



Accumulator Technology 30.000

Filter Technology 70.000

Process Technology 77.000

Filter Systems 79.000

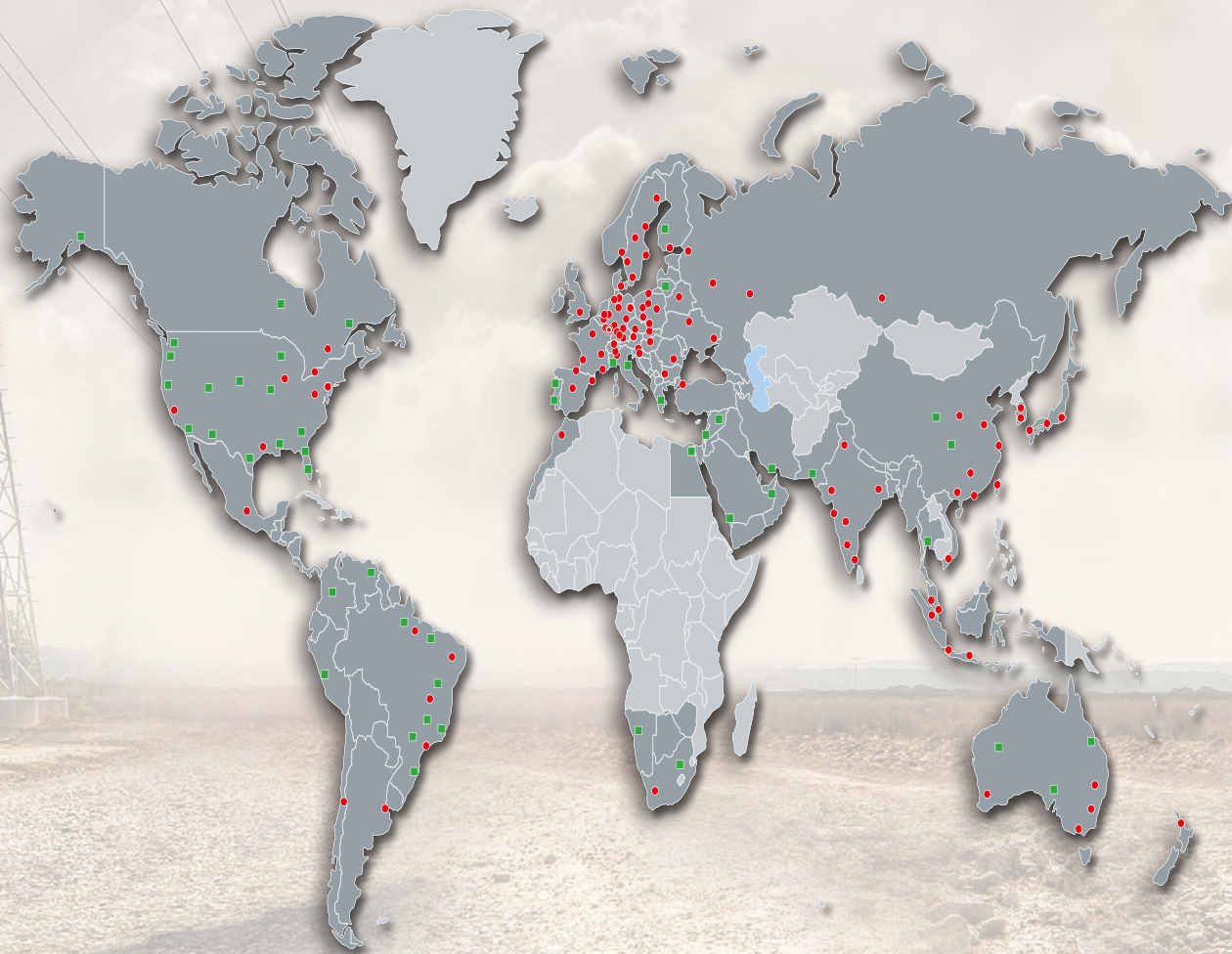
Compact Hydraulics 53.000

Accessories 61.000

Electronics 180.000

Cooling Systems 57.000

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NOTE

The information in this brochure relates to the operating conditions and applications described.

For applications and operating conditions not described, please contact the relevant technical department. All technical details are subject to change.

D 10.116.3/04.16

HYDAC

INTERNATIONAL

Components,
Systems and Service
for Hydraulic Excavators



D 10.116.3/04.16

Your partner for expertise in system solutions in various excavator applications.

HYDAC has been one of the leading suppliers of fluid technology, hydraulics, electronics and cooling equipment for more than 50 years and has over 8,000 members of staff worldwide.

With our wide range of products, and with our acknowledged expertise in development, manufacturing, sales and service we provide solutions for the wide range of requirements in the machine tool industry.

For use in various excavator applications, HYDAC offers a wide range of industry-specific components and systems from the areas of hydraulics, cooling, electronics and control technology in addition to its standard products. Intelligent integration of products also creates innovative and technologically advanced subsystems and complete systems for the increased requirements of specialist machinery.

Customer benefits:

- Cost optimisation achieved by customised system solutions which use standard components
- Reduction in number of models through standardisation and modular construction
- On hand everywhere: more than 45 foreign companies and more than 500 Sales and Service Partners
- Fluid engineering and service: Support in technical design, for commissioning, maintenance, training and in the event of claims.
- Customised solutions: designs can be tailored to individual customer requirements, made-to-order solutions for your machines.
- Advice on and implementation of the safety requirements in accordance with DIN EN ISO 13849



Overview of the various hydraulic excavator categories

Mini excavators from 0.3 to 6.0 to.

Compact excavators from 5.0 to 12.5 to.

- Adjustable undercarriage
- Boom can swivel to side
- Dozer blade
- Upper carriage tilting
- Quick-coupler systems



Mid-range excavators from 12 to 60 to.

- Standard boom or adjustable boom
- Dozer blade for short-swing excavators
- Quick-coupler systems



Large excavators from 60 to 200 to.

- Backhoe excavators
- Shovel excavator
- Quick-coupler systems



Mining excavators 200 to 1000 to.

- Backhoe excavators
- Shovel excavators



Walking excavators up to 12.0 to.

- Up to 4 control circuits (with four hydraulic pumps)
- Boom can swivel to side
- Hydraulic telescopic boom
- Complete hydraulic chassis adjustment
- Hydrostatic two-wheel and four-wheel drive
- Mechanical telescopic leg (3 fold)
- Hydr. telescopic support (slope support)
- Rope winch connection on chassis (optional)
- Quick-coupler systems



Mobile excavators from 5.0 to 30 to.

- Adjustable boom
- Dozer blade and support brackets
- Axle oscillation lock
- All-wheel steering and all-wheel drive
- Quick-coupler systems



Material handling excavators/machines

- Wheel or crawler chassis
- For wheel chassis - all-wheel steering and all-wheel drive
- Support plate or support brackets
- Adjustable driver's cab



Excavators – special designs

- Road-rail vehicles
- Short-swing/zero-swing excavators
- Long front (slope equipment)
- Demolition (demolition equipment)
- Forestry (forestry equipment)
- Pipelayer (pipe-laying equipment)
- Telescopic boom
- Cable / rope excavators

Function overview

Main functions:

- Boom, stick and bucket cylinders
- Swing drive
- Traction drive (wheel / crawler chassis)
- Additional control circuits

Additional functions:

- Boom adjustment (mobile excavators)
- Dozer blade (mini, compact, mobile and short-swing excavators)
- Support brackets (mobile & material handling excavators)
- Track adjustment (mini & demolition excavators)
- Quick coupler
- Hammer function
- Grab & pincer function (turning, opening/closing)
- All-wheel steering (mobile & material handling excavators)
- Cab adjustment (material handling excavators)
- Articulated joint adjustment (mini & compact excavators)

Energy efficient, safe, comfortable.

Challenges in the various excavators

The development of modern machinery is characterised by shared requirements across the various excavator sizes. The machine operators are supported and the work process is optimised in this context with the aid of modern electronic assistance and visualisation systems.

Changes to the regulatory framework result in increased investment in the functional safety of the machines and to a further development of the drive and control systems of the excavators. As is also the case with the EU & US exhaust emissions regulations, the emerging markets in the rest of the world are taking up these standards and are introducing new standards at the same time.

HYDAC's contribution

HYDAC offers a variety of components and systems that meet these requirements and fulfil your demands. In addition to standard components, HYDAC offers a comprehensive modular system designed for excavator applications. Furthermore, HYDAC will also work with you to develop a customised solution for your device.

