HYDAC INTERNATIONAL

System Solutions for Sprayers

E 10.121.1/02.15

Your partner for expert system solutions for trailed and self-propelled sprayers

System Overview

System Intelligence

Spraying System Overview

Spraying System in Detail

Suspension & Steering

Comfort & Safety

Additional Solutions

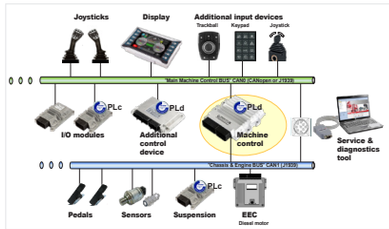
System Intelligence

Hardware

- Electro-hydraulic control technology

Software & Service

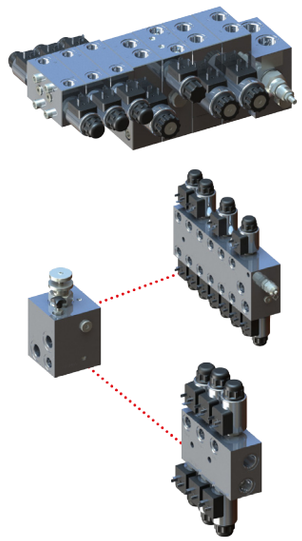
- Software development
- "MATCH" development environment
- Software development
- Software library
- System development support



Spraying System Overview

Boom

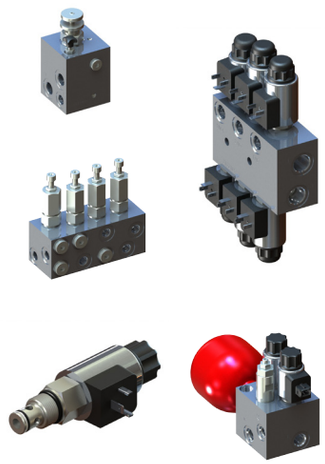
- Central control system
- Decentralised control system



Spraying System in Detail

Boom

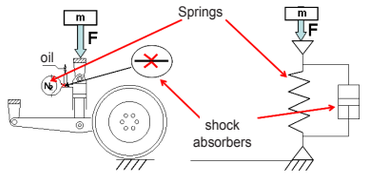
- Inlet blocks
- Extending & retracting
- Slope and distance control
- Height adjustment
- Valves for rinsing water, agitator, and spray pumps
- Suspension



Suspension & Steering

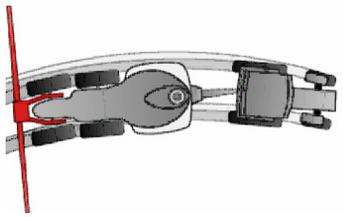
Suspension

- **Axle and drawbar suspension**
  - Hydro-pneumatic axle suspension
  - Hydro-pneumatic drawbar suspension



Steering

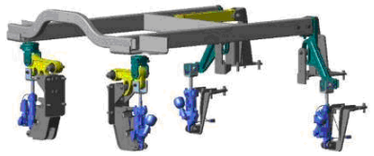
- Electro-hydraulic primary and auxiliary steering systems
- Modular steering valve unit



Comfort & Safety

System Solutions

- Hydro-pneumatic cabin suspension
- Cabin air filter for very fine and nano dust: CabinAirCare
- Cabin air testing station



Additional Solutions

Accessories

Cooling

- Hydraulic oil cooling
- Combination coolers
- Fan control components and control blocks

Storage & Filtration

- Plastic tanks
- Filters

Solutions for various sprayer types ...

... are based on the special needs of each spraying system.

On-board sprayers

- Quick and easy attachment
- Light and stable system design
- Narrow transport width

Trailed sprayers

- Stable ride
- Easy and comfortable handling
- Quick set-up time
- Simple and robust technology

Self-propelled sprayers

- Compact design
- Generous ground clearance
- Convenient handling
- High speed
- Clean working and environmental conditions in cabin

Energy efficient, safe, convenient.

Challenges in modern sprayers

The purpose of modern sprayers is to increase agricultural yield efficiently while conserving resources. The focus is on larger working widths, a continuous supply of pressure to ensure constant flow of spray fluid as well as delivering the exact amount of spray required. However, legal and social factors such as safety regulations, emission guidelines, as well as comfort and health & safety requirements also determine the technology and appearance of today's machinery.

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 sprayer applications. HYDAC will also work with you to develop an individual solution for your machine.

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

Sensitive control moves sprayer boom into optimal operating position.

Nozzle-to-ground distance is maintained through the use of fast-acting proportional valves in the distance control.

- **Increases in:**
  - ⇨ Travel speed ("speed spraying")
  - ⇨ Corrosion resistance owing to surface coating and special materials
- **Reductions in:**
  Material stress thanks to boom suspension and damping
  - ⇨ Time and effort on piping and installation through combined hydraulic function units
  - ⇨ Mechanical stress due to axle and drawbar suspension
  - ⇨ Noise emissions and power consumption by regulating fan speeds
  - ⇨ Driver vibration load due to hydro-pneumatic cabin suspension
  - ⇨ Driver's exposure to aerosols due to cabin ventilation systems
  - ⇨ Hydraulic oil tank sizes by simulating and optimizing air separation in hydraulic oil
  - ⇨ Installation space, component weight and electrical power requirement by reducing solenoid valve sizes
- **Extension of:**
  - ⇨ Maintenance intervals by monitoring hydraulic oil quality
- **Reduction in:**
  - ⇨ Software development time through the use of tested and certified software libraries

Your benefits

- **Energy efficiency**
  - ⇨ Reduced fuel consumption
  - ⇨ Lower hydraulic losses
  - ⇨ Energy saving
  - ⇨ Precise cooling requirement temperature control
  - ⇨ Reduced electrica power requirement

- **Safety**
  - ⇨ Certified software modules
  - ⇨ Service life increased by protecting materials

- **Noise reduction**
  - ⇨ Lower noise level in partial-load range of fan control

- **Health & safety**
  - ⇨ Reduced vibrations
  - ⇨ Reduced aerosol exposure

- **Installation space reduction**
  - ⇨ 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 driver
  - ⇨ Sustained driver performance on longer jobs

- **NOx**
  - ⇨ Compliance with the Emissions Directive
  - ⇨ Reduced nitrogen oxide and CO_2 emissions

System Intelligence

Electro-hydraulic system solutions provide the interface between actuators and sensors.

