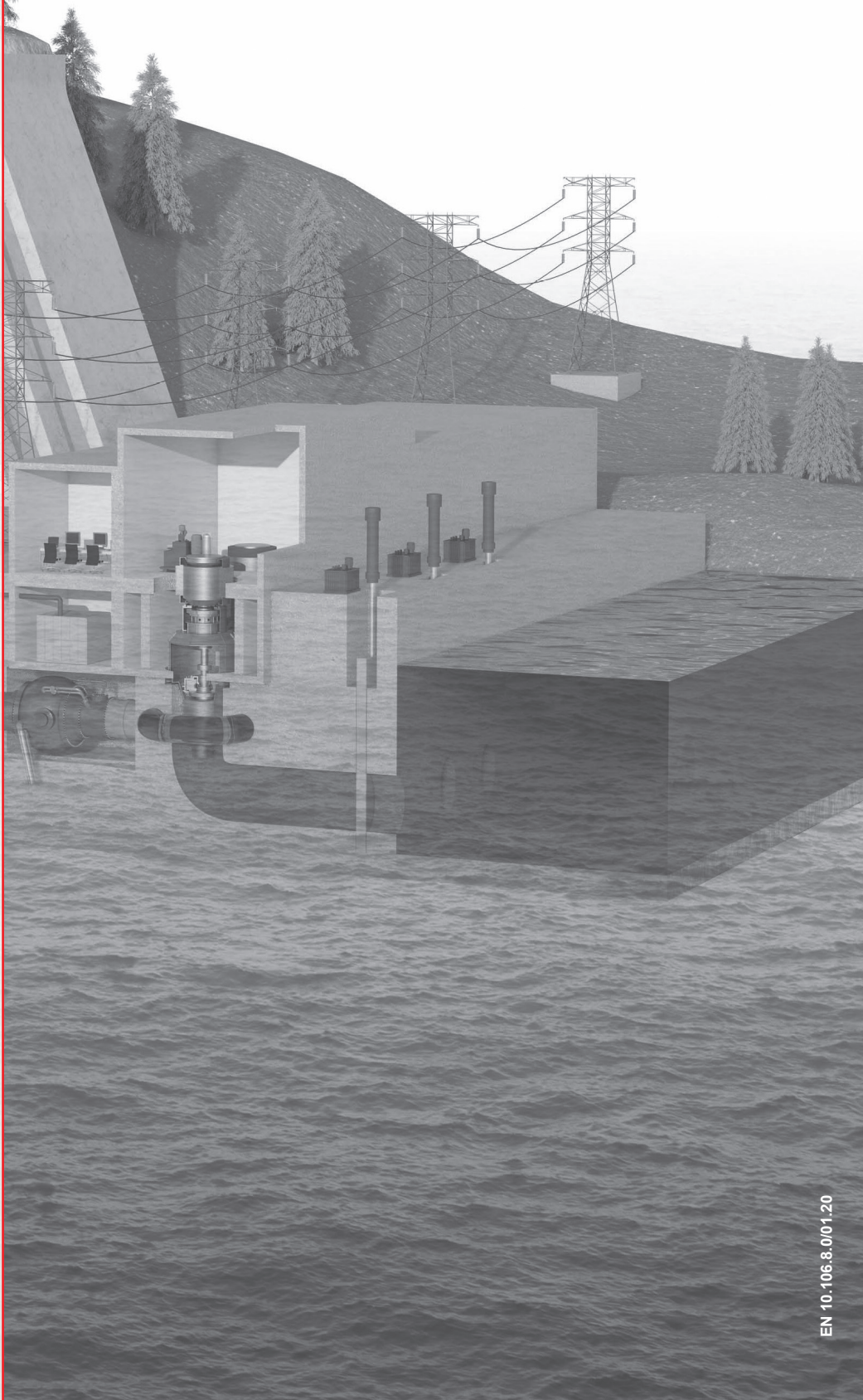
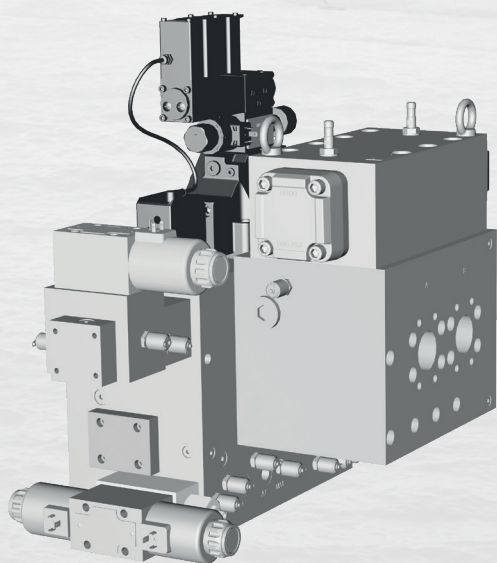


HYDAC

INTERNATIONAL

Turbine control block TSB for hydropower turbines



CONTENTS	Page
1. DESCRIPTION	3
2. MODEL CODE	4
3. STRUCTURAL DESIGN OF THE TURBINE CONTROL BLOCK WITH CIRCUIT DIAGRAM	6
4. ADD-ON BLOCK	7
5. EMERGENCY SHUT-DOWN FUNCTION ESD	8
6. FLANGE-ON BLOCK	8
7. HYDRAULIC LOCK	8
8. RELAY VALVE	9
9. MAIN VALVE	9
10. TSB DIMENSIONS AND CONNECTIONS	9