HYDAC's key issues

Our development team and application engineers are working continuously to further develop our products. The focus of these developments is on the following key topics:

Our technology

- **Increases in:**
 - ⇒ Excavation & digging performance (digging forces and breakout forces)
 - ⇒ The use of energy-efficient pumps and valve technology, optimal positioning in working position with sensitive controls, accurate repeatability for automatic and control functions
 - ⇒ Corrosion resistance owing to surface coating and special materials
- **Reduction in:**
 - ⇒ Piping and installation expenditure due to combined hydraulic function units
 - ⇒ Noise emissions and power consumption through regulated fan speeds
 - ⇒ Driver's exposure to dust due to cabin ventilation systems
 - ⇒ Hydraulic oil tank sizes by optimizing air separation in hydraulic oil, proven through simulation and testing
 - ⇒ Installation space, component weight and electrical power requirement by reducing solenoid valve sizes
 - ⇒ Learning curve of the drivers through intelligent control and visualisation systems
- **Extension of:**
 - ⇒ Maintenance intervals by monitoring the hydraulic oil quality
- **Reduction in:**
 - ⇒ Software development time by using tested and certified software libraries
 - ⇒ Development times by means of HYDAC modular systems and industry know-how
 - ⇒ Assembly times through control technology tailored to customer specifications

Your benefits

- **Energy efficiency**
 - ⇒ Reduced fuel consumption
 - ⇒ Lower hydraulic losses
 - ⇒ Energy saving and recovery
 - ⇒ Precise cooling-requirement temperature control
 - ⇒ Reduced electrical power requirement
- **Reliability**
 - ⇒ Certified software modules
 - ⇒ Systems for functional safety
 - ⇒ Service life increased by protecting materials
- **Noise reduction**
 - ⇒ Lower noise level in partial-load range of fan control
- **Health & safety**
 - ⇒ Reduced exposure to dust for the driver
 - ⇒ Reduced aerosol exposure for the driver
- **Takes up less space**
 - ⇒ Combined functional units
 - ⇒ Integrated tank and filter systems
- **Function integration**
 - ⇒ Reduced number of components
 - ⇒ Reduced weight
 - ⇒ Reduced joints and leakage points
- **Comfort**
 - ⇒ Improved working environment for the driver
 - ⇒ Sustained driver performance on longer jobs
- **NoX**
 - ⇒ Compliance with the Emissions Directive
 - ⇒ Reduced nitrogen oxide and CO₂ emissions

System intelligence Electro-hydraulic system solutions as the interface between actuators and sensors.

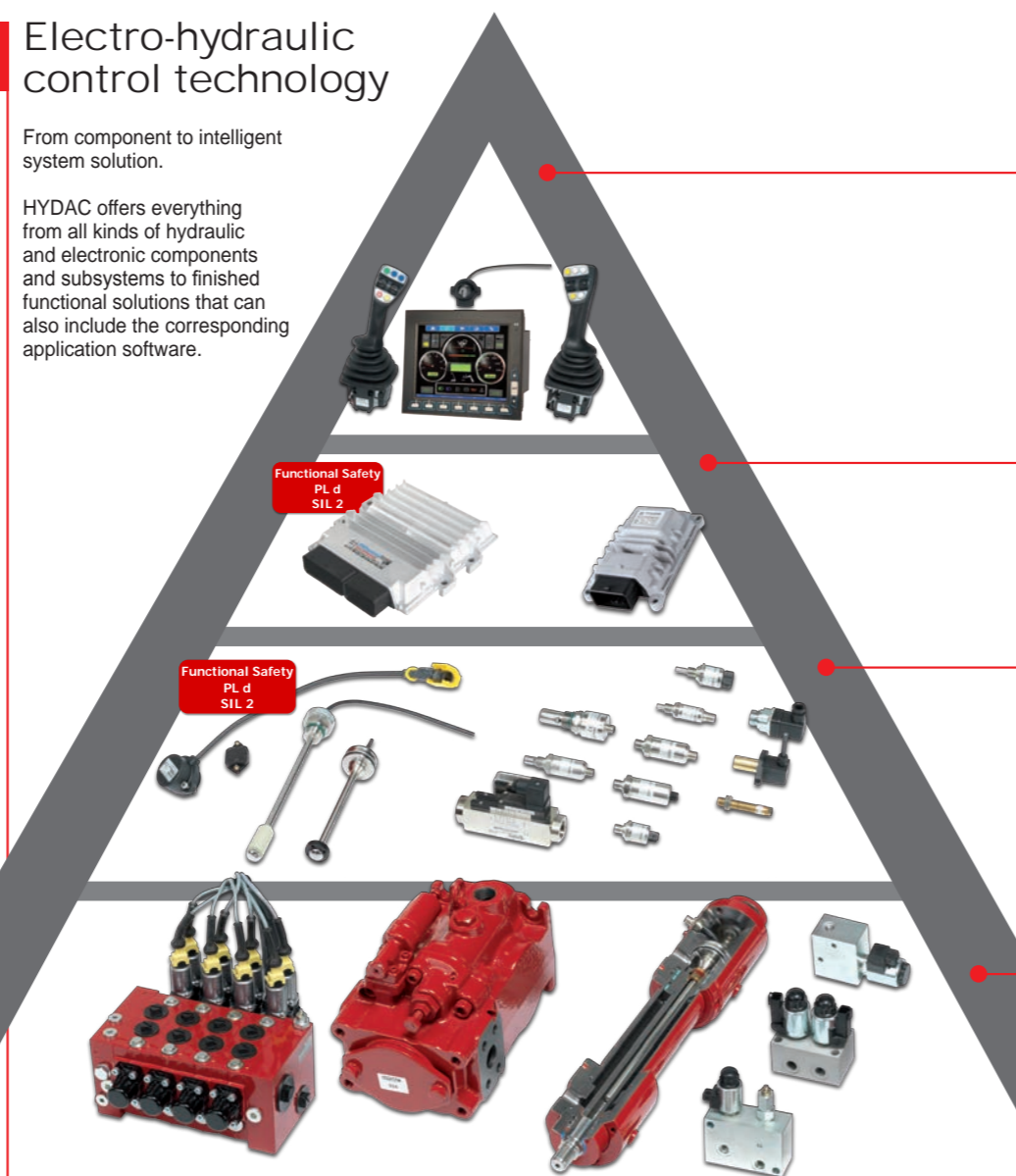
The demands of modern excavators are leading to ever-increasing complexity of control systems. Modern machines require a variety of assistance and control systems wherever simpler operating concepts and a better overview and controllability of the machine functions become necessary.



Electro-hydraulic control technology

From component to intelligent system solution.

HYDAC offers everything from all kinds of hydraulic and electronic components and subsystems to finished functional solutions that can also include the corresponding application software.



HYDAC

See catalogue 18.500 – Control Technology for Mobile Machinery
See brochure 18.000 – Measurement Equipment for Hydraulics and Pneumatics

USER LEVEL

- Displays for the most demanding visual requirements
- Peripherals, e.g., joysticks

CONTROL LEVEL

- Controllers in various classes
- I/O expansion modules
- Standard version and versions with increased functional safety are available

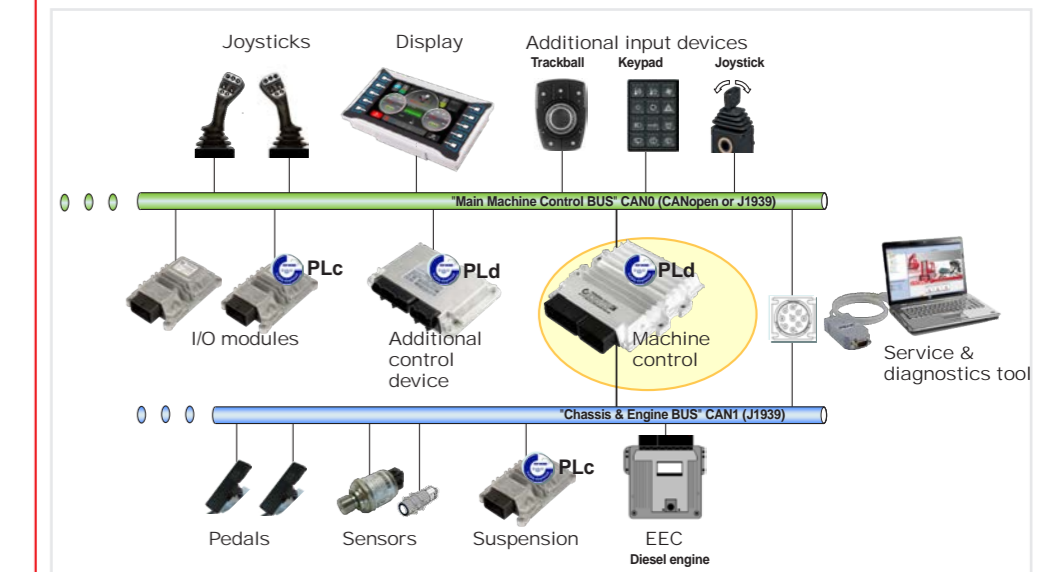
SENSOR LEVEL

- Pressure and temperature
- Distance, position, angle, inclination and level
- Drive speed
- Flow and oil level
- Standard version and versions with diagnostics and increased functional safety available

ACTUATOR LEVEL

- Pilot-controlled and direct-acting valves
- Control blocks (monoblock/sandwich)
- Pilot and primary control systems
- Intelligent axles
- Cylinders, pumps and motors

System development



Example of control architecture

Based on the customer's requirements, HYDAC offers support across the spectrum with developing electro-hydraulic control systems for mobile machinery. The scope of development is determined together with the customer according to the task.

