	
Coupling connector	Low oil leakage	Type W
Piston diameter	mm	25
Piston rod diameter	mm	16
Load mass	kg	15
Stroke	mm	200

Writing surface for WS290

Material no.:	1827003705
Type short description	WRITING SURFACE TS-MC-DS3/DS4

Writing surface for insertion into the oil pan of the component carrier. For writing notes regarding exercise instructions and procedures.

Dimensions	mm (L x W x H)	275 x 360 x 25
Weight	kg	0.53
Material	PMMA, white	
Delivery unit	Pieces	2



Spare parts for hydraulic components

Mini gauge port G1/4		
Material no.:	R900009090	
Type short description	MEASURING COUPLING MCS20-SDS-E-G1/4-ST3&	
With screw-in studs G 1/4 A		
Dimensions	mm (L x W)	46 x 22
Weight	kg	0.1
Max. operating pressure	bar	630



Coupling plug G1/4		
Material no.:	R961000482	
Type short description	COUPLING PLUG TS-HC-FF-005-2-XX014-AAAF	
Dimensions	mm (L x W)	68 x 22
Weight	kg	0.17
Operating pressure	bar	120
Connection thread	G 1/4 A	
Sealant	O-ring for mounting on plate	



Coupling socket G 1/4		
Material no.:	R961000480	
Type short description	COUPLING SOCKET TS-HC-1-15-005-0-XX010-AAA	
Dimensions	mm (L x W)	68 x 22
Weight	kg	0.17
Operating pressure	bar	120
Connection thread	G 1/4 A	
Wrench size	mm	19
Sealant	O-ring for mounting on plate	



Spare parts for hydraulic components

Coupling socket M16 x 1.5

Material no.:	R961000481	
Type short description	COUPLING SOCKET TS-HC-1-15-005-0-L1016	
Dimensions	mm (L x W)	68 x 22
Weight	kg	0.17
Operating pressure	bar	120
Connection thread	M16 x 1.5	
Wrench size	mm	19
Sealant	24° inner cone according to DIN 2353	



Measuring tube with mini gauge port and hex nut

Material no.:	R900083425	
Type short description	MEASURING TUBE DN2-630/MCS20-MCS20/1000ST3Z00Z-P	
Hose length	mm	1000
Weight	kg	0.1
Operating pressure	bar	630



Component plate for directional control valves, complete

Material no.:	R961002568	
Type short description	SUBPLATE TS-HC-LEER-MIT-BEF-4K-4SCHR	
Device plate with connection hole pattern according to ISO 4401-03-02-0-05 with clamping mechanism for grids and connections via self-sealing coupling connectors		
Dimensions	mm (L x W x H)	80 x 115 x 25



Spare parts for hydraulic components

Empty device plate with fixture for grid		
Material no.:	R900022483	
Type short description	PLATE TS-HC-EMPTY-WITHF	
Empty device plate, with clamping mechanism for grids, for individual mounting of components		
Dimensions	mm (L x W x H)	115 x 80 x 30



Protective housing for differential cylinder CD70F25/16-200 (R961009526)		
Material no.:	R961009528	
Type short description	PROTECTIVE HOOD TS-MC-ZYL-46X52X263	
Intrusion protection for differential cylinder 200 mm plexiglass with ruler and through hole for tie rod		



Protective housing for differential cylinder CD70F25/16-400 (R961003495)		
Material no.:	R961000369	
Type short description	PROTECTIVE HOOD TS-MC-ZYL-46X52X463	
Intrusion protection for differential cylinder 400 mm plexiglass with ruler		



Spare parts for hydraulic components

Protective housing for gear motor (R961004259)	
Material no.:	R961004248
Type short description	PROTECTIVE HOOD TS-MC-HYMOT-152X136X68
Plexiglass intrusion protection for gear motor	



Protective housing for axial piston motor (R961002811)	
Material no.:	R900241023
Type short description	PROTECTIVE HOOD TS-MC-AXIAL-MOT
Plexiglass intrusion protection for axial piston motor	



Protective housing for planetary motor (R961008748)	
Material no.:	R961008749
Type short description	PROTECTIVE HOOD TS-MC-110X110X45 4XD5.5
Plexiglass intrusion protection for planetary gear motor	

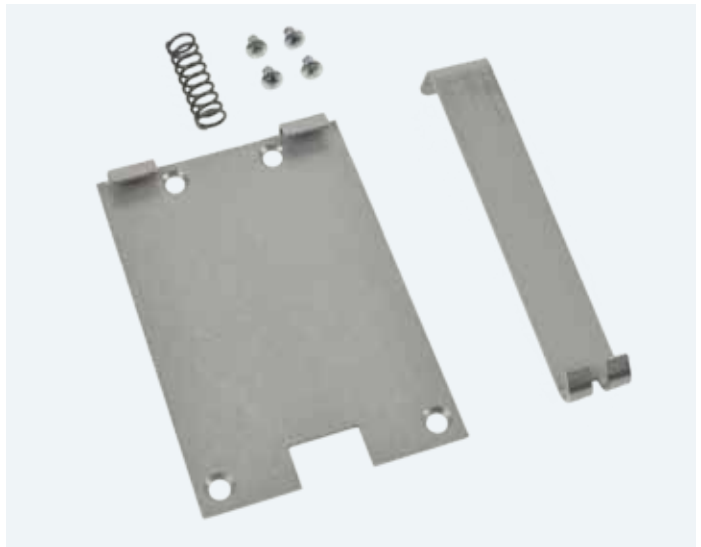


Spare parts for hydraulic components

Clamp holder for grid system		
Material no.:	R961003498	
Type short description	HOLDER TS-MC-GIT50-MANO	
For mounting the pressure gauge on the grid		
Dimensions	mm (L x W x H)	55 x 44 x 110
Weight	kg	0.130



Gripping technology	
Material no.:	R901393362
Type short description	MOUNTING SET TS-HC-10X
Gripping technology for mounting device plates to the grid	



Grid holder	
Material no.:	R901393364
Type short description	MOUNTING SET TS-HC-20X
Gripping technology for mounting device plates to the grid	



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WS290 workstation, hydraulics, 230 V/50 Hz, double sided for 4 - 6 trainees, without module frame - assembled, including packaging	R961009864	85
WS290 workstation, hydraulics, 230 V/50 Hz, single sided for 2 - 3 trainees, complete - assembled, including packaging	R961009454	84
WS290 workstation, hydraulics, 230 V/50 Hz, single sided for 2 - 3 trainees, without module frame - assembled, including packaging	R961009862	84
WS290 workstation, hydraulics, 230 V/60 Hz, double sided for 4 - 6 trainees, complete - assembled, including packaging	R961009456	85
WS290 workstation, hydraulics, 230 V/60 Hz, double sided for 4 - 6 trainees, without module frame - assembled, including packaging	R961009865	85
WS290 workstation, hydraulics, 400 V/50 Hz, double sided for 4 - 6 trainees, complete - assembled, including packaging	R961009455	85
WS290 workstation, hydraulics, 400 V/50 Hz, double sided for 4 - 6 trainees, without module frame - assembled, including packaging	R961009866	85
WS290 workstation, hydraulics, 400 V/50 Hz, single sided for 2 - 3 trainees, complete - assembled, including packaging	R961009453	84
WS290 workstation, hydraulics, 400 V/50 Hz, single sided for 2 - 3 trainees, without module frame - assembled, including packaging	R961009863	84

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