GENERAL OVERVIEW

Fluid technology in the hydropower industry

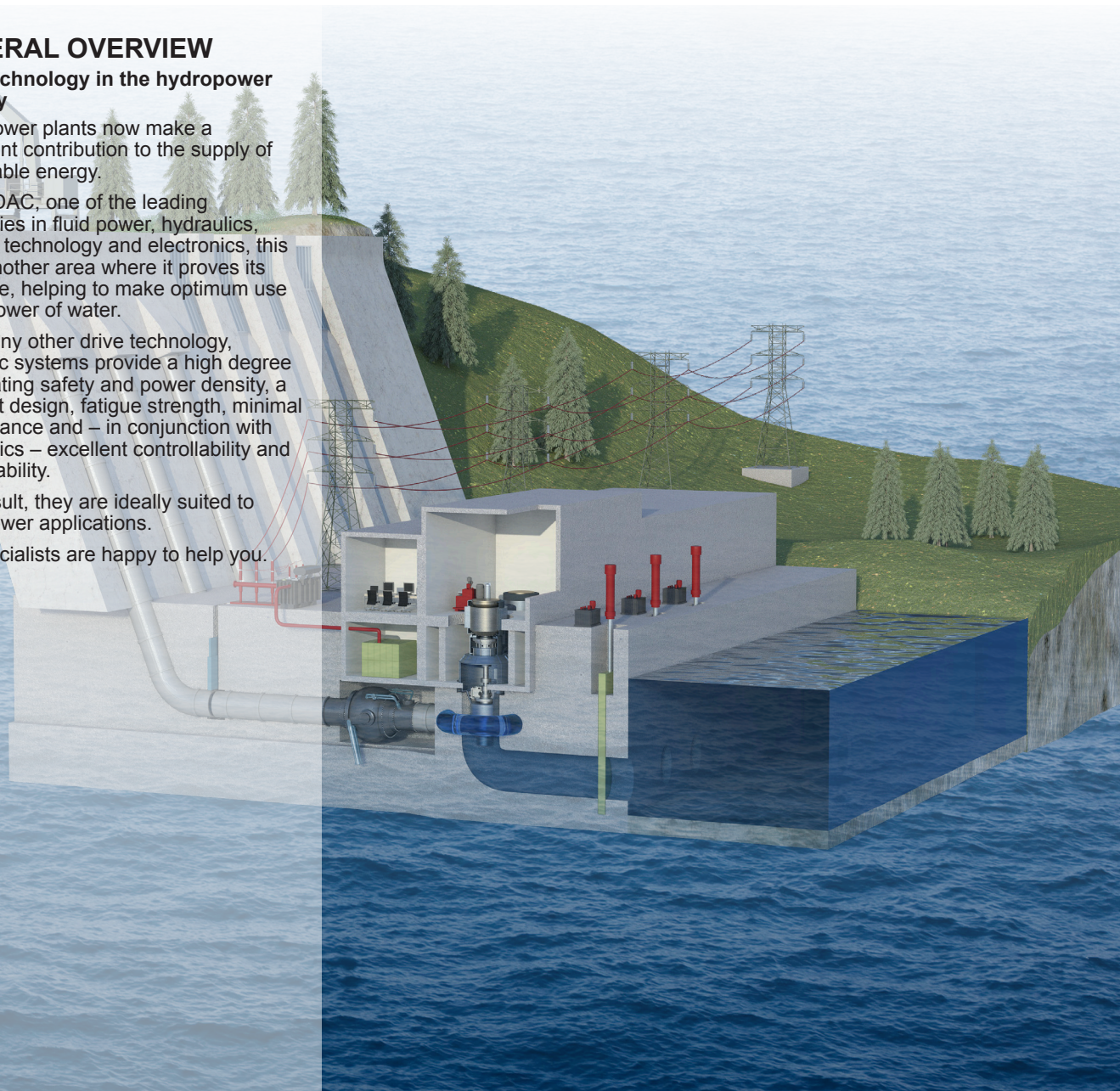
Hydropower plants now make a significant contribution to the supply of sustainable energy.

For HYDAC, one of the leading companies in fluid power, hydraulics, process technology and electronics, this is yet another area where it proves its expertise, helping to make optimum use of the power of water.

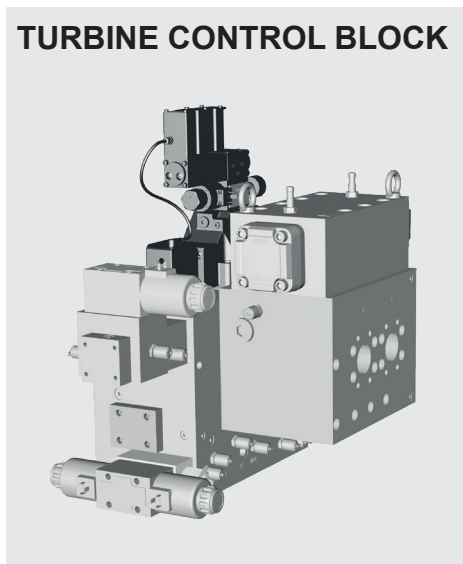
Unlike any other drive technology, hydraulic systems provide a high degree of operating safety and power density, a compact design, fatigue strength, minimal maintenance and – in conjunction with electronics – excellent controllability and monitorability.

As a result, they are ideally suited to hydropower applications.

Our specialists are happy to help you.



TURBINE CONTROL BLOCK



1. DESCRIPTION

The TSB turbine control blocks in sizes 16 and 25 are modular control blocks for use in Pelton, Francis and Kaplan medium and large hydro turbines.

The modular design means that the hydraulic control system can be adapted to the functions of the particular turbine.

A complete hydraulic control system is made up of the base block and a directional valve as a minimum.

The base block can be supplemented with add-on blocks to suit the particular turbine type.

- Pump block
 - active cartridge
 - directional valve
- Relay valve
 - hydraulically controlled valve for cartridge functions
- Hydraulic lock
 - directional valve; proportional directional valve
- Emergency shut-down
 - connection for mechanical overspeed device
 - stacking of 1–2 directional valves, poppet valves size 10 / 6
- Flange-on block
 - directional valve mount

1.1 AVAILABLE MODEL WITH MAXIMUM EQUIPMENT

- Base block with main valve and time adjustment plate
- Pump block
- Flange-on block with directional valve
- Directional valves; proportional valve for locking cylinder
- Directional valves; poppet valves for emergency shutdown
- Directional valves for control of cartridge valve

1.2 YOUR BENEFITS

- Modular and compact design, range of functions can be extended
- Simple and robust control system set-up
- Minimal space, piping and maintenance time required
- Good accessibility for adjustment functions during commissioning and maintenance

1.3 TECHNICAL DATA

General data	Nominal sizes	
	Size 16	Size 25
Design	Modular design	
Weight and dimensions	See page 9	
Connections (hydraulic)	See page 9	
Ambient temperature range	Min. 20 °C to max. 60 °C	
Mounting position	Horizontal	