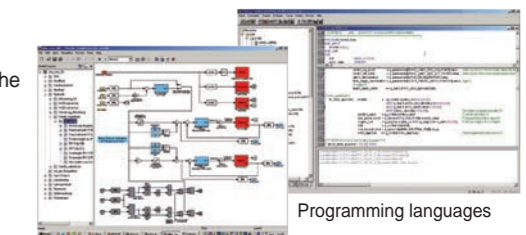
Services can include:

- Creating customer-specific application software (according to specification)
- Integrating intelligent subsystems into the customer's machine (e.g., suspension systems, secondary steering systems, fan controls)
- Complete control solutions for mobile machinery (safety functions, electrical/electronic control architecture, application software)

Software development

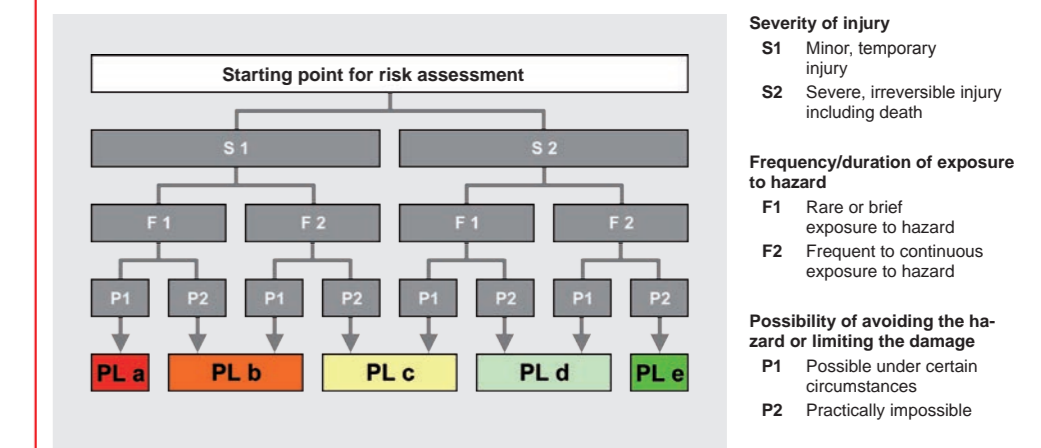
Depending on the hardware, the following programming languages can be used to program the application software:

- CoDeSys 2.3 / 3.5 / 3.5 SIL2
- C
- MATLAB/SIMULINK



Programming languages

System development support

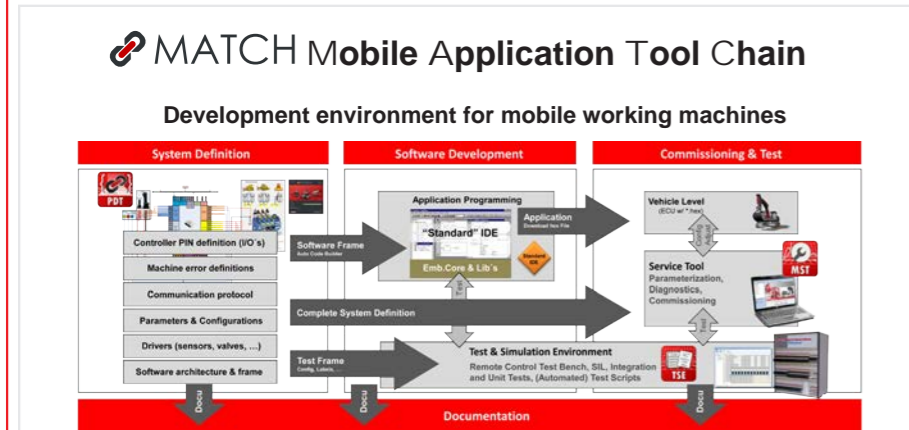


HYDAC offers extensive consultation and support for customer projects with regard to:

- Hazard and risk (H&R) analysis
- Definition and description of safety functions
- Drafting safe system architectures and user interfaces (HMIs)

HYDAC

"MATCH" development environment



Mobile Application Tool Chain

With the "MATCH" (Mobile Application Tool Chain) development environment, HYDAC offers a tool chain for system-level software development by the customer that is specially suited to the requirements of mobile machinery. "MATCH" supports development from defining the system at the vehicle level and creating the application software to start-up, testing, and documentation.

"MATCH" offers modules for:

- Defining the system at the vehicle level
- Starting up and servicing the machine
- Testing software
- Documentation

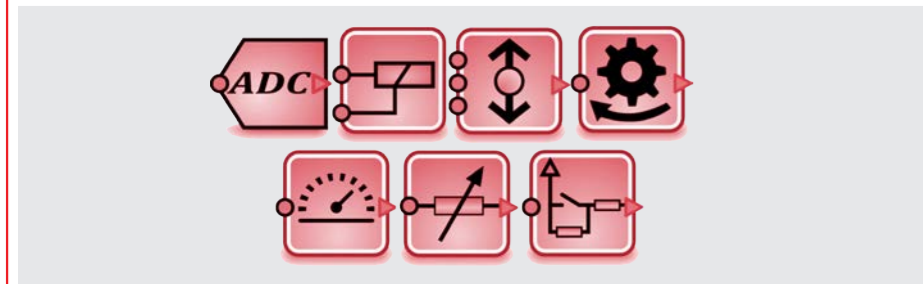
Furthermore, an "Embedded Middle Ware" is offered which permits a hardware-independent programming of the application and which contains a multitude of basic functions. A comprehensive selection of library modules (e.g. for sensor and valve drives) is also available for an efficient development of the application software.

Functional safety

"MATCH" can also write application software with increased functional safety according to the following safety standards:

- "SIL 2" to IEC 61508
- "PL d" to EN ISO 13849

Software library



Selection of library modules

In order to make software development significantly easier for the customer, HYDAC offers software libraries with ready-made modules as part of its "MATCH" development environment. The library modules can be configured and parameterised as desired.

Examples of library modules include:

- Sensors
- Switches
- Proportional and switching valves
- Relays, LEDs
- Transfer functions/signal elements

Special error modules can also be used to detect system errors.

Sensors, system electronics and control systems. Solutions perfectly tailored to the application – all from a single source.



Sensors

Function

The range of sensors includes products for measuring pressure, temperature, distance, position, level, flow rate, speed, inclination and angle as well as contamination and oil condition. In addition to products for standard applications, the product portfolio covers special applications such as potentially explosive atmospheres or applications with increased functional safety.

Electronic sensors and controls to complement the system electronics.

- Max. load regulation
- Electro-hydraulic load sensing
- Working hydraulics
- Positioning
- Controls of special equipment
- Switch-off devices
- Safety systems

Features

- The sensors are available with a variety of output signals, connectors and fluid port connection options
- Robust design
- ECE type authorisation
- Approved for potentially explosive atmospheres
- Separate product portfolio, especially for applications with increased functional safety (SIL 2.3 / PL c.d)

See brochure 18.000 – Measurement Equipment for Hydraulics and Pneumatics



Controller for mobile applications HY-TTC 500

Mobile Controller HY-TTC 500

Function

The HY-TTC 500 controller series is based on a 32-bit processor with a modern micro-controller platform. The controller is notable for its impressive 96 inputs and outputs and for its high performance capability. This new HY-TTC 500 controller series is therefore especially suitable for complex control tasks in centralised and decentralised control architectures. The controller has up to three alternative PWM shutdown groups for differentiated safety functions.

Features

- SIL 2 / PL d
- Up to three alternative PWM shut-off groups
- Up to 36 PWM power outputs with current measurement
- Numerous and highly flexible I/O groups
- Excellent computer performance
- High number of interfaces, communication and information interfaces
- 7 CAN-bus interfaces
- Optional: Ethernet interface for extremely fast software download and debugging

See catalogue 18.500 – Control Technology for Mobile Machinery



HY-TTC 30X

I/O Expansion Module HY-TTC 30X / 30XS

Function

The new HY-TTC 30X series of I/O expansion modules provides an outstanding power balance combined with extremely compact design.

The HY-TTC 30X series extension modules are integrated very easily.

They provide a simple extension of on-board electronics.

The communication and integration of the extension modules takes place via CANopen according to CiA DSP 401. It enables inputs and outputs to be configured and parameterized via the control configuration of the available control device in a simple and uncomplicated way.

The different I/O modules provide a large number of high performance switching outputs or diverse PWM outputs with internal current measurement as well as configurable analogue and flexible digital inputs.

Our product range includes two additional safety-oriented versions for the implementation of distributed applications with enhanced functional safety (Safety PL c, EN ISO 13849).

Features

- PL c (HY-TTC 30XS)
- Freely configurable Node-ID via pin
- 30 I/Os, with up to 8 PWM outputs, 6 of these with integrated current measurement
- Robust, very compact housing

See Product Catalogue 18.500 – Control Technology for Mobile Machinery



Displays with integrated HY-eVision² controller

Mobile Display HY-TTC eVision²

Function

The compact background-lit TFT colour displays with integrated high-end display controller are characterised by a very high image quality, low reflections and high colour saturation as well as optimal readability, even under the most unfavourable light conditions.

The displays are protected by a robust aluminium or plastic housing and can be either built directly into the instrument panel or surface-mounted in the field of vision of the driver/operator using a RAM Mount® system in the cockpit.

Ten programmable illuminated control keys along with the optional touchscreen feature create an easy-to-use human-machine interface.

Up to two external cameras can be connected to the display via the two integrated composite video ports, and controlled via software.

Features

- User-friendly, self-explanatory and time-saving graphical design and operation interface
- Good portability via CoDeSys platform
- High image brilliance
- High refresh rate
- Fast boot-up times
- Impressive display options such as 3D, picture-in-picture, overlapping effects, etc.
- Two pictures can be displayed simultaneously
- Up to 4 CAN, USB and Ethernet interfaces
- Robust housing with appealing design, suited for mobile applications

Hydraulic systems

The optimal working hydraulics for fast, accurate and efficient control.

Open center primary control valves

HYDAC's open center primary control valves offer a modular system with which to design robust, energy efficient and cost-effective open centre controls for mechanical, pneumatic, hydraulic and electro-hydraulic controls.