System Intelligence

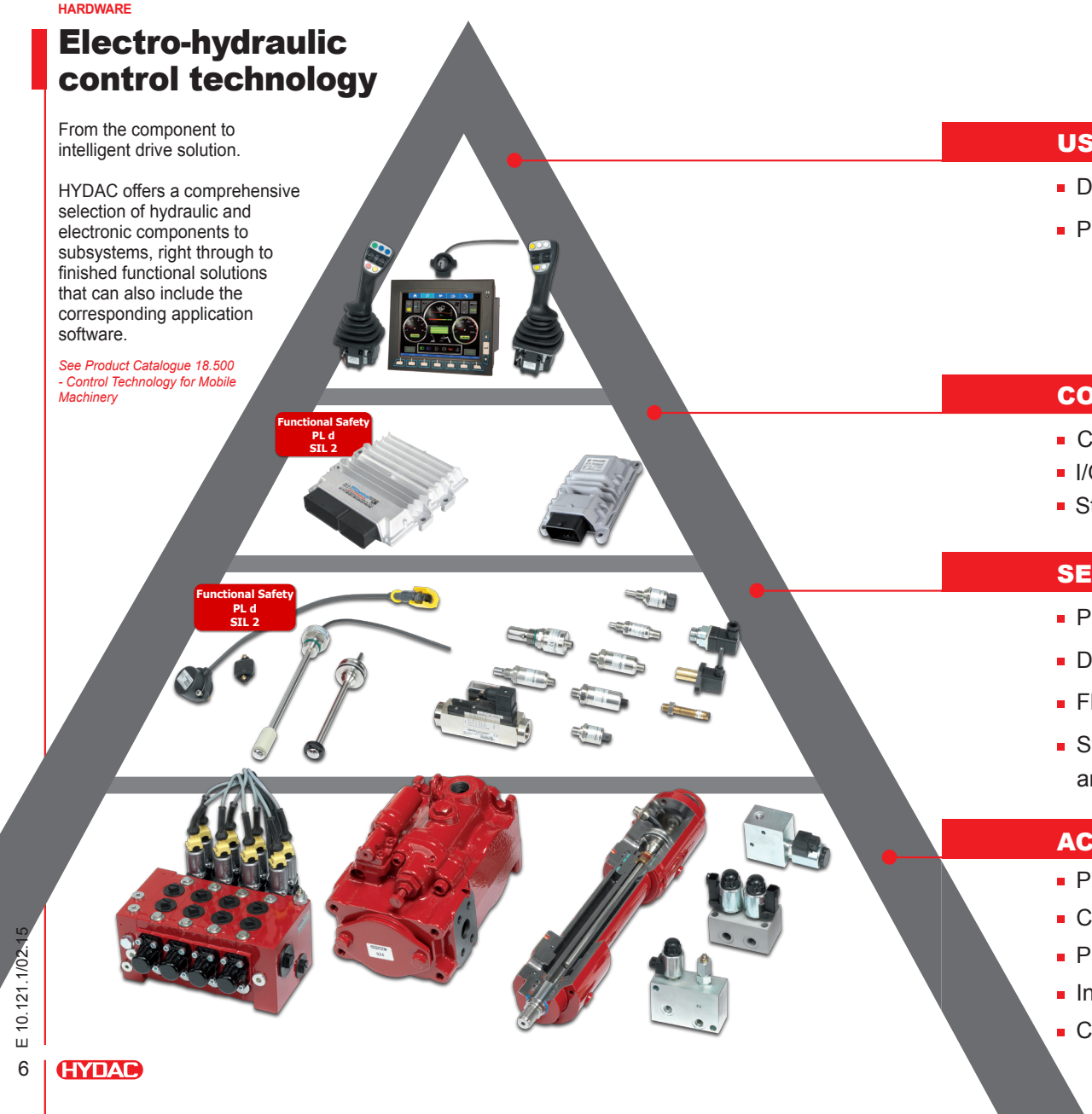
HARDWARE

Electro-hydraulic control technology

From the component to intelligent drive solution.

HYDAC offers a comprehensive selection of hydraulic and electronic components to subsystems, right through to finished functional solutions that can also include the corresponding application software.

See Product Catalogue 18.500 - Control Technology for Mobile Machinery



USER LEVEL

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

CONTROL LEVEL

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

SENSOR LEVEL

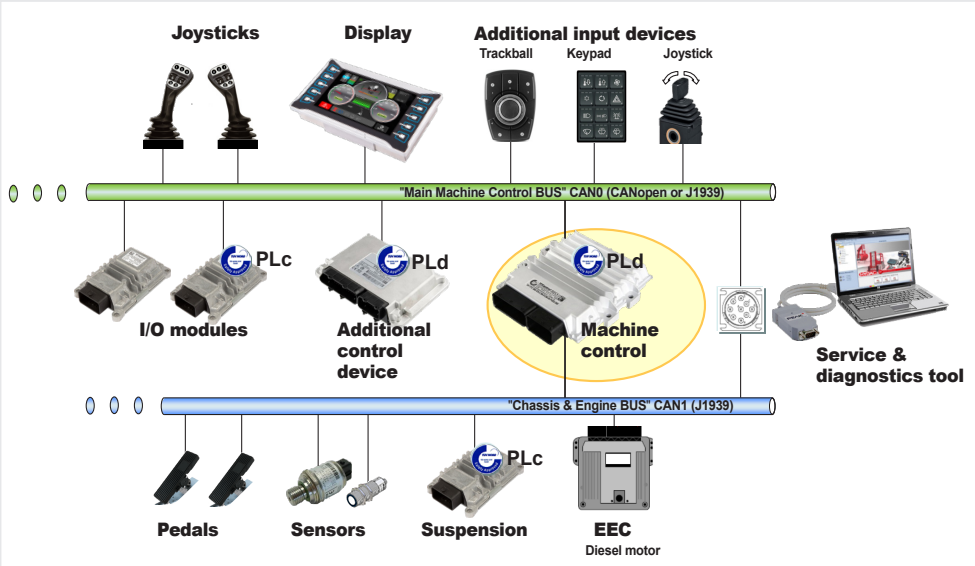
- Pressure, temperature, and level
- Distance, position, angle, inclination, and speed
- Flow and oil level
- Standard version and versions with diagnostics and increased functional safety available