Hydraulic specifications	Nominal sizes	
	Size 16	Size 25
Maximum operating pressure	200 bar	
Maximum flow rate in p channel	220 l/min	400 l/min
Maximum flow rate in T channel	220 l/min	400 l/min
Operating fluid	Hydraulic oil according to DIN 51524, Parts 1 and 2	
Temperature range of operating fluid	15 °C to 60 °C	
Operating fluid viscosity range	Min. 10 cSt to max. 380 cSt	
Cleanliness class according to ISO 4406	16 / 14 / 11 or cleaner	

Electrical specifications	Nominal sizes	
	Size 16	Size 25
Type of voltage	Direct current	
Rated voltage	24 V	
Voltage tolerance	±10 %	
Protection class	IP 65 with mounted and locked connectors	
Electrical connection	M12x1 connector, 4-pin, coding A (not included in the scope of delivery)	
Switch position monitoring		
Electrical connection for sensors		

2. MODEL CODE

TSB- 25-X-G0-D0-E000-R0-M00-A00-H00

Nominal size

16
25

Series

X

Base block for main stage fail-safe P-B / A-T

Connection with subplate

- 0 5-port size 25
- 1 5-port size 25 with time-adjustment plate
- 2 4-port size 25 with adapter plate
- 3 4-port size 25 with time-adjustment plate
- 4 5-port size 16 with adapter plate
- 5 5-port size 16 with time-adjustment plate
- 6 4-port size 16 with adapter plate
- 7 4-port size 16 with time-adjustment plate

Fluid power supply

- 0 none
- 1 add-on block / active cartridge, position-monitored
- 2 add-on block / active cartridge, position-monitored, 4/2 directional valve
- 3 add-on block / cartridge, position-monitored

Emergency shut-down

- 000 subplate overspeed oscillation and cover plate
- 010 subplate 1 emergency closing valve, poppet valve size 6, reducing plate size 10 / 6
- 011 010 with position monitoring
- 020 subplate 1 + 2 emergency closing valve, 2x poppet valve size 6, 2x reducing plate size 10 / size 6
- 021 020 with position monitoring
- 030 subplate 1 emergency closing valve, directional valve size 10
- 031 030 with position monitoring
- 040 subplate 1 + 2 emergency closing valve, 2x directional valve size 10
- 041 040 with position monitoring
- 050 subplate 1 + 2 emergency closing valve, poppet valve size 6, reducing plate size 10 / size 6, directional valve size 10
- 051 050 with position monitoring

Relay valve

- 0 cover plate without valve
- 1 relay valve size 10, hydraulically controlled with interconnecting plate

Main valve

- 00 5-port size 25, without fail-safe plate, no position monitoring
- 01 5-port size 25, fail-safe plate hydr. controlled, no position monitoring
- 02 5-port size 25, fail-safe plate hydr. controlled, with position monitoring
- 03 5-port size 25, fail-safe plate electr. controlled, no position monitoring
- 04 5-port size 25, fail-safe plate electr. controlled, with position monitoring
- 05 4-port size 25, without fail-safe plate, no position monitoring
- 06 4-port size 25, fail-safe plate hydr. controlled, no position monitoring
- 07 4-port size 25, fail-safe plate hydr. controlled, with position monitoring
- 08 4-port size 25, fail-safe plate electr. controlled, no position monitoring
- 09 4-port size 25, fail-safe plate electr. controlled, with position monitoring
- 10 5-port size 16, without fail-safe plate, no position monitoring
- 11 5-port size 16, fail-safe plate hydr. controlled, no position monitoring
- 12 5-port size 16, fail-safe plate hydr. controlled, with position monitoring
- 13 5-port size 16, fail-safe plate electr. controlled, no position monitoring
- 14 5-port size 16, fail-safe plate electr. controlled, with position monitoring
- 15 4-port size 16, without fail-safe plate, no position monitoring
- 16 4-port size 16, fail-safe plate hydr. controlled, no position monitoring
- 17 4-port size 16, fail-safe plate hydr. controlled, with position monitoring
- 18 4-port NG 16, fail-safe plate electr. controlled, no position monitoring
- 19 4-port NG 16, fail-safe plate electr. controlled, with position monitoring