Properties:

- Structural design as monoblock, multi-section and slice construction
- Key data: $Q_{max} \leq 180$ l/min; $p_{max} = 350/420$ bar
- Energy-saving Q-inlet option
- Robust, high quality and maximum controllability
- Low internal leakage
- Inlet track switching for safe volume flow distribution
- Electrical pump volume current cut-off
- Main consumer in parallel, series and tandem switching
- Simple integration of secondary safeguards
- Optional switch position monitoring of the main control spool
- Optionally also for the actuation of LS variable pumps

Key data for open center primary control valves (see photos on right):

- DI-2 primary control valve $\Rightarrow Q_{max} = 60$ l/min; $p_{max} = 250$ bar
- RS 220 main control valve $\Rightarrow Q_{max} = 80$ l/min; $p_{max} = 300$ bar
- DX-6 primary control valve $\Rightarrow Q_{max} = 140$ l/min; $p_{max} = 350$ bar



DI-2
Open center primary control valve



RS 220
Open center primary control valve



DX-6
Open center primary control valve

Load-sensing primary control valves

HYDAC's load-sensing primary control valves offer a modular system with which to design load-compensated, energy efficient load-sensing controls for mechanical, pneumatic, hydraulic and electro-hydraulic controls.

Properties:

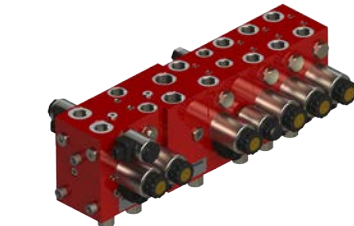
- Structural design as monoblock, multi-section and section construction
- Key data: $Q_{max} \leq 180$ l/min; $p_{max} = 350/420$ bar
- Extra-large 10 mm piston stroke for optimal high-precision control
- Load-independent parallel actuation without reciprocal influencing possible
- Simple integration of primary/secondary safeguards
- Inlet track switching for safe volume flow distribution
- Electrical pump volume current cut-off
- Optional switch position monitoring of the main control spool
- Optional switch-off of individual sections with complete functionality of the remaining sections

Key data for load-sensing primary control valves (see photos on right):

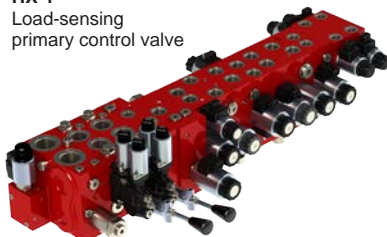
- HX-1 load-sensing primary control valve $\Rightarrow Q_{max} = 120/35$ (prop) l/min; $p_{max} = 250$ bar
- LX-6 load-sensing primary control valve $\Rightarrow Q_{max} = 160$ l/min; $p_{max} = 350$ bar



LX-6
Load-sensing primary control valve



HX-1
Load-sensing primary control valve



LX-6 + HX-1
Primary control valve combination solution

1 HYDAC axial piston pumps are specially designed to suit LS-controlled hydraulic circuits to supply the main functions of a device. With a maximum displacement of 180 cm³/rev and a displacement pressure of 350 bar, they are available in an SAE version and with drive shafts for multiple combinations

2 HYDAC fixed displacement pumps to supply secondary circuits and for pilot pressure supply. In special combination, also suitable for electro-hydraulic fan control. Also available as multiple-pump combination.

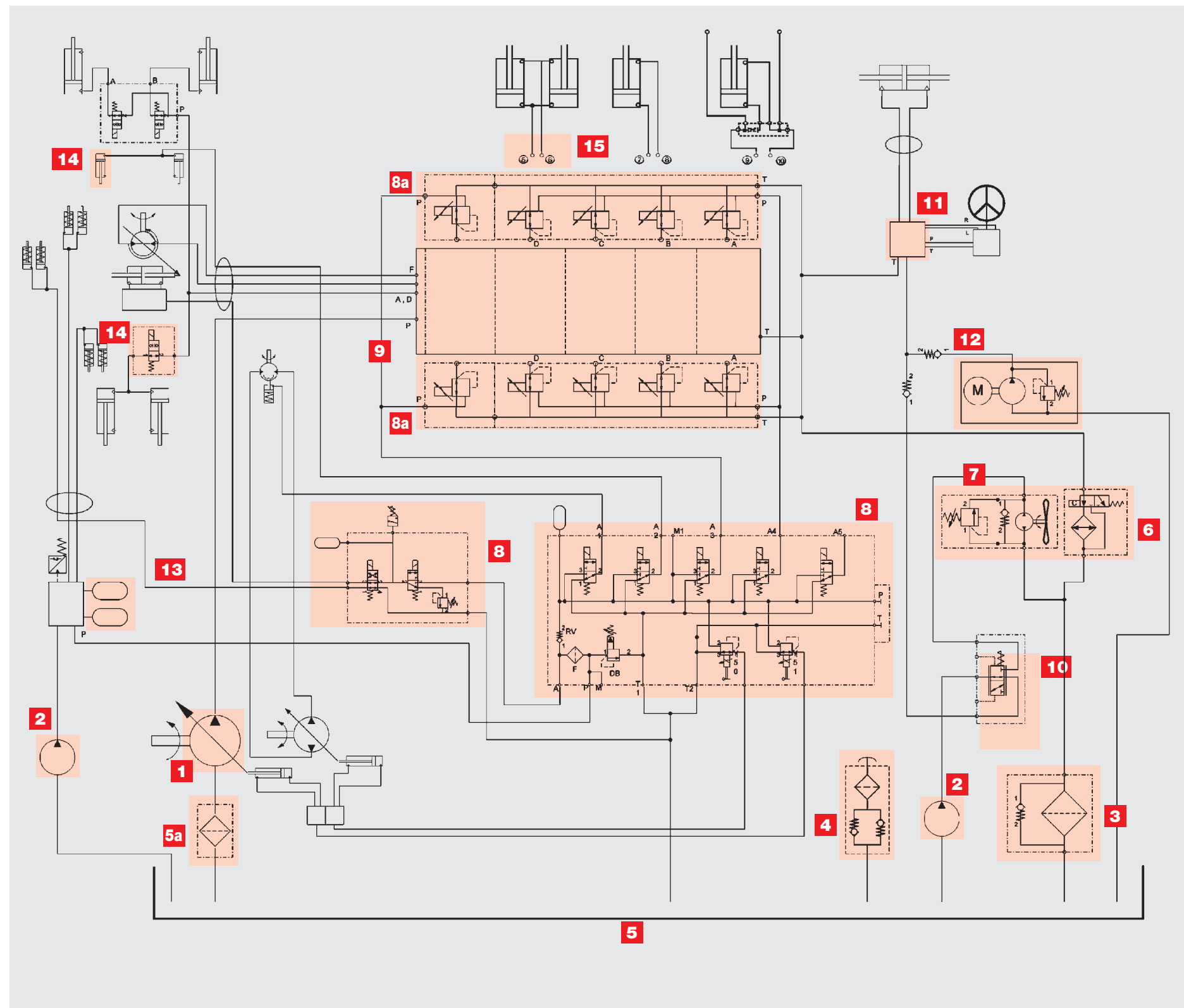
3 The RFM return line filter is perfect for use in mobile machinery with multiple circuits. An upstream thermo-bypass allows warm oil to be channeled directly via the cooler before it reaches the tank via the return line filter. Versions available as inline filter, tank-mounted or tank-integrated filter.

4 The fillers/breathers (ELF/BF) are important components in all hydraulic systems. They ensure that filtered air always reached the tank as the oil level fluctuates. They also prevent oil from escaping unchecked during offroad driving (integral baffle).

5 Accessories specially designed for various tanks, such as fluid level gauges, clamping bands, clamps of various designs and ball valves.

5a Suction line filters specially produced for tank mounting to protect attached hydraulic pumps from course contamination.

6 Mobile cooler combinations (CMS) for demand-driven cooling of all kinds of media circuits (water, oil, charge air, diesel, etc.). Available customised to suit individual requirements and installation conditions, and as extra/retrofit cooler.



7 The fan drives can be realised on the basis of electric and electro-hydraulic controls for the speed control of the fan motor. To prevent any drop in cooler power, reversing can be optionally integrated to change the fan's rotation direction, to "purge" the cooler fins.

8 Pilot control blocks are used to supply hydraulic joysticks and low-pressure applications in the excavators. They can be fitted with a diaphragm accumulator (to safeguard emergency functions) and a pressure filter. In combination with low-pressure valves, additional individual consumers can be controlled, such as safety shutdown, rotating mechanism brake, parking brake and differential lock.

8a To control the large primary valves in mobile excavators, specially designed proportional pressure control valves are being used increasingly often. This eliminates the need for a separate pilot control. We can supply them in various versions as cartridge or compact valves.

9 Our primary control valves offer you a modular system that can be used to design complex control systems. The main control is based on our modular open centre or load-sensing valve systems, with manual, electro-hydraulic or proportional function control. Using special valve sliders allows the number of additional valves to be reduced.

10 Priority valves (MPV) are needed to distribute flow, with one function given priority and the remaining flow made available to other consumers. A typical application for priority supply is CC steering.

11 Our electro-hydraulic steering systems allow you to depict all-wheel steering types, with various steering modes, above all as superimposed steering in mobile excavators and material handling machines.

12 Emergency steering unit (DC1) is an integrated motor-pump assembly that is supplied ready for installation, with a temperature switch to protect it from overload. It mainly provides emergency supply for the steering in mobile machines, as no hydraulic oil supply is available in the event of diesel engine failure.