ACTUATOR LEVEL

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

SOFTWARE & SERVICE

System development



Example of control architecture

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

Services include:

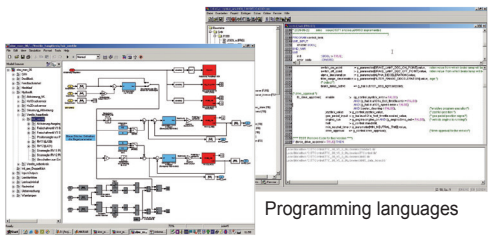
- Writing customer-specific application software (according to specification)
- Integrating intelligent subsystems into the customer's machine (e.g., suspension systems, auxiliary steering systems, fan controls)
- Complete control solutions for mobile machinery (safety functions, electrical/electronic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

SOFTWARE & SERVICE

Software development

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

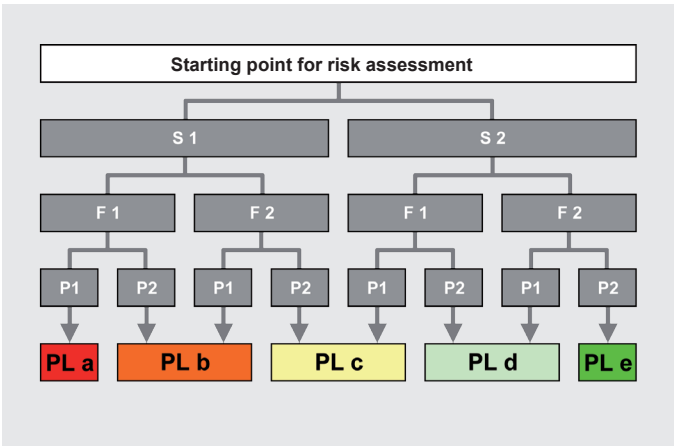
- CoDeSys 2.3, 3.5, 3.5 SIL2
- C
- MATLAB/SIMULINK



Programming languages

SOFTWARE & SERVICE

System development support



Severity of injury

- **S1** Minor, temporary injury
- **S2** Severe, permanent injury incl. death

Frequency/duration of exposure to hazard

- **F1** Rare or brief exposure
- **F2** Frequent to continuous exposure

Possibility of avoiding hazard or limiting damage

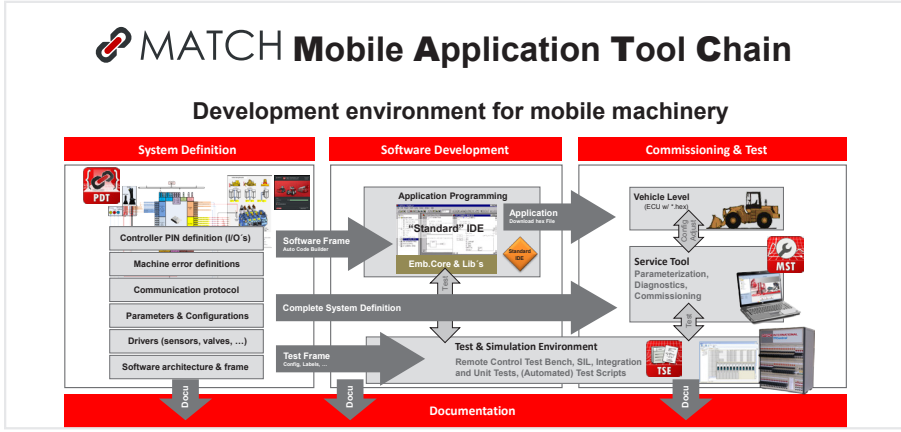
- **P1** Possible under certain circumstances
- **P2** Practically impossible

HYDAC offers extensive consultation and support during customer projects in relation to:

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

SOFTWARE & SERVICE

"MATCH" development environment



Mobile Application Tool Chain

With the "MATCH" (**M**obile **A**pplication **T**ool **C**hain) 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, to creating the application software, to start-up, testing, and documentation.

"MATCH" offers building blocks for:

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

In addition, "embedded middleware" is also offered which allows the application to be programmed regardless of hardware and contains a number of basic functions. A comprehensive selection of library modules (e.g. for sensor and valve drivers) is also available to enable the application software to be developed efficiently.

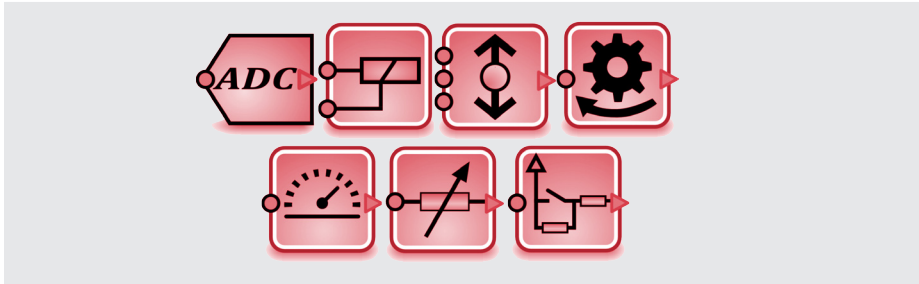
Functional safety

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

- "SIL 2" as per IEC 61508
- "PL d" as per EN ISO 13849
- "AgPL d" as per ISO 25119 or EN 16590

SOFTWARE & SERVICE

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 blocks can also be used to detect system errors.

See Product Catalogue 10.133 - Control Technology for Mobile Machinery

Spraying System Overview

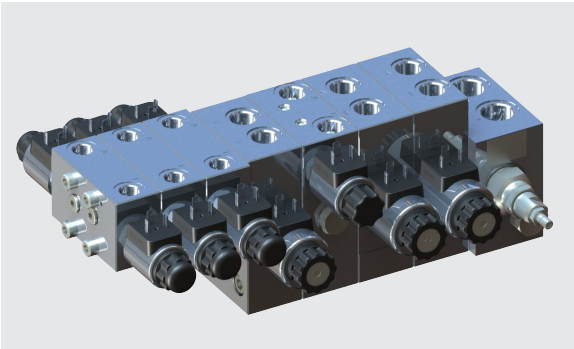
Individual spraying systems. Individual solutions.