- A main stage with position monitoring

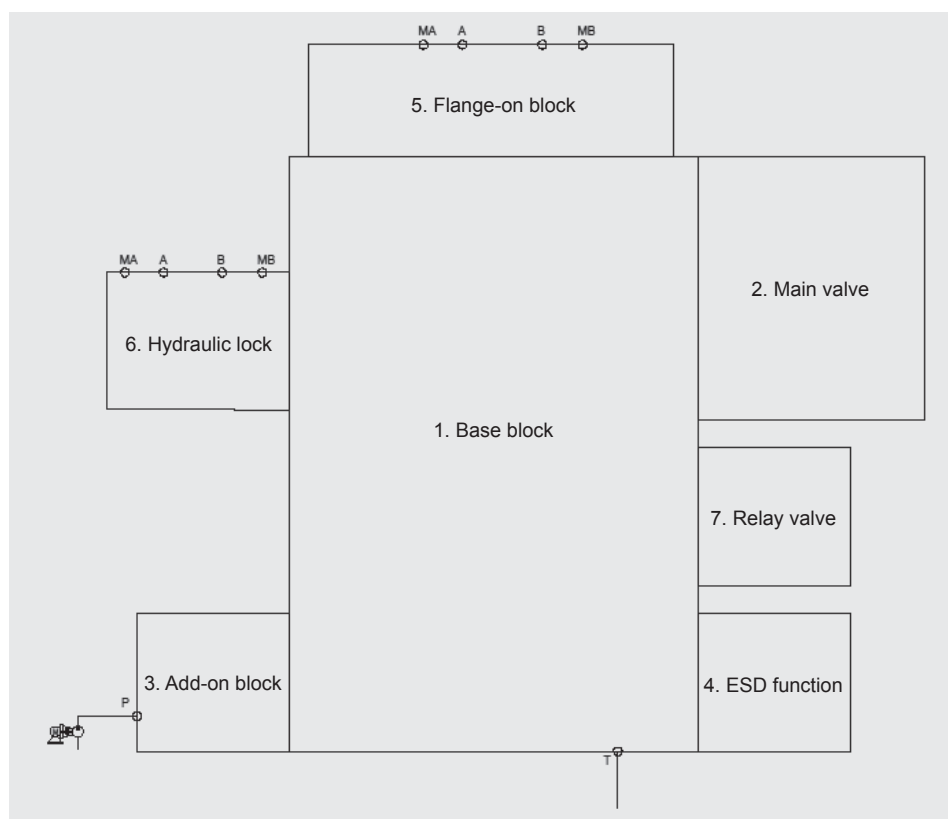
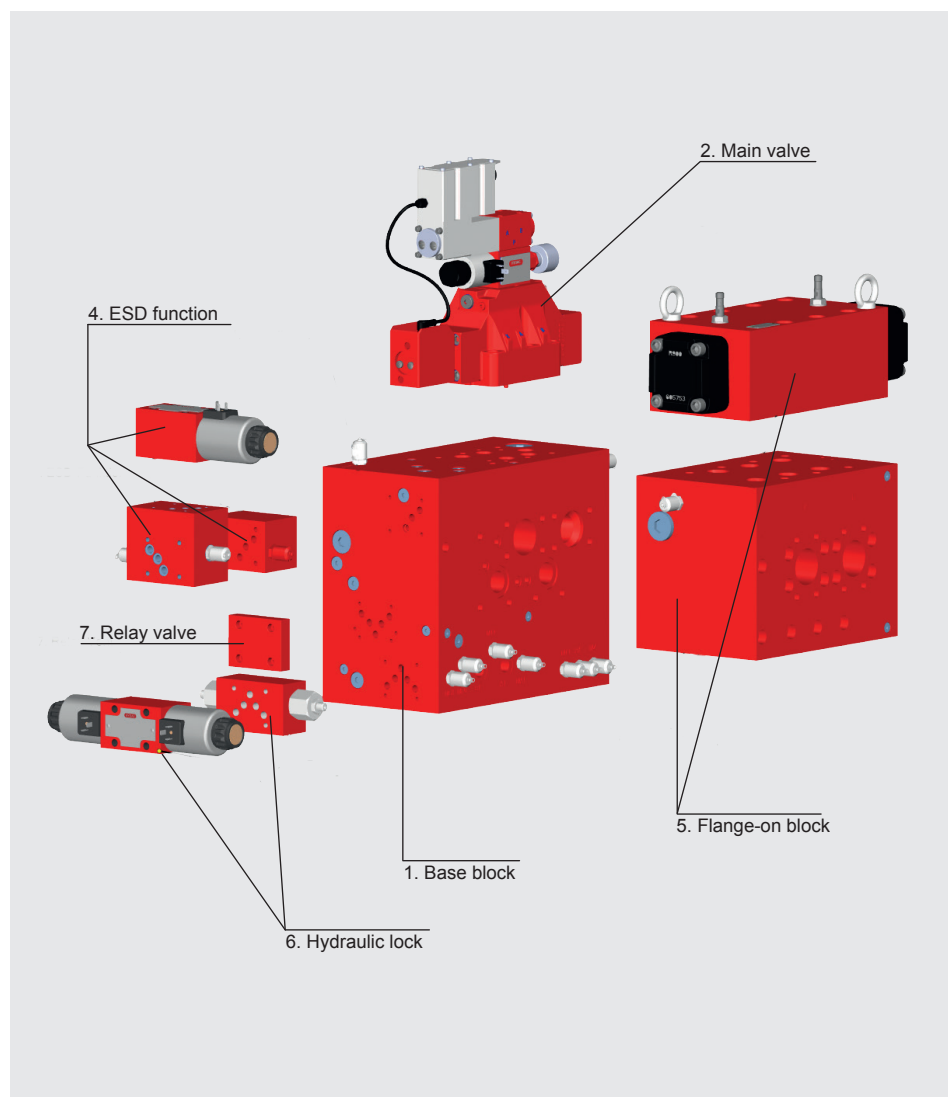
Flange-on block

- 00 no flange-on block
- 01 flange-on block with 2 x directional valve size 25 hydraulically controlled
- 02 flange-on block with 2 x directional valve size 25 hydraulically controlled, position-monitored
- 03 flange-on block with 2 x directional valve size 16 hydraulically controlled
- 04 flange-on block with 2 x directional valve size 16 hydraulically controlled, position-monitored
- 05 flange-on block with 6/2 directional valve size 32 hydraulically controlled
- 06 flange-on block with 6/2 directional valve size 32 hydraulically controlled, position-monitored
- 07 flange-on block with 6/2 directional valve size 16 hydraulically controlled
- 08 flange-on block with 6/2 directional valve size 16 hydraulically controlled, position-monitored
- 09 flange-on block with active cartridge hydraulically controlled, position-monitored

Hydraulic lock

- 00 cover plate
- 01 4/2 directional valve size 10
- 02 4/2 directional valve size 10, time-adjustment plate
- 03 proportional directional valve size 10
- 04 proportional directional valve size 10, time-adjustment plate

3. STRUCTURAL DESIGN OF THE TURBINE CONTROL BLOCK WITH CIRCUIT DIAGRAM



3.1 BASIC VERSION

Base block with main valve, subplate, ESD function and cover plates.

3.2 RANGE OF FUNCTIONS

1. Base block

- Pump and tank connections P and T
- Main valve connection
- Add-on block connection
- ESD function connection
- Flange-on block connection
- Hydraulic lock connection
- Relay valve connection