13 Energy storage blocks are mainly used to safeguard the vehicle system, i.e. the safety functions such as vehicle brake, parking brake or steering. The accumulator charging function, a pressure monitor and the corresponding accumulator are all integrated into them.

14 HYDAC can provide special valves for transmission applications in mobile machines. Typical applications are the actuation of the all-wheel drive, changing gears, changing to crawling speed and differential lock use.

15 The hydropneumatic boom suspension system is used to hydraulically decouple the boom from the upper carriage of the excavator, preventing pitching vibrations from occurring during transport journeys. It can be adjusted to suit any machine and any load conditions. This allows it to significantly increase driving stability, steering performance and overall driving safety.

Focus on energy efficiency

Hydraulic hybrid technology

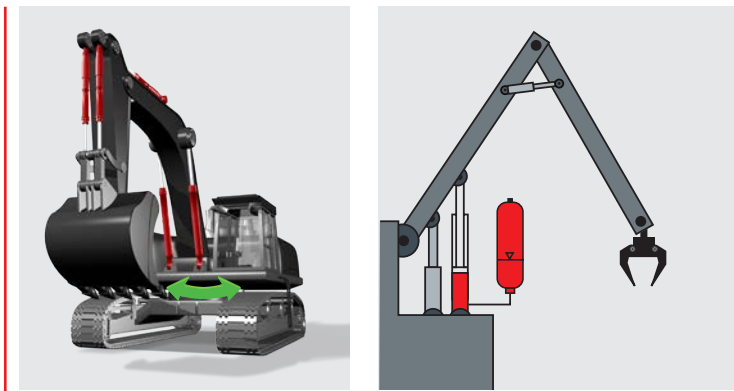
In many construction machines, the typical work cycles involve phases of high dynamics with pronounced load peaks. This makes it possible to save fuel by implementing hybrid systems on the machines.

In excavators, various approaches to hybridisation can be taken, depending on the particular application. For example, the kinetic energy of the rotating upper structure during deceleration can be recovered hydraulically and stored temporarily in a hydraulic accumulator. In load compensation systems, such as those realised with an additional cylinder connected to a hydraulic accumulator, the boom's net weight is eliminated as much as possible, which can also significantly improve the efficiency of the entire machine.

HYDAC offers its customers a wide product portfolio when it comes to hydraulic hybrid technology, providing optimum support even in the initial development steps.

Our comprehensive hydraulic accumulator expertise forms the foundation of successful joint hybrid projects performed in close collaboration with the customer.

HYDAC's range of products includes customised control blocks with optimum valve solutions, safety devices and sensors and hybrid subsystems with their own actuator.



Energy recovery swing drive

Example of load compensation

- Bladder, piston and diaphragm accumulators
- Control blocks
- Valves
- Safety devices
- Sensors
- Control equipment
- Mounting technology



Product portfolio in hydraulic hybrid technology

► See brochure 10.140 – Hydraulic Accumulators in Hybrid Technology

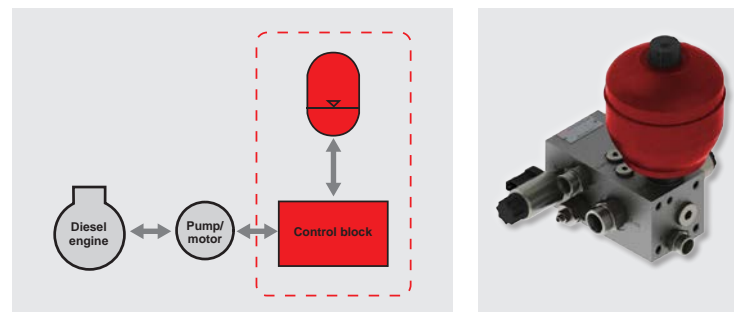
Hydraulic start/stop technology

In cars, electrical start/stop systems have already become established technology. This allows considerable fuel savings to be made. In excavators, automatically switching off the diesel engine when it is idling is a source of major potential savings, depending on the particular application.

Existing hydraulics infrastructure can normally be used to realise start/stop functionalities. For example, work-hydraulics pumps in a modified form can also be used as hydraulic motors.

After an automatic 'idle stop', the diesel engine is restarted by means of the work-hydraulics pump in motor mode for example. The energy required for this is taken from a hydraulic accumulator that was previously charged 'in the background' during normal machine operation.

The hydraulic start/stop solutions generally provide quicker starting processes than electrical systems, which above all improves operator acceptance. HYDAC has extensive experience in hydraulic control blocks and is a specialist in hydraulic accumulator solutions.



The structure of a hydraulic start/stop system

Example of a 'control block + accumulator' solution



Piston accumulator (series SK280)

Diaphragm accumulator

With its extensive product portfolio and in-depth know-how, HYDAC has what it takes to be the perfect development partner for hydraulic start/stop solutions:

- Extensive valve portfolio
- Customised control block solutions
- Optimum hydraulic accumulator solutions
- Robust sensors



Cartridge valves



Pressure sensors

Applications for excavator functions

We offer you different solutions for the various primary and auxiliary functions of your excavator.



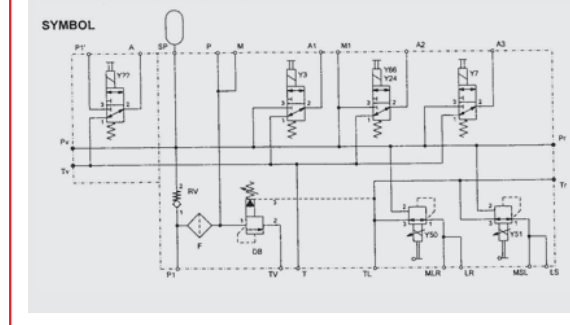
Pilot control blocks/PCM

Used to control the pilot control circuit (low-pressure applications) in excavators and material handling machines. The combination of 3/2 valves, flow regulators, pressure relief valves, etc. allows individual consumers to be actuated, such as:

- Supplying hydr. joystick control
- Safety shutdown of the hydraulic functions
- Changing travel speed
- Rotating mechanism brake
- Locking the pendulum axle
- Control of excavator support
- Parking brake
- etc.

Technical data:

- Q_{max} : 15–23 l/min
- P_{max} : 210 bar



Example circuit diagram



Proportional pilot control

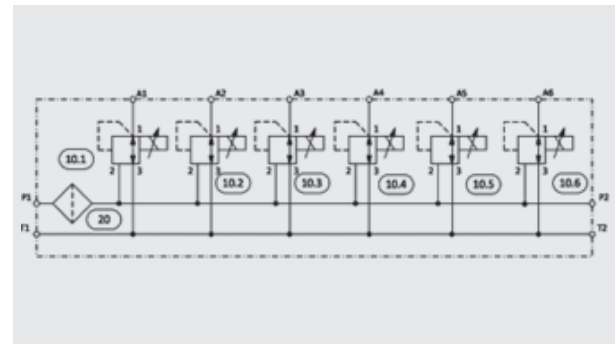
To control the large primary valves in mobile excavators, proportional pressure control valves designed specially for this application are being used increasingly often, eliminating the need for a separate pilot control. Various versions can be provided, as cartridge or compact valves.

Main characteristics:

- Low hysteresis
- High sensitivity
- Low leakage
- High switching reliability
- High dynamic performance for primary control valves

Technical data:

- Operating pressure at port 2 (pump): max. 250 bar
- Reducing pressure at port 1 (pilot circuit): max. 50 bar
- Nominal flow: max. 18 l/min



Example circuit diagram

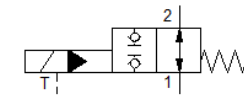
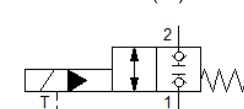


Support control

With our zero-leakage WSM 20121 solenoid poppet valves, we can provide direct control for mobile machine support. The need for a separate pilot control is thus eliminated. They are available in normally open (V) or normally closed (W) versions.

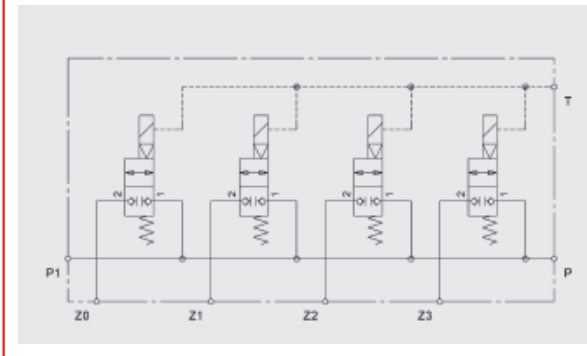


WSM20121V(W)



Technical data:

- Pressure range: 420 bar
- Flow rate: 350 l/min



Example circuit diagram



RSM load-holding valves

The family of type RSM lowering brake shut-off valves is made up of flexible high-performance valves with a greater variance on pilot ratios than previously. The valves are available in the sizes 10, 12 and 16. Using a drilled inner sleeve allows four flow levels to be preset easily. Five different pilot ratios are available – one as load pressure-independent pilot control. Consumer speed control of lowering speed proportional to the upstream flow.