Spraying System Overview

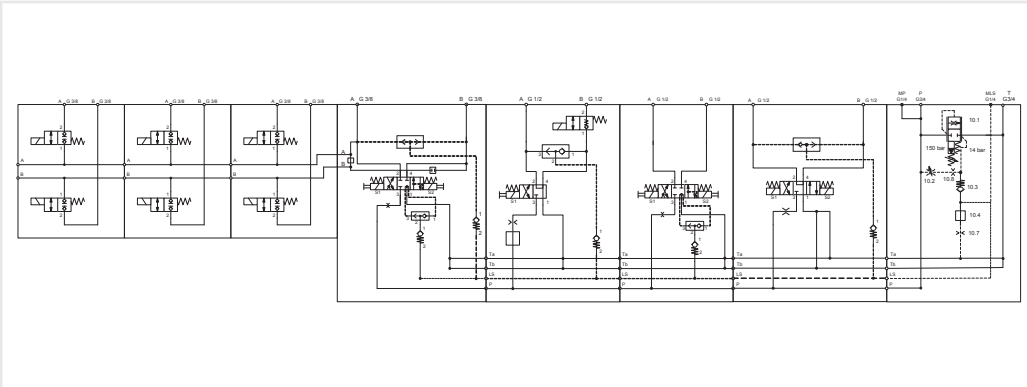
BOOM

Central control system

The HX1 modular manifold system contains all hydraulic control functions used in a sprayer. It can be used to prioritise steering actuation.



Modular control block



Sample circuit diagram

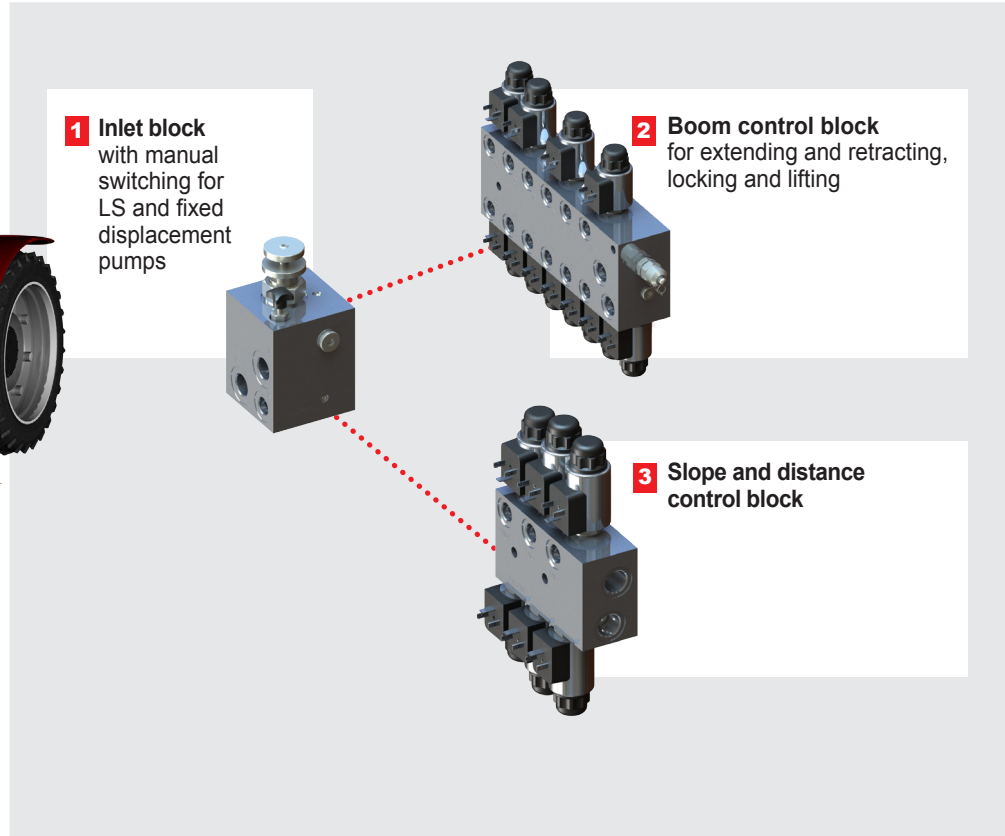
Connection options: load sensing (LS) and/or fixed displacement pump systems.
The example shows a modular system consisting of inlet plate and double/single acting function modules.
The modules can also be equipped with proportional valves as desired.
The system can be expanded and fits all machines.

See Brochure 5.256 - The Modular Manifold System for Mobile Machinery

BOOM

Decentralised control system

Each standardised function is built into separate control blocks and installed in the machine in various positions. Unlike a central control system, all control functions are located directly on the various consumers in the machine.

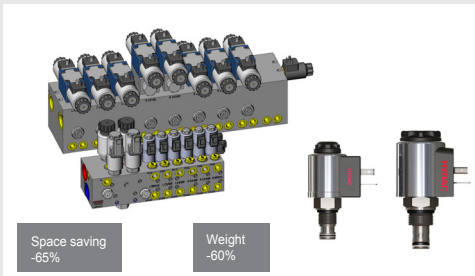


General

Mini-valve technology

- By using our NG6 mini-valve series, installation size can be reduced and installation space optimally utilised
- High corrosion resistance thanks to a zinc/nickel coating on the valves (720 hrs salt spray test) and special paint on the control block

See Catalogue 53.000 - Fluid Technology



Space saving mini-valve technology

Solenoid coils

- Maximum force with minimum space required
- Fully encapsulated coil - internal coil seal prevents moisture from penetrating, preventing short circuits in the winding
- Designed for 100 % duty
- Low energy consumption (18 W) due to optimal power/energy ratio
- High thermal load capacity - insulation material class H (180 °C, VDE 0580)
- Five different types of electrical connection as standard - with protection rating IP65, IP 67 (DIN/EN, Junior Timer, Kostal, flying leads) and IP6K9K (Deutsch plug)

See Brochure 5.215 - Solenoid Coils for Proportional Valves

Solenoid valves with various valve connector types

Spraying System in Detail

Modular system for tailored solutions.