2. Main valve

- Control for guide vanes, deflectors
- Sizes 25 and 16

3. Add-on block

- Pump connection
- Shut-off function via cartridge valve

4. ESD function

- Mechanical speed controller connection
- Emergency closing valve size 6 and 10

5. Flange-on block

- Fail-safe function via valves P-B / A-T

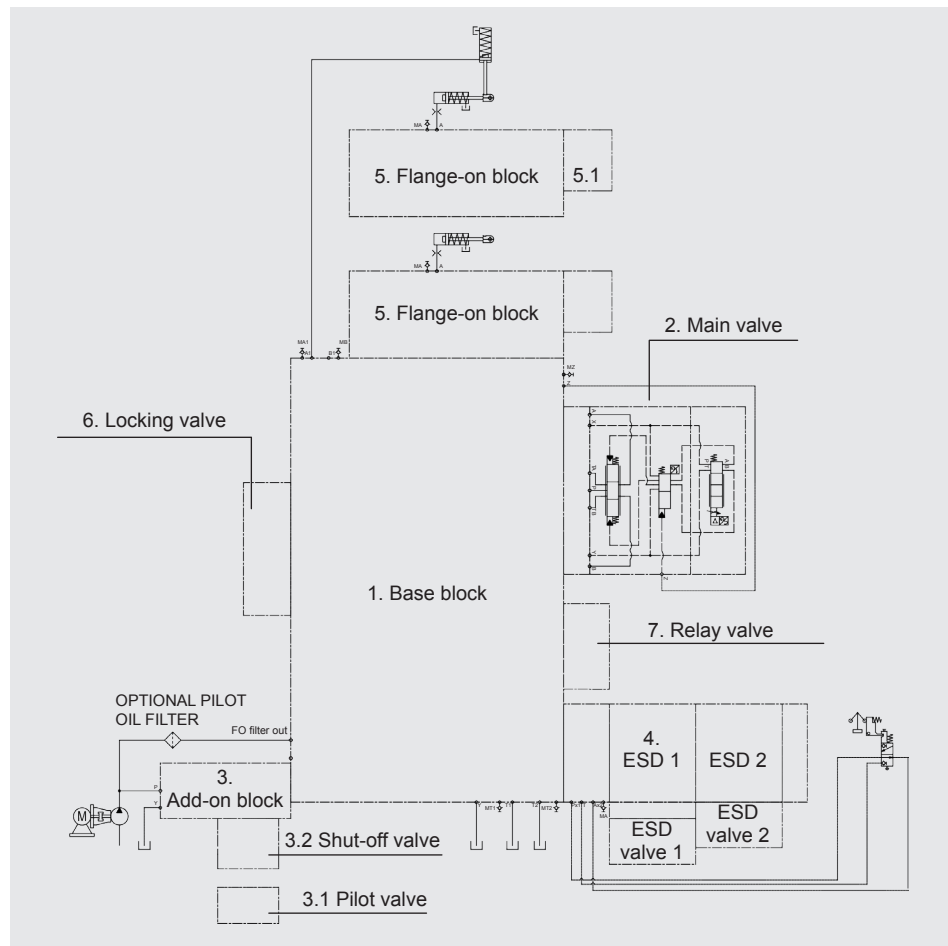
6. Hydraulic lock

- Connection of valve size 10 for additional function

7. Relay valve

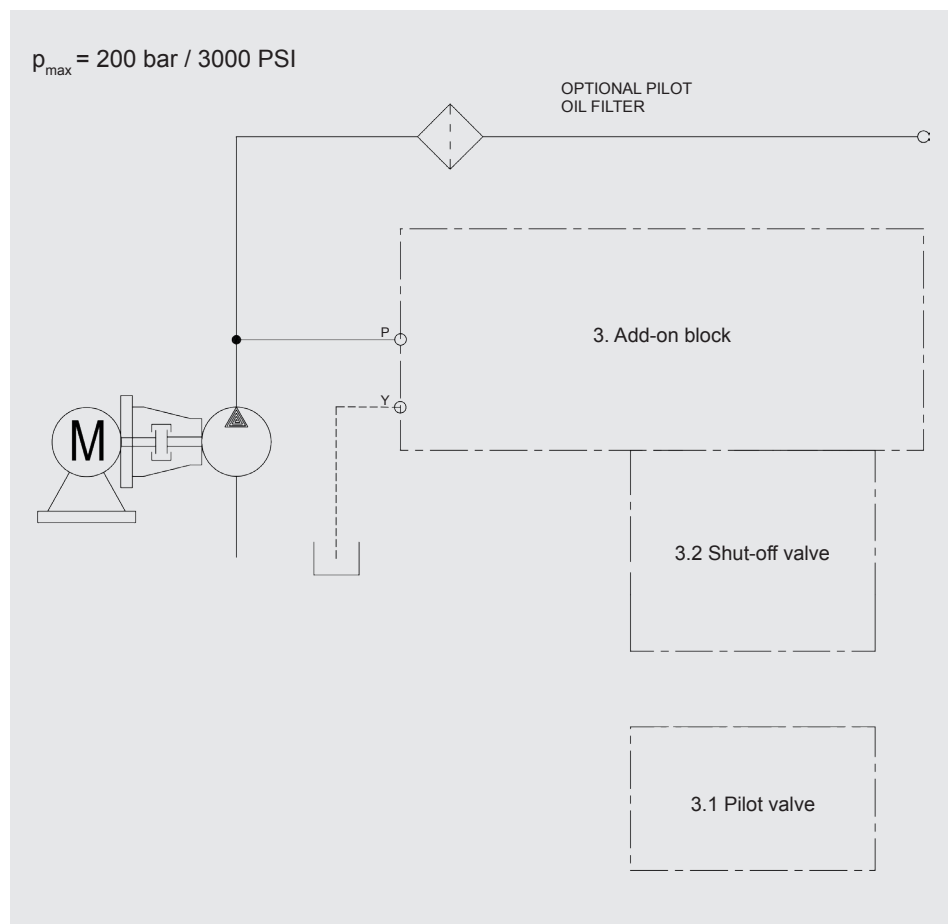
- Control of cartridge valve in pump block and flange-on block

3.3 DESCRIPTION OF THE BASE BLOCK



The pump and tank lines are connected to the base block (1). Blocks and control valves can be added to the base block on an individual basis to implement turbine controls for hydropower applications.

4. ADD-ON BLOCK



4.1 ADD-ON BLOCK WITH ACTIVE CARTRIDGE

Thanks to the active cartridge (3.2) in the add-on block, the oil flow from the pump/accumulators is either released or blocked in order to supply the base block.

The active control of the valve, with flow from B to A, is controlled by the mechanical speed control.

If the turbine speed is in the optimum range, pilot oil flows via the emergency closing valve(s) (4) to connection PX at relay valve (7). The switching position P-A / T-B causes pilot oil to flow to connection Z2 in the add-on block/to the ring side of the active cartridge. Flow from B to A is open and the base block is supplied with oil.

If the turbine runs outside of its normal speed range, the pilot oil is interrupted by the emergency closing valve(s) (4).

Pilot oil is no longer available at the relay valve. The valve moves to fail-safe position P-B / A-T. Pilot oil now flows from connection P to B or to X at the add-on block. Pressure is applied to the piston area of the active cartridge and the valve blocks oil flow from B to A.

To monitor correct functioning, the active cartridge can be equipped with a position sensor.