The RSM series which is available in 3 sizes for 60, 120 or 240 l/min offers the following features:

- Load pressures up to 420 bar
- Different pilot ratios
- Zero leakage
- Fine control sleeve for optimising the cylinder movement
- Internal venting, either to atmosphere or separately to tank
- Pressure loss-optimised check function
- Load pressure-independent version
- Hysteresis-optimised version
- Cavity to ISO 7789
- Increased corrosion protection due to ZnNi coating
- Comprehensive range of housings available as accessories

Advantages:

- The fine control sleeve can be used to adapt the valve function precisely to critical applications, specifically by throttling the lowering function.
- In the lift function, despite its compact design, the valve achieves an optimised and therefore energy efficient pressure drop value.
- Sensible size distribution at the same time as a wide range of models ensures the most appropriate valve can be selected for the application

► See brochure 5.933 – RSM



Filter/tank solutions from a single source

The ongoing development of engine technology and the high cost pressure are leading to increasingly complex and small hydraulic tank designs. This results in a dramatic drop in air removal in the tank and thus an increased amount of free air in the hydraulic system. As a result, the hydraulic filter needs to be redesigned to meet the requirements of these new tanks, with the air release capacity and the flow behaviour of the filter/tank system investigated in detail. Our engineers have various simulation options at their disposal for these studies, and they can then research and confirm their findings in our HYDAC FluidCareCenter.

Complete tank systems ready for installation, optimised with reference to component protection, system cleanliness and bleeding, for steel and plastic tanks.

The following components can be integrated:

- Tank filler & breather filters
- Return line filters (integrated or mounted)
- Elements with quality protection
- Suction line filters with pump connection
- Fluid level gauges
- Various line connections
- Tank fastenings
- Integration into offline filtration



Customised plastic tank solution with patented, leak-free connection between tank-mounting filter and tank surface.

► See Brochure 7.020 - Mobile Machinery Update



Combination cooler CMS

Customised solution made up of a combined set of cooling elements that can be arranged either side by side or front to back. With the optional addition of a fan cover, a protective grille and a fan (also available with motor) this cooler package is supplied to the customer ready for installation.

Configured for installation into a compact short swing excavator: the simulation software KULI is used to determine the best possible combination and arrangement of the heat exchangers.

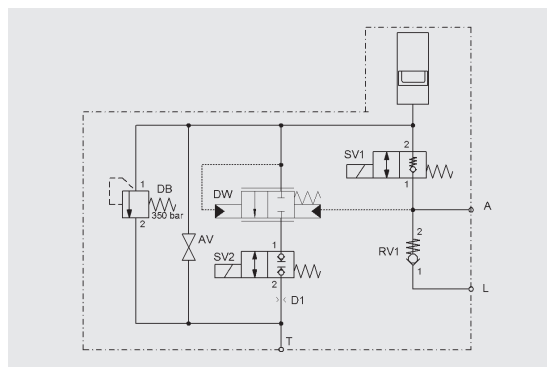
The solution is a combination cooler for three cooling circuits, specially designed to suit the contour of the upper carriage and to ensure optimum cooling capacity even in cramped spaces.



► See brochure 5.812 – Mobile Coolers CMS

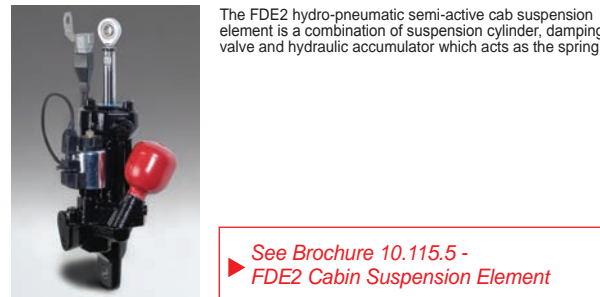
Hydropneumatic boom suspension

The boom suspension is a hydropneumatic suspension system specially for mobile excavators and material handling machines. The "hydraulic decoupling" of the lifting cylinder from the upper carriage significantly reduces the pitching vibrations that the vehicle undergoes. This provides greater driving and steering stability, thus making a crucial contribution to increasing the machine's performance.



Hydro-pneumatic cab suspension

Modern hydropneumatic suspension systems offer a discernible improvement in ride quality. They protect the driver against vibrations and shocks. A hydro-pneumatic cab suspension which is also available with adjustable damping can adapt to various driving situations.



See Brochure 10.115.5 - FDE2 Cabin Suspension Element

Customer benefits:

- ⇒ Minimal vertical acceleration of the cab
- ⇒ Reduced rolling and pitching
- ⇒ Reduction in movement of the drive relative to the instruments and control elements
- ⇒ Increased comfort enabling driver to concentrate better
- ⇒ Protects the driver from shocks and vibrations
- ⇒ Contributes to compliance with Directives on Health and Safety at Work, Noise and Vibration

Electro-hydraulic steering

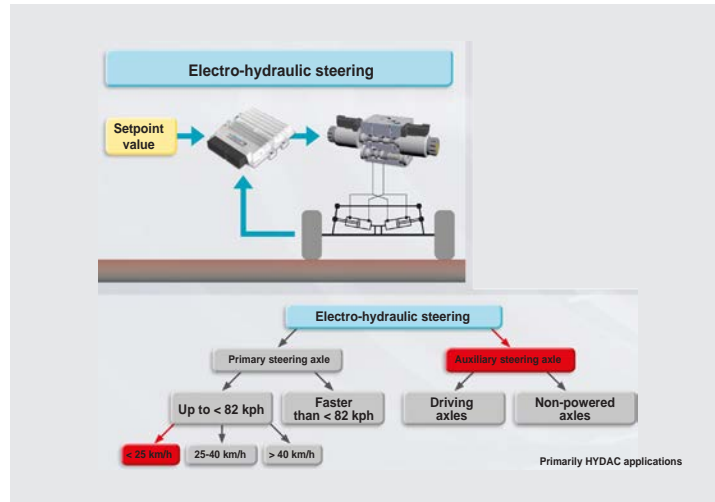
$Q_{max} = 20 \text{ l/min}$
 $P_{max} = 350 \text{ bar}$
Electro-hydraulic steering, e.g. for tandem and tridem axles

Electro-hydraulic steering systems enable various types of steering to be realised in wheel-mounted excavators. Various special types of driving (such as all-wheel and crab steering) are possible in addition to the normal driving varieties. In combination with the hydraulic steering systems of the front axles, electro-hydraulic superimposed steering systems and additional steering systems for the rear axles are possible.

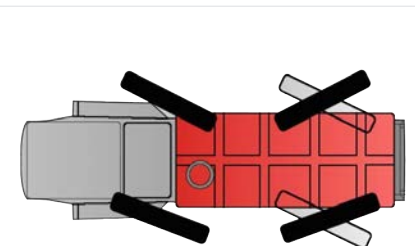
For wheel-mounted material handling machines, we can use our modular steering valves to meet the various steering requirements for auxiliary steering in one or more axles with optional free-wheel or lock-out circuits of the steering cylinder.

The steering valve modules from the EHZ series can be used in mobile excavators. By using different inlet modules, they can be connected to all types of hydraulic system. The proportional valves are specially optimised for use in steering systems. The basic version is intended to be used on a steering axle. Adding a second module makes it suitable for two-axle vehicles. Other modules can be added to disconnect, lock or centre the steering cylinders. Shock valve modules are also available to protect the steering cylinders against external factors.

See brochure 10.116.9 - HY-Steer

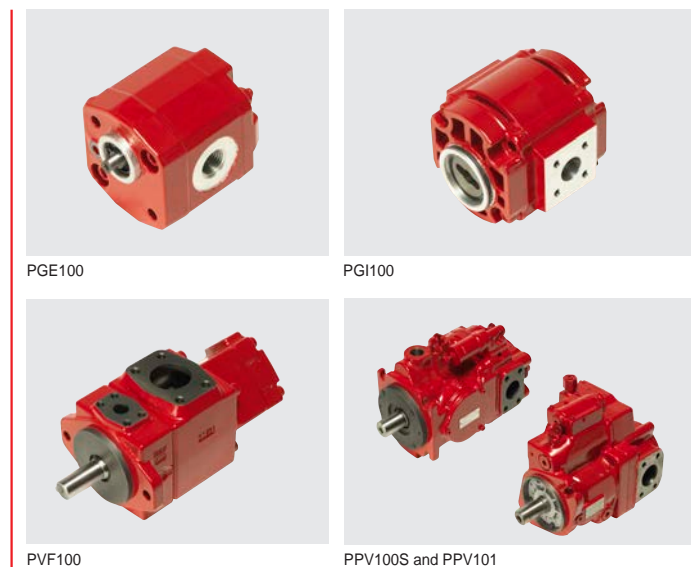


Electro-hydraulic steering systems in modular form



Electro-hydraulic auxiliary steering for all-wheel & crab steering

Hydraulic supply Optimal solutions from the HYDAC technology platform.



Drive technology

HYDAC offers a wide range of pumps for the working hydraulics of lift-lower systems in open hydraulic circuits. The pump range includes fixed and variable displacement pumps of various designs from 0.25 ccm/rev to 560 ccm/rev and pressure ranges of up to 400 bar.

HYDAC fixed displacement pumps for auxiliary circuits and control oil supply:

- **External gear pump PGE**
from 0.25 ccm/rev to 60 ccm/rev, nominal pressure up to 250 bar and peak pressure up to 300 bar. Also available in multiple pump combinations.
- **Internal gear pump PGI**
from 3.8 ccm/rev to 250 ccm/rev, nominal pressure up to 330 bar and peak pressure up to 400 bar. Also available in multiple pump combinations.
- **Vane pump PVF**
from 5.8 ccm/rev - 237 ccm/rev, nominal pressure up to 210 bar. Ideally suited to off-line cooling and filtration circuits. Also available in multiple pump combinations.