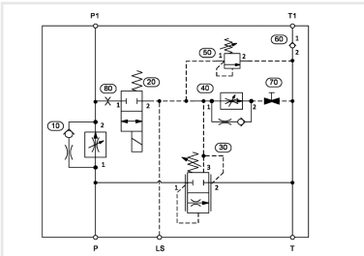
Spraying System in Detail

BOOM

Inlet blocks 1

Customised solutions with switching options for use on load sensing and fixed displacement pump systems are possible for self-propelled and trailed sprayers. In the basic version, switching can be done manually in various modes with or without tools. A version with an electric switching valve (bypass valve) is available for constant pressure functions. The inlet module comes with a maximum pressure limiting block. A pressure filter can also be integrated. LS discharge can be variably configured for adapting to a wide range of tractor types. An LS boost valve is also available.

Inlet module

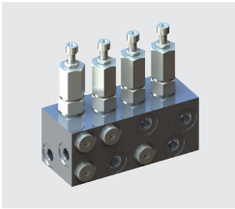


Sample circuit diagram

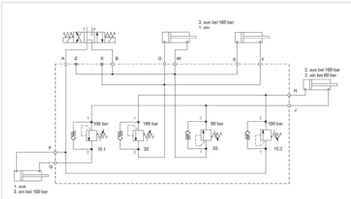
BOOM

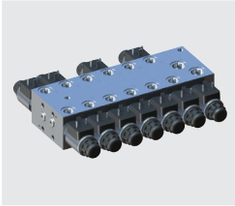
Extending & retracting 2

Whether retracting inward or to the side, we can offer various solutions for hydraulically retracting the sprayer boom to suit your needs. From the hydraulic pressure sequencing manifold for smaller working widths to the deluxe version with solenoid valves that also allow for partial retraction. A meter-out flow control or counterbalance valve can be added to the modules for advancing loads.

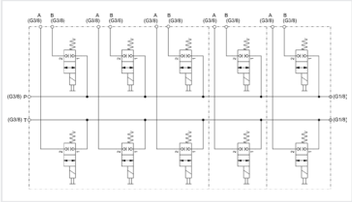


Pressure sequencing manifold





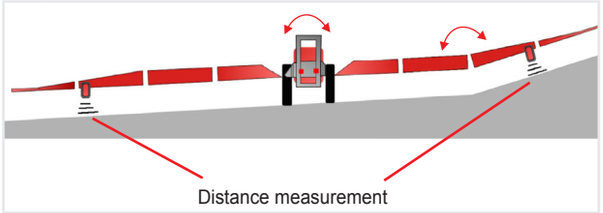
Deluxe version with solenoid valves

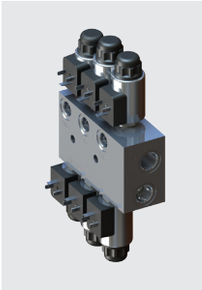


BOOM

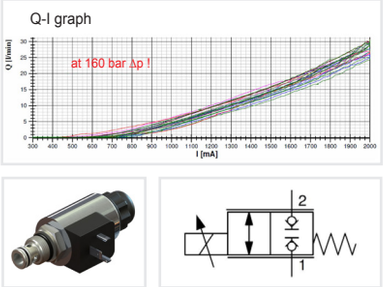
Slope and distance control 3

Optional active tracking systems are available to maintain consistent distance between the sprayer boom and the crop, even on slopes and uneven terrain. The distance is measured and readjusted as necessary by actuating solenoid valves. This places great demands on the valve technology. The PWSM 06020 W proportional poppet valve has been specially developed for this application. Given the standardised installation space, an on/off valve can also be used. The suitably adapted characteristic curve allows for sensitive angling and quick adjustment.





Slope and distance control block



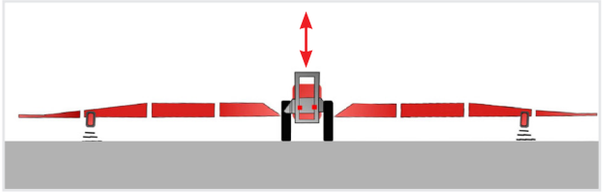
PWSM 06020 W proportional valve characteristic curve and symbol

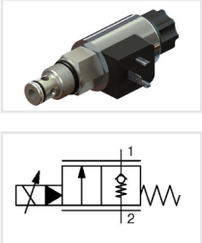
BOOM

Height adjustment

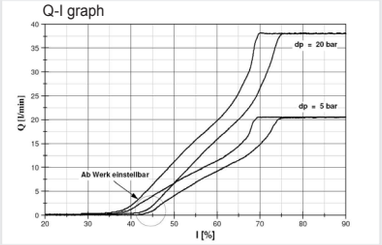
By adjusting the height of the sprayer boom precisely over the crop, the spray can be optimally distributed and unwanted drift is prevented. The PWS08Z, PWS10Z and PWS16Z series of proportional valves specially developed for use in lift applications allows for fine tuning in the control range and rapid lift or lowering thanks to its suitably adapted characteristic curve.

See Brochures 5.125, 5.126, 5.127





PWS08Z proportional valve symbol



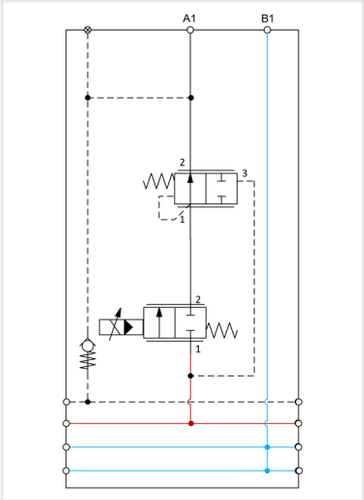
Performance

BOOM

Valves for rinsing water, agitator, and spray pumps

A hydraulic motor is often used to prepare and distribute the spray, or drive the water pump and compressor. The hydraulic motors can be supplied with load-compensated flow controls for pre-set or proportionally adjustable oil flow rates. Downstream pressure compensators increase stability when operating various actuators simultaneously.
Two-way or three-way proportional flow regulators are used to regulate oil flow when actuating the hydraulic motors for the spray pump, agitator pump, and rinsing water pump. These are available in combined cartridge valve form and separately in the control block.