4.2 ADD-ON BLOCK WITH ACTIVE CARTRIDGE AND 4/2 DIRECTIONAL PILOT VALVE

The oil supply to the base block can be realised electrically by a 4/2 directional valve (3.1).

When current is applied, pressure acts on the ring surface of the active cartridge. There is a flow from B to A and the base block is supplied with oil.

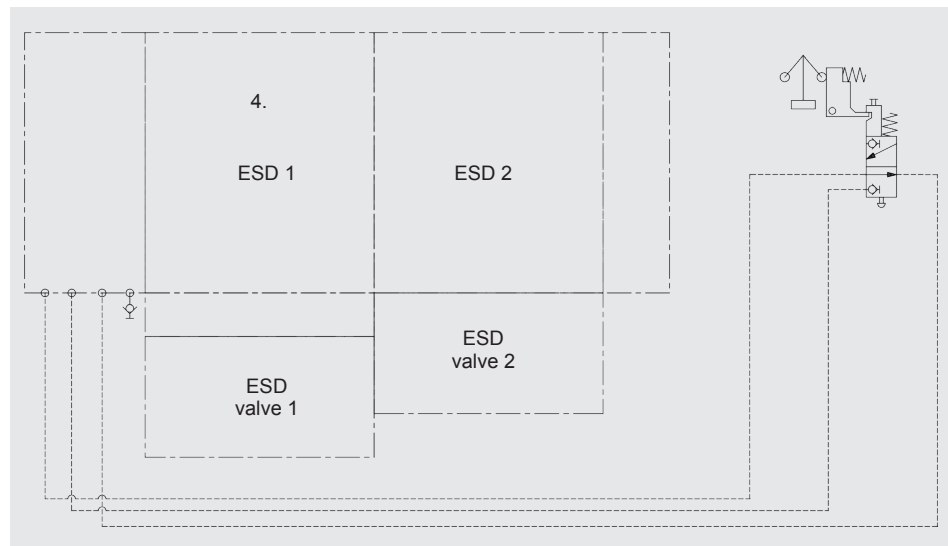
When voltage drops at the valve, pressure is applied to the piston area of the active cartridge. The valve closes and oil flow from B to A is interrupted.

4.3 ADD-ON BLOCK WITH CARTRIDGE

It is also possible to equip the add-on block with a standard cartridge valve.

When connection X is depressurised, oil can flow from B to A – if pressure is applied at connection X, the cartridge valve closes.

5. EMERGENCY SHUT-DOWN FUNCTION ESD

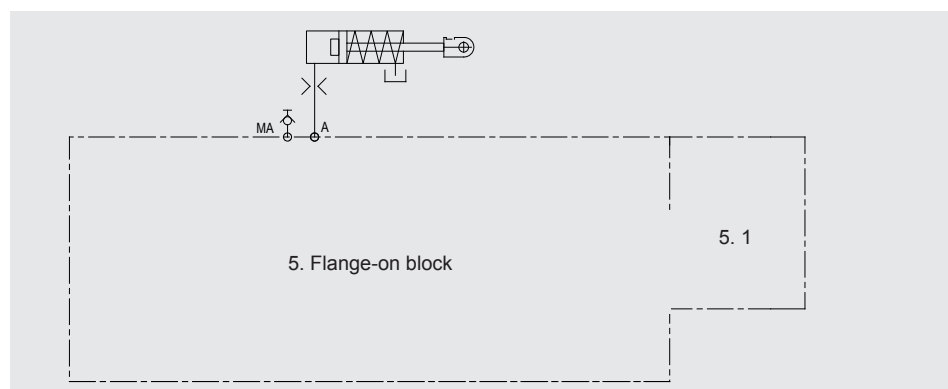


The ESD function plays a critical role in ensuring the safety of the turbine control. The turbine's mechanical overspeed monitoring determines the pilot oil that is made available to the base block. In the event of turbine overspeed, the pilot oil is interrupted and corresponding functions move to their fail-safe position.

Installing 1 to 2 (ESD1 / ESD2) sandwich plates enables the pilot oil feed to be interrupted via electric poppet valves or spool valves (valve 1 / valve 2) in size 6 and size 10.

There is also the option of equipping the valves with additional position monitoring.

6. FLANGE-ON BLOCK



Depending on the turbine type, various flange-on blocks can be used.

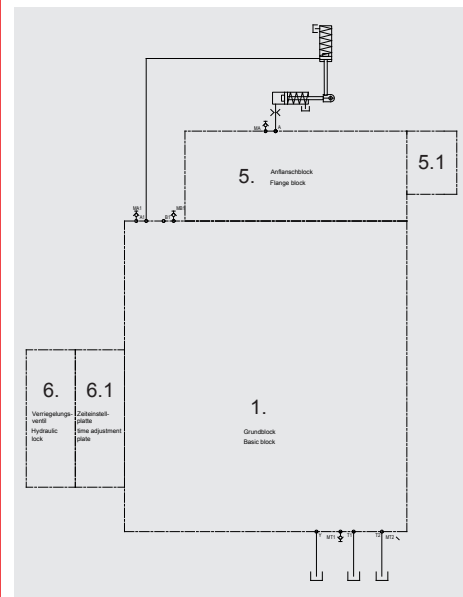
For a single-acting servo motor, an active cartridge (5.1) and pilot oil in connection X (relay valve in fail-safe position) are used to open the active cartridge to allow the oil to flow from the piston-side of the servo motor to the tank.

In flange-on blocks controlled hydraulically by a 6/2 directional valve, a pressure drop in the pilot oil causes the 6/2 directional valve to move to the fail-safe position (P-B / A-T) and the servo motor is supplied with pressure via connection B and moved to a safe position.

The position of the valve can also be monitored by a sensor.

The principle that applies to the 6/2 directional valve can also be realised with two 4/2 directional valves. Optional position monitoring is also available.