HYDAC variable displacement pumps for main functions:

- **Axial piston pump PPV100S**
from 16 ccm/rev to 180 ccm/rev, nominal pressure = 315 bar and peak pressure = 350 bar. High speed reserves, finely graduated flow levels, control range constantly being expanded. Design standard in accordance with DIN ISO 3019-2 and SAE. Also available in multiple pump combinations.
- **Axial piston pump PPV101**
from 45 ccm/rev to 200 ccm/rev, nominal pressure = 320 bar and peak pressure = 350 bar. High speed reserves, versatile controller program. Design standard in accordance with DIN ISO 3019-2 and SAE. Also available in multiple pump combinations.

See product catalogue 2.900 - Pump Specifications



Bladder, piston and diaphragm accumulators for mobile applications

Accumulators

HYDAC offers an exceptionally wide product portfolio of accumulators and dampers for a very wide array of hydraulic applications involving mobile machines. This enhances the working comfort and functionality of the machines and thus minimises stress for both humans and machines. Typical accumulator tasks and benefits resulting from them include:

- Power supply for emergency functions
→ increase in performance with comparatively equal technical conditions
- Pulsation damping in the hydraulic system
→ longer service life for attached parts, as vibrations minimised
- Energy storage to safeguard the vehicle system and to compensate for leakages
→ vehicle braking systems, rotating mechanism brake, parking brake, etc.
- Emergency and safety tasks in the pilot circuit
→ Increase in functionality
- Use in hydropneumatic suspensions
→ increased driving stability and operator health

Advantages:

Our accumulator specialists have decades of experience in the development and design of all types of accumulator construction at their disposal. This means that they are in a position to select the type of accumulator construction that suits the application out of the comprehensive product range and to lay it out in accordance with operating conditions. The correct accumulator is still the best support for an application and HYDAC accumulators can be used world-wide with country-specific acceptances.

See product catalogue 30.000 - Accumulator Technology



Fuel pump for diesel fuel

Fuel pumps

- Fuel pump for diesel or hydraulic oil
- Flow rate
- Diesel: up to 80 l/min
- Mineral oil: up to 15 l/min
- Installation position optional

HYDAC fuel pumps are compact units with direct current drive for quick and simple tank-to-tank transfer of diesel fuel or hydraulic oil.

Advantages:

- Filling the fuel tank is possible on the vehicle independent of a stationary tanking system.
- Self-priming up to 2.5 m in height; no initial filling prior to commissioning required
- Compact design; saves on both space and weight
- DC motor with protection rating IP65
- Good efficiency, low current consumption
- Suitable for dry running; Safe also for short run periods without fuel
- Optionally with non-return valve, leak-tight

See Brochure 7.125 - Diesel PreCare



Diesel PreCare filter

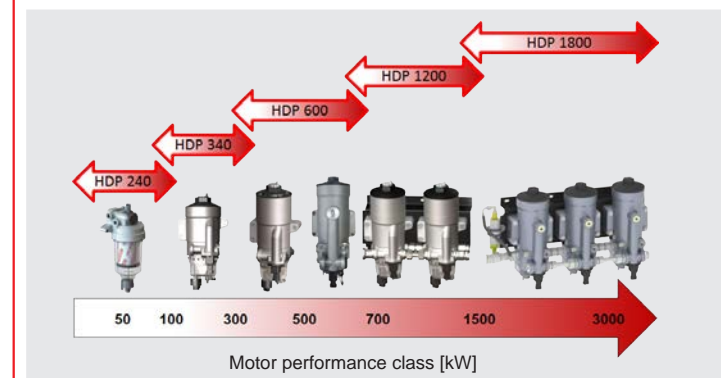
Diesel filtration

- Suction-side pre-filter and water trap
- Manual or automatic water discharge
- Option: water sensor, fuel pre-heater, manual/electrical filling/booster pump
- Variants for diesel engines up to > 3000 kW

Guarantees the fuel purity required of modern common rail diesel engines to meet the requirements of the exhaust emissions standards Euro6 and Tier4, and component protection of the fuel system through the use of the latest, fully synthetic filter media and continuously reliable water separation. Reduction of the Life Cycle Cost (LCC) by extending the service life and service intervals.

Advantages:

- Protection of all of the components of the fuel system, e.g.: suction pump, common rail injection pump, diesel injectors, by:
- Excellent water removal
- Maximum contamination retention capacity
- Very long service life
- Very low pressure drop



See Brochure 7.125 - Diesel PreCare



Filtration

Our broad filter range offers inline filters (LF, MDF, DF) with various pressure ratings and materials in addition to filter/breathers (ELF) for the hydraulic tanks. We also have a broad range of in-tank return line filters (RF) and return line & suction boost filters (RKM). Specially designed in-tank return elements (RMTR) offer good distribution of oil flow in the tank, highly effective air separation and thus a reduction in the size of the hydraulic tank.

The filters can also be used in explosion-hazard areas (ATEX).

Advantages

- High level of operating safety thanks to first class filtration
- Protection of system components
- Element is easy to change and filter housing is easy to install
- Low operating costs thanks to low pressure drops across the filter and filter element
- Improvement in operating safety through the use of filter clogging indicators
- Brand labelling to protect the spare parts business
- Tank/filter complete systems, optimised for component protection, system cleanliness and bleeding
- Ultra-modern laboratory and test rig technology

Hydraulic Load Cycle Test (HCLT)

- Filter performance data measured in accordance with practical flow conditions (dynamic flow) rather than static multi-pass test to DIN 16889.
- The practical flow rate can, for example, be measured at the excavator and then simulated on a 1:1 basis on the test bench.

See product catalogue 70.000 - Fluid Filters see brochure 10.777 - Filtration and Fluid Care

Tank and filtration systems

A comprehensive range of hydraulic and breather filters, fitted with high-quality filter element material ensures high operational safety and extended maintenance intervals, e.g.:

Return line / return line suction filtration

Using RFM and RKM filters (with optional thermal bypass valve built into head). Tank-mounted or tank-integrated filters

Supply circuit filtration

using inline filters LPF

Pressure oil filtration

using inline filters MFM, HFM, DF

Gear oil filtration

Suction line filters for gear oil and hydraulic oil

Removal of coarse contamination

using inline filter ILF

Air filtration

using breather filters BF, ELF, ELFL, BDE. Extensive standard product range, optionally with duo-valve for tank pressurising, anti-sloshing protection possible, version with air drying air filter systems for motors

Filter clogging indicators (VA)

to improve safety of operation and possibly display maintenance intervals

Brand labelling to protect the spare parts business

Marking of the filter elements to improve product identification and to secure spare parts demand.

Tank/filter solutions from a single source

Ready-to-install complete systems, optimised for component protection, system cleanliness and bleeding

Filtration solution for Ad-Blue and SCR cooling

See product catalogue 70.000 - Fluid Filters see brochure 10.777 - Filtration and Fluid Care

Cooling

Hydraulic oil cooling

- Oil/air cooler with DC or hydraulic motor
- Electro-hydraulic fan controls

Air coolers with DC motors (OK-ELD) or hydraulic motors (OK-ELK) are used to cool hydraulic oil. They have been specially designed for mobile applications where high performance and easy installation in confined spaces are required.

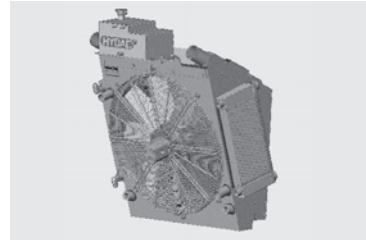
Properties:

- ⇒ Robust aluminium plate construction
- ⇒ High performance air fin with very good anti-contamination properties
- ⇒ Low-noise fan

The efficiency of a cooler also depends greatly on the fan control. In general, fan drives are divided into three different drive concepts:

- ⇒ Direct fan drive
- ⇒ Electric fan drive
- ⇒ Hydraulic fan drive

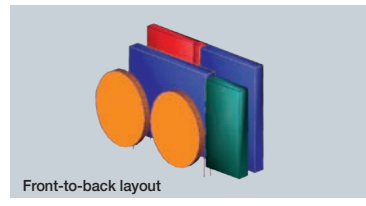
HYDAC offers the latter two designs. They regulate the speed of the fan depending on the temperature of the medium. As an option, these controls can also be supplied with a reversing function, to "purge" the cooler of dirt (e.g. dust and debris).



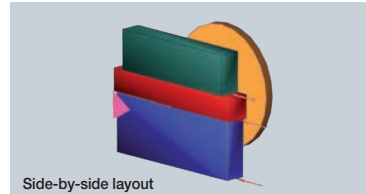
CMS oil/air cooler – hydraulic drive motor



CMS oil/air cooler with fine filter grille, folding design, for easy, tool-free cleaning



Front-to-back layout



Individual cooler requirements for combination cooler systems – oil, water and charge air cooling

Combination coolers

- CMS combination coolers for hydraulic oil, transmission oil, charge air, coolant, diesel fuel

The following cooling circuits can be combined together in various ways in a CMS mobile cooler:

- ⇒ Charge air cooling (CAC)
- ⇒ Coolant cooling (RAD)
- ⇒ Oil circuits: transmission, hydraulics, fan drive
- ⇒ Fuel cooling

If required, an air conditioning condenser can also be integrated into the cooling system. With the aid of our cooling calculation software (KULI), and on the basis of available data, it is simple to adjust for pressure losses and heating of the cooling air which will also occur as a result of installing a condenser.