See Brochure 5.130



Sample diagram of 2-way flow control with downstream pressure compensator (stability, speed precision)

PSRM 3-way proportional flow control valve

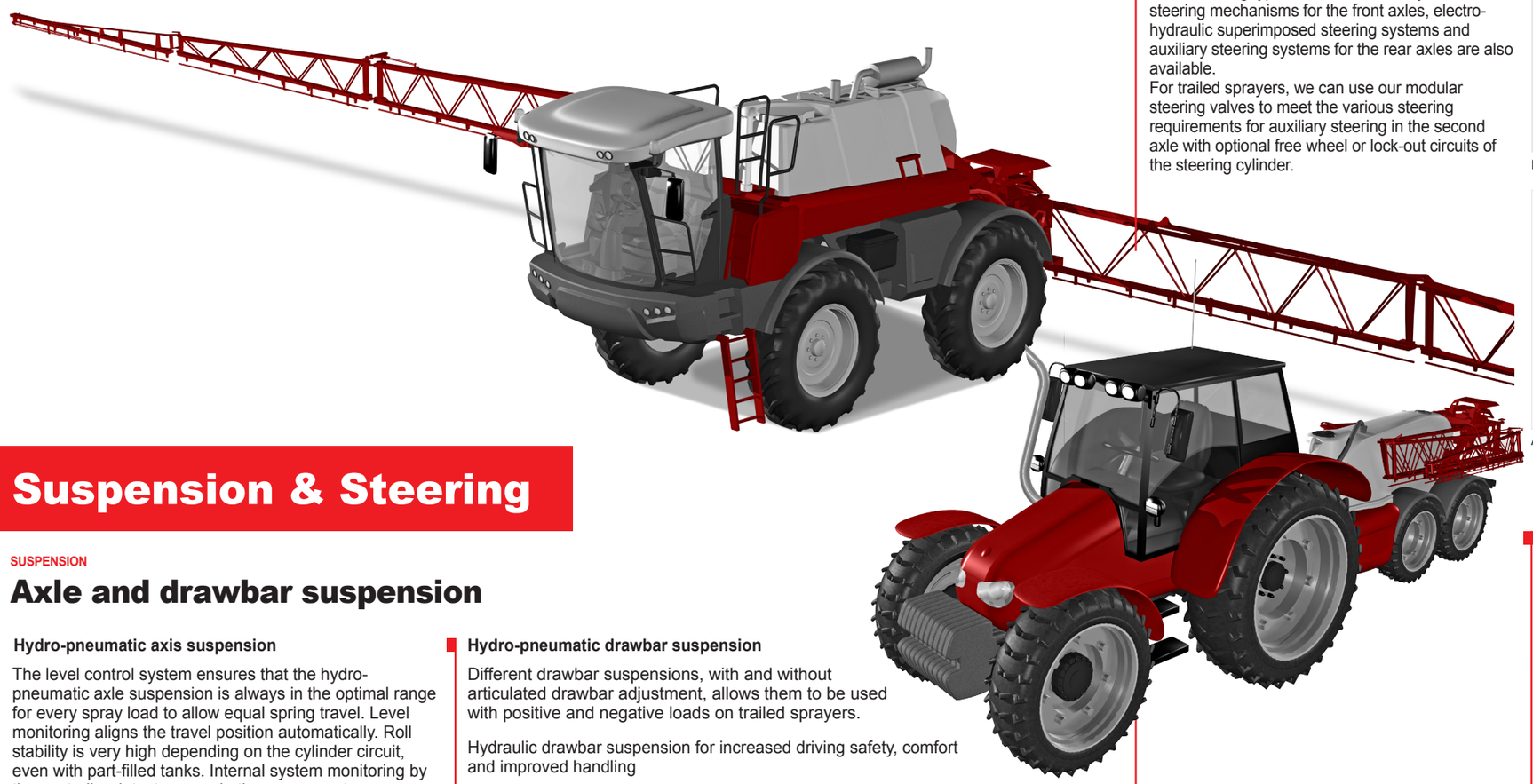
BOOM

Suspension

To provide vertical and horizontal suspension in the boom, SBO type diaphragm accumulators, appropriate for the positioning cylinder and with integrated pressure relief valve and shut-off valves, are included in the control block.

Suspension & Steering

High level of driving safety.
Low drawbar load.
Evenly distributed spray.



Suspension & Steering

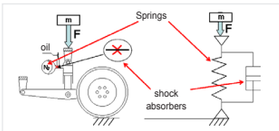
SUSPENSION

Axle and drawbar suspension

Hydro-pneumatic axis suspension

The level control system ensures that the hydro-pneumatic axle suspension is always in the optimal range for every spray load to allow equal spring travel. Level monitoring aligns the travel position automatically. Roll stability is very high depending on the cylinder circuit, even with part-filled tanks. Internal system monitoring by the controller detects errors in the components.

LCS/HCU series of intelligent hydro-pneumatic axle suspension systems for self-propelled and trailed sprayers with fixed and variable spring characteristics. Additional, modular equipment available for lock the suspension functions.

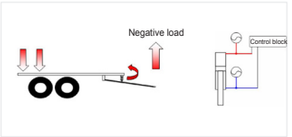


See Brochure 10.105.1 - Systems/Components for Agricultural Machinery

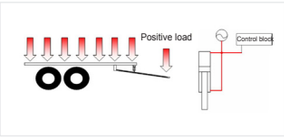
Hydro-pneumatic drawbar suspension

Different drawbar suspensions, with and without articulated drawbar adjustment, allows them to be used with positive and negative loads on trailed sprayers.