7. HYDRAULIC LOCK

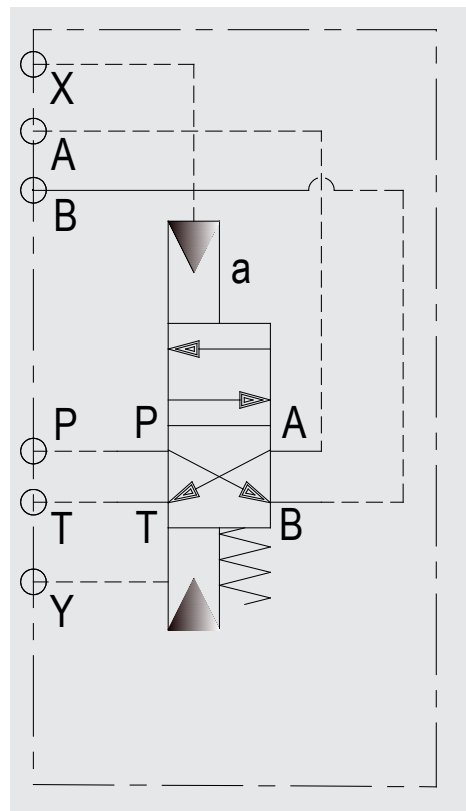


The hydraulic lock function (6) makes it possible to hold the servo motor in a safe position using a locking cylinder. The locking cylinder can be designed as a single-acting or double-acting cylinder.

Control is provided by a 4/2 directional valve, with the travel speed set via a time-adjustment plate (6.1).

Thanks to the size 10 CETOP connection on the base block, any size 10 valves can be connected, e.g. a proportional valve can be added to adjust the orifice in a Pelton turbine.

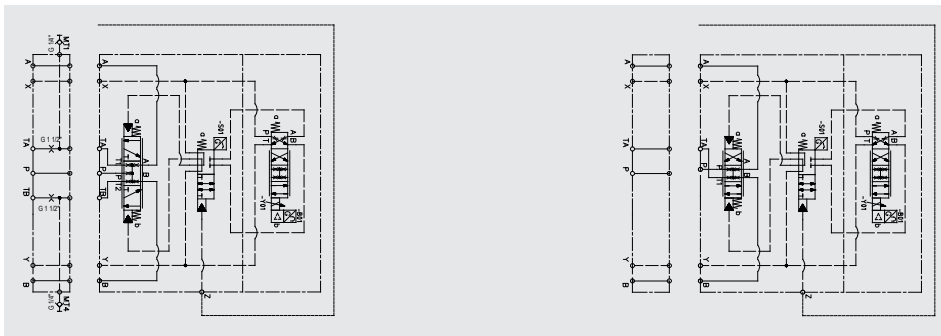
8. RELAY VALVE



The relay valve (7) is a hydraulically controlled 4/2 directional valve with a spring return mechanism for fail-safe position P-B / A-T.

If an add-on block and/or a flange-on block (5) is installed with a cartridge (5.1) for the turbine control, the relay valve is used. The valve's spool position controls the active cartridges in the add-on block and in the flange-on block, in accordance with the ESD function.

9. MAIN VALVE



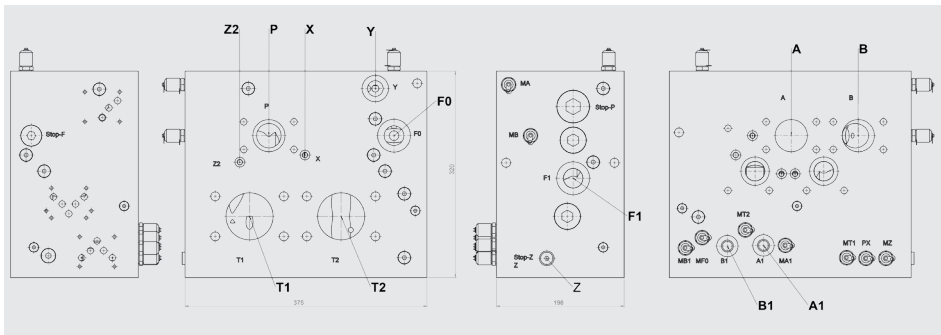
The main valve controls the stroke of the servo motor which is responsible for adjusting the turbine's guide vanes.

The valve design is available in various configurations, depending on requirements:

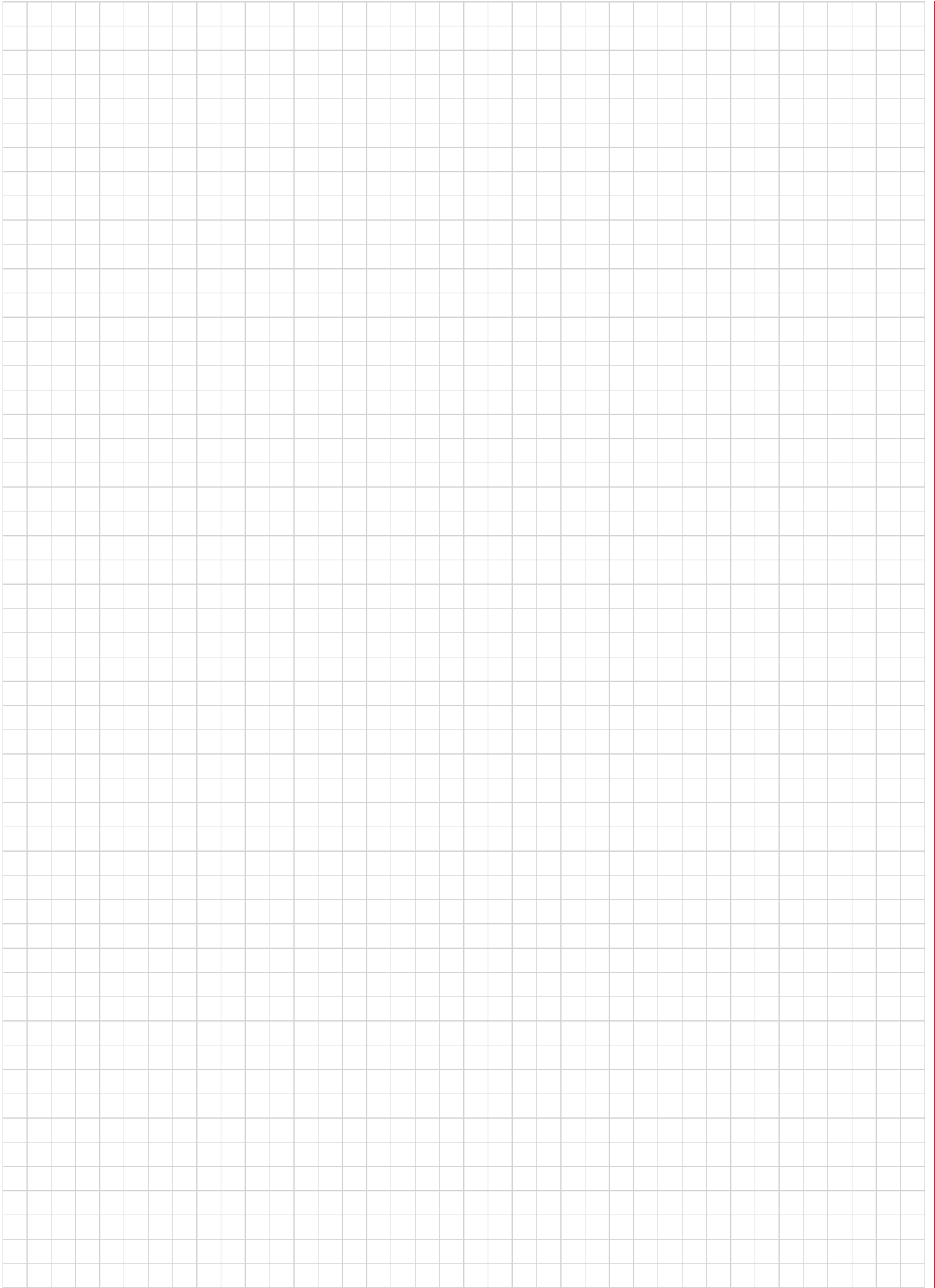
- As a 4 or 5-port valve
- As a 6/2 sandwich plate valve, hydraulically or electrically controlled, with or without position monitoring
- The connection to the block is provided by a size 25 5-port valve, directly to the block