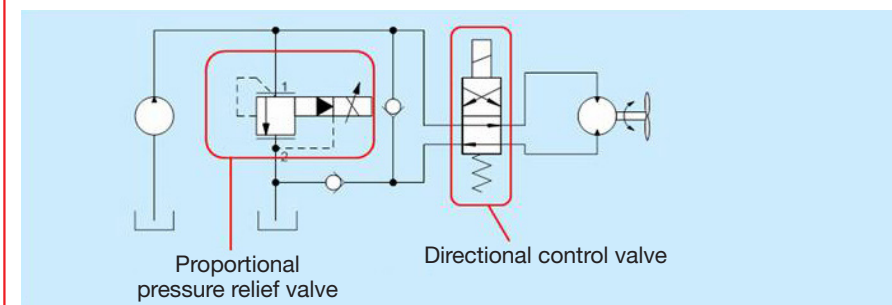
▶ See product catalogue 57.000 – Cooling Systems
See brochure 5.812 – CMS Mobile Coolers

Fan control components and control blocks

Hydraulic and electro-hydraulic controls for regulating fan motor speed with optional reversal of rotation direction for use with various types of pumps.

Valves specially developed for the application:

- Directional control valves
- Non-return anti-cavitation valves
- Manually adjustable pressure relief valves
- Inversely proportional pressure relief valves



Example of fan control application

▶ See Brochure 5.315 - A Breath of Fresh Air in Electro-Hydraulic Cooling Control

Additional solutions Perfectly tailored to the HYDAC Technology Platform.

Cab-air filter for very fine and nano dust: CabinAirCare.

Construction machines must not be used in contaminated areas unless the driver's cab is equipped with filtration and/or compressed air systems to ensure an air supply of sufficient breathing quality.

For tasks such as landfill sealing or encapsulation or land rehabilitation, a CabinAirCare module can be retrofitted to existing vehicles to provide optimum protection for the driver without having to make drastic changes to the existing air-conditioning system or the cab.

For a healthy environment that promotes performance, HYDAC Filter Technology already offers highly effective air filtration systems that can be equipped or retrofitted.

▶ See Brochure 7.010.1 - CACR CabinAirCare

Customer benefits:

- ⇒ Easy to install and expand (on existing air conditioning or filter systems)
- ⇒ Sufficient system reserve (fan power, media sizing) for common cabin sizes in construction and agriculture
- ⇒ Robust and simple construction
- ⇒ Filters airborne pollutants, including nano-particles and gases



Fine dust filter



HEPA filter



Active carbon filter

Accessories for every sector

For the completion of hydraulic systems

- Standard fittings and ball valves (high pressure)
- Mounting clamps for hydraulic hoses and pipes, cylinders, electrical cables and accumulators
- Tamper-proof inductive proximity switch (high pressure resistance)
- Fluid level sensors
- Temperature switch TSE
- Standard clamp 3015 Air/water reservoir clamping bands
- "Test point" connections
- Quick-release couplings
- Special clamps for particle filters

Customer benefits:

HYDAC Accessories is your expert for modifications and special solutions at all times, and especially when custom jobs are required because standard parts are unsuitable. HYDAC's in-house engineering, coupled with our multidisciplinary approach and worldwide know-how, guarantees state-of-the-art technology and rapid development times.

HYDAC Accessories provide the final perfect touch to your machine with a broad range of standard and special components, also available in stainless steel.

▶ See product catalogue 61.000 – Accessories



Ball valves

Cylinder systems

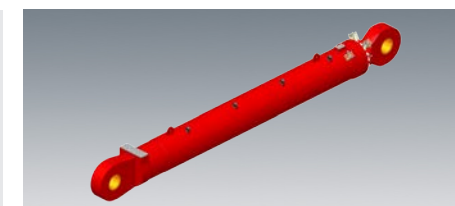
Our cylinder systems are notable for their versatility and extreme compactness. We offer cylinder drives with integrated valve technology and guarantee optimal operation of your machine, even with increased operational loads:

- Special mobile cylinders for large excavators and mining excavators, with integrated distance measurement system and special coating for the forged piston rod
- Special suspension cylinders and chain-tensioning units
- Outrigger cylinders with relief
- Mast inclination and kinematics cylinders
- Locking and clamping cylinders

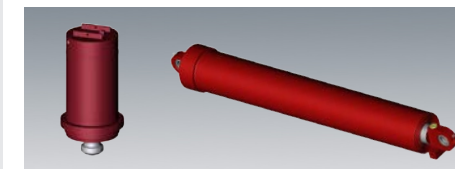
The cylinders can also be weight-optimised and they can be supplied with an integrated distance measurement system.

Customer benefits:

Our own Service Center offers you a comprehensive customer service. We support you with the design, assembly, maintenance and commissioning of your system. We begin working closely with the customer right from the development stage. Because of our knowledge, we can achieve the best cylinder solution for your product, e.g. by using special surface coatings for the piston rod. FE simulations or fatigue strength calculations also come under our Engineering Standard.



Boom cylinder with integrated position sensor system



Outrigger cylinder

▶ See brochure HS-D 10.102 – Cylinders and Cylinder Systems for Mobile Hydraulics

Fluid conditioning systems

To provide flexible servicing on machines, there are convenient mobile units for removing solid particles

- Portable filtration units
- Mobile filtration units
- Built-in filtration units (offline)

Customer benefits:

- ⇒ Clean filling and flushing
- ⇒ Versatile design – can be used on a variety of systems
- ⇒ Relief for the in-line filter
- ⇒ Greater system availability
- ⇒ Reduction in Life Cycle Cost



Mobile filtration systems

▶ See product catalogue 79.000 – Filter Systems

FluidCareCenter

We get involved in the process early on. With our clean room in the FluidCareCenter, we promise you exceptional cleanliness, from the component to the system: Technical Cleanliness is becoming ever more important in mobile hydraulics. Phrases such as "reduction and prevention of production-stage breakdowns" and the difficulty of longer warranty periods are driving up the demands for component cleanliness.

Customer benefits:

- ⇒ By understanding the relevant cleanliness data of your components, you will be a step ahead of your competitors.
- ⇒ A laboratory approved and recommended by well-known automotive suppliers
- ⇒ Many years' experience in the area of technical cleanliness owing to active collaboration on VDA Volume 19 and ISO 16232
- ⇒ Analysis with the help of extraction units developed at HYDAC
- ⇒ High-quality analysis equipment
- ⇒ Ongoing continual development of equipment and processes to meet the increasing requirements and needs of customers



FluidCareCenter

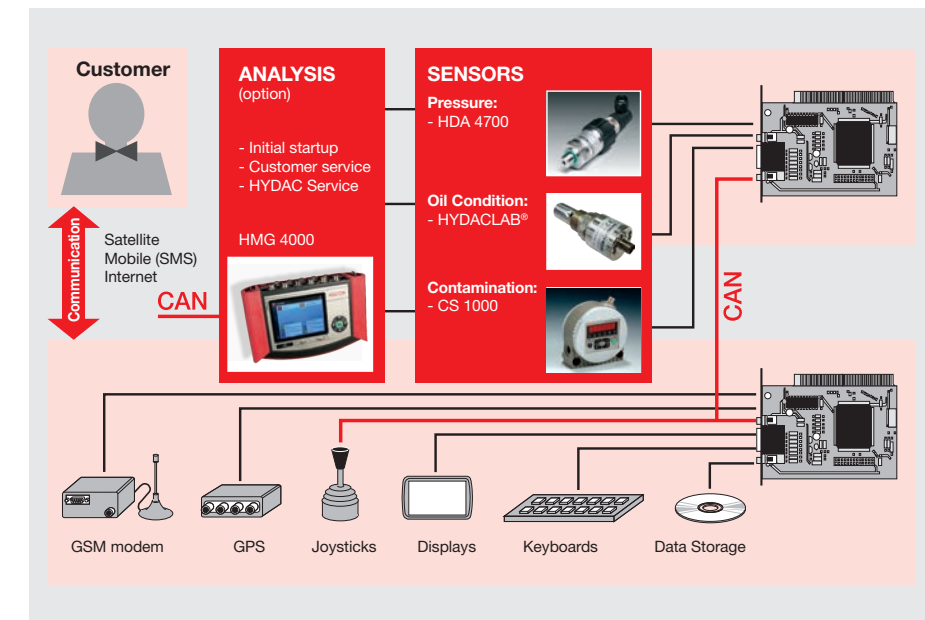
▶ See brochure 7.128 – FluidCareCenter

Condition monitoring and service

Constantly growing demands for operational availability, reduction in downtime, detailed load and service management (economic viability, wear, service, warranty) require innovative and comprehensive monitoring, service and control concepts. A variety of sensors provides the ideal basis for the development of such integrated system solutions.

- Oil condition, e.g. time deterioration or presence of contaminating fluids can be determined via the saturation level, temperature, change in electrical conductivity, change in dielectric constant (HYDACLAB®)
- Saturation level (AS)
- Particle contamination (CS)
- Pressure (HDA)
- Flow rate (EVS)
- Fluid level (ENS, HNT)

In combination with portable measuring instruments (HMG series), this data can be recorded and analysed to supplement the machine electronics (service).



▶ See brochure 10.122 – Condition Monitoring for Efficient Life Cycle Cost Management
see brochure 18.000 – Measurement Equipment for Hydraulics and Pneumatics