Hydraulic drawbar suspension for increased driving safety, comfort and improved handling



Drawbar suspension with load compensation



Drawbar suspension without load compensation

Variant 1
Electro-hydraulic switching

Variant 2
Standard

Variant 3
Negative loads - manually adjustable

Variant 4
Negative loads - remotely adjustable

Customer benefits:

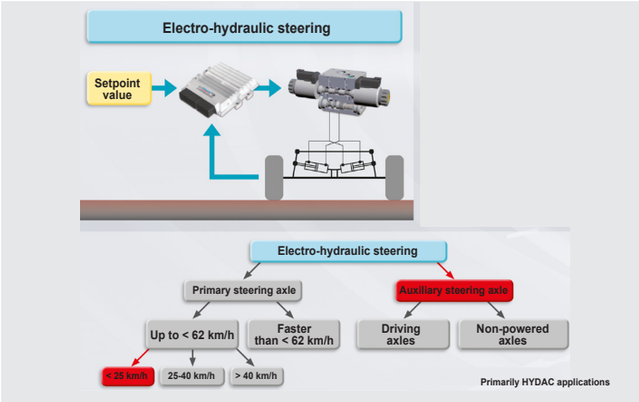
- ⇨ Greater driving safety
- ⇨ Better comfort
- ⇨ Improved handling
- ⇨ Reduced rocking of tractor at high speed
- ⇨ Optimal tractor braking (anti-snaking)
- ⇨ Reduced mechanical stress on drawbar

STEERING

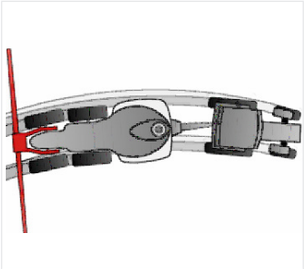
Electro-hydraulic primary and auxiliary steering systems (EHZ)

- Front axle steering
- Rear axle steering
- All-wheel steering

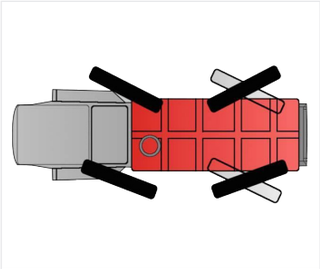
Electro-hydraulic primary and auxiliary steering systems allow for various steering types in self-propelled and trailed sprayers. For self-propelled sprayers, various special variants (e.g. all-wheel or crab steering) are available in addition to the normal driving types. Combined with hydraulic steering mechanisms for the front axles, electro-hydraulic superimposed steering systems and auxiliary steering systems for the rear axles are also available.
For trailed sprayers, we can use our modular steering valves to meet the various steering requirements for auxiliary steering in the second axle with optional free wheel or lock-out circuits of the steering cylinder.



Electro-hydraulic steering systems in modular form



Axle steering for trailed sprayers

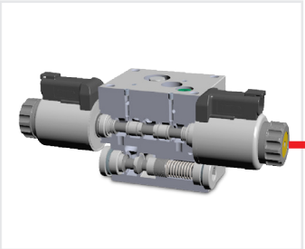


Electro-hydraulic auxiliary steering for all-wheel & crab steering for self-propelled sprayers

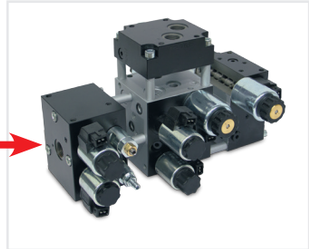
Overview of EHZ steering valve unit	
Basic block with 15 l/min E-spool	MT-EHZ-GB-E15-X-X-X
Basic block with 15 l/min J-spool	MT-EHZ-GB-J15-X-X-X
Expansion block with 15 l/min E-spool	MT-EHZ-EW-E15-X-X-X
Expansion block with 15 l/min J-spool	MT-EHZ-EW-J15-X-X-X
Manifold mounted block with 250 bar pressure relief	MT-EHZ-DB 250 V
Expansion block with upstream pressure compensator	MT-EHZ-EW-DW-X-X-X
Steering cylinder lock block	MT-EHZ-ZB-X-X-X

Modular steering valve module

The EHZ series steering valve module can be used in single-axle or multi-axle self-propelled and trailed sprayers. By using different inlet modules, it 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.



Core component proportional valve with pressure compensator, up to 25 l/min direct-acting, greater flow rates possible with pilot-operated valve



Modular steering unit
Inlet, steering, and centring plate

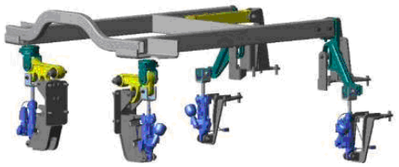
Customer benefits:

- ⇨ Can be connected to all pump types
- ⇨ Unlimited number of steerable axles
- ⇨ Different safety concepts can be selected
- ⇨ Assistance systems easy to integrate
- ⇨ Hydraulics and electronics combined in a single system
- ⇨ From the component to the system – all from a single source

Comfort & Safety

Observing international health & safety laws.

Comfort & Safety



Hydro-pneumatic cabin suspension

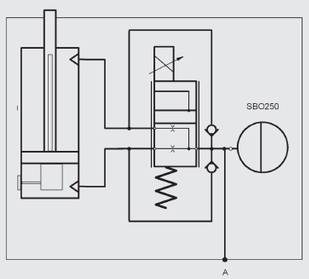
SYSTEM SOLUTIONS

Hydro-pneumatic cab suspension

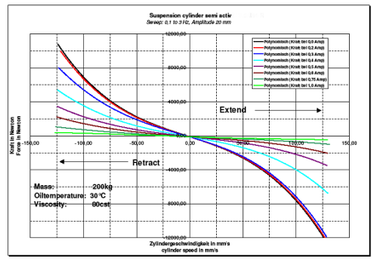
Modern hydro-pneumatic suspension systems ensure a marked improvement in comfort in self-propelled sprayers. They protect the driver against vibrations and shocks. A hydro-pneumatic cab suspension which is also available with adjustable damping can adapt to various driving situations.

The FDE2 hydro-pneumatic semi-active cab suspension element is a combination of suspension cylinder, damping valve, and hydraulic accumulator which acts as the spring.

See Brochure 10.116.6 - FDE2 Cab Suspension Element



Symbol for a semi-active suspension element



Characteristic curves for cab suspension element

Customer benefits:

- ⇨ Minimal vertical acceleration of the cab
- ⇨ Reduced rolling and pitching
- ⇨ Reduced motion relative to instruments and control elements
- ⇨ Increased comfort allows driver to concentrate better
- ⇨ Protects driver against shocks and vibrations
- ⇨ Complies with health & safety, noise and vibration legislation

SYSTEM SOLUTIONS

Cabin air filter for very fine and nano dust: CabinAirCare.