For all other configurations, the following components are available: corresponding adapter plates, adapter plates with a time-adjustment function via orifices.

10. TSB DIMENSIONS AND CONNECTIONS

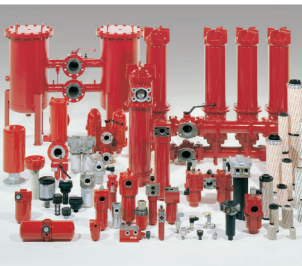


Fitting	Size
P	SAE 2.0-3
T1; T2	SAE 3.0-3
A, B	SAE 2.0-3
A1, B1	G 1/2"
X	G 1/4"
Z2	G 1/4"
F1; F0	G 1"
Y	G 3/4"
Z	G 1/4"
M	G 1/4"
Weight	150 kg





Accumulators 30.000



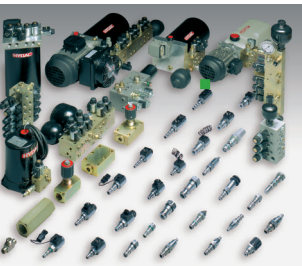
Fluid Filters 70.000



Process Technology 77.000



Filter Systems 79.000



Compact Hydraulics 53.000



Accessories 61.000

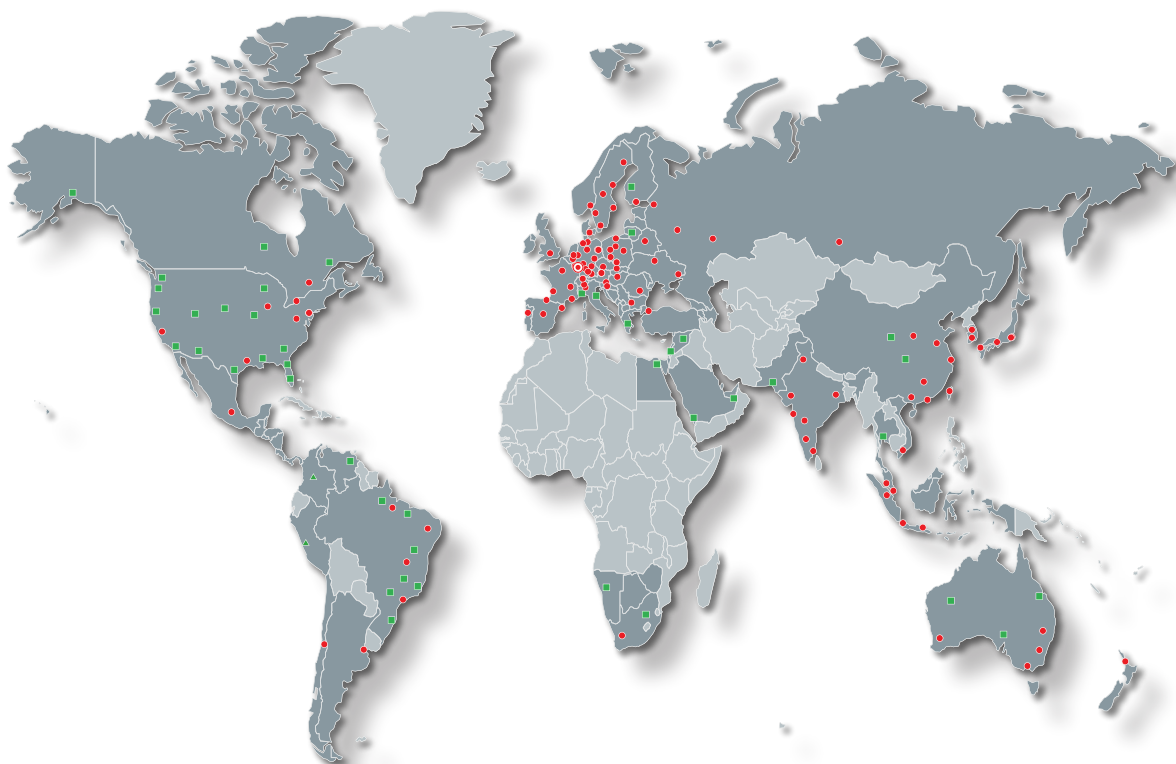


Electronics 180.000



Cooling Systems 57.000

Global Presence. Local Expertise. www.hydac.com



- HYDAC Headquarters
- HYDAC Companies
- HYDAC Sales and Service Partners
- ▲ Free Sales Partners

HYDAC INTERNATIONAL

HYDAC INTERNATIONAL
GMBH

Industriegebiet
66280 Sulzbach/Saar
Deutschland

Telefon
+49 6897 509-01

Fax:
+49 6897 509-577

info@hydac.com
www.hydac.com

Note

The information in this brochure relates to the operating conditions and applications described. For applications and / or operating conditions not described, please contact the relevant technical department.

Subject to technical modifications.