DIN EN 15695: Agricultural tractors and self-propelled sprayers – protection of the operator (driver) against hazardous substances

For health reasons, and to protect the operator and the environment, self-propelled sprayers must be equipped with a certified Category 4 cab (EN 15695-1). In effect, a certified driver cab replaces personal protective equipment (PPE) in the cab where an appropriate Category 4 filtering system is installed.

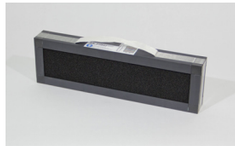
For modular retrofitting on existing tractors and self-propelled sprayers, CabinAirCare provides optimal Category 4 passenger protection without having to substantially modify the existing air conditioning system or cab.

For a healthy and productive working environment, HYDAC Filtration Technology already offers highly effective air filtration systems as original equipment or for retrofitting.

See Brochure 7.016.1 - 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

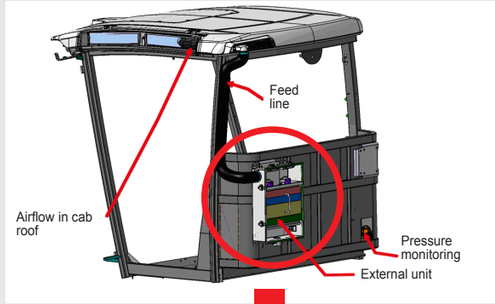


Active carbon filter

HEPA filter

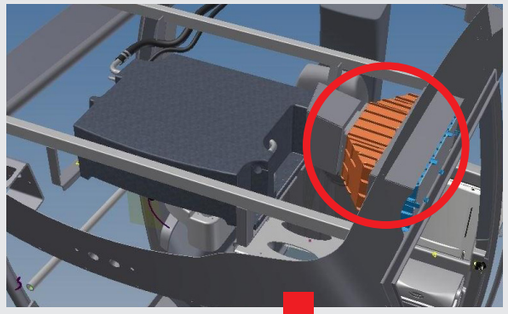
Fine dust filter

CACR for retrofitting

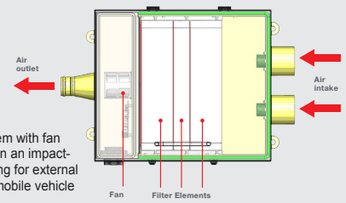


Example of retrofitting

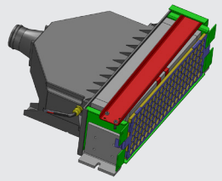
CACR for full integration



Example of installation



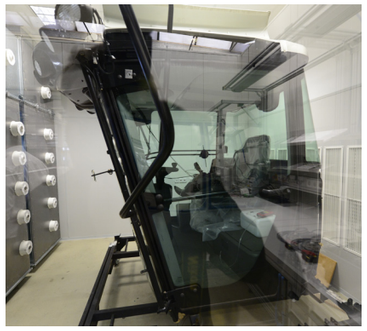
Complete system with fan and filter units in an impact-resistant housing for external connection to mobile vehicle cabs



Cabin air testing station

Cabin category & testing options under DIN EN 15695-1:

- Category 1: Cabin, no defined protection rating
- Category 2: Cabin that protects the driver from dust
- Category 3: Cabin that protects the driver from dust and aerosols
- Category 4: Cabin that protects the driver from dust, aerosols and vapours



Technical data:

- Air flow rate: 30 to 120 m^3/h
- Possible pressure above atmospheric in vehicle cabin: 25 Pa to 300 Pa
- Central control unit with status indicator (optional)
- Power supply: 24 V DC or 12 V DC
- Weight: approx. 16 kg (with filter elements)
- Removable and sealed housing cover
- Service life of filter stages with regular use: approx. 100,000 km or 2,000 hrs or 3 months

Additional Solutions

Optimised cooling systems.
Efficient filtration concepts.
Intelligent mounting systems.

Additional Solutions

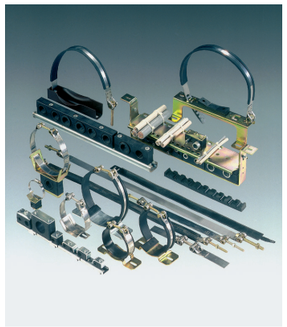
Accessories for every sector

HYDAC's comprehensive range can supply the right component on demand and in all standards for all your sprayer requirements: for locking, switching and control; for installing lines and components and for connections, couplings and damping, with all the benefits of a single supplier.

HYDAC 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, guarantee 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 Catalogue 61.000 - Accessories



Mounting technology

Ball valves

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

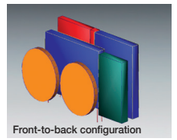
⇨ Electric fan drive

⇨ Hydraulic fan drive

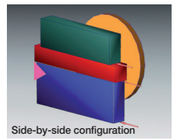
HYDAC offers the latter two designs. They regulate the speed of the fan depending on the temperature of the medium. As an option, these controls are also available with a reversing function to purge the fins of dust and debris.

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 configuration



Side-by-side configuration

Individual cooler configuration for combined oil, water and charge air cooler systems

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.

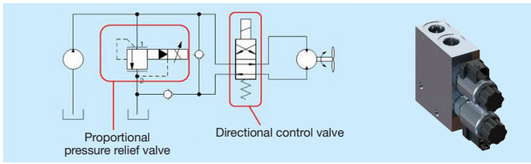
See Product Catalogue 5.700 - Cooling Systems

Fan control components and control blocks

Hydraulic and electro-hydraulic controls for regulating fan motor speed with optional rotation direction reversing 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

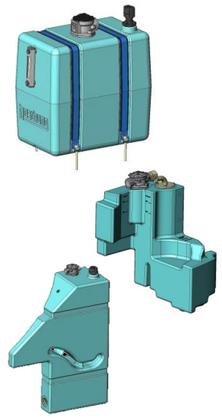
See Brochure 5.315 - A Breath of Fresh Air in Electro-Hydraulic Cooling Control

Storage & Filtration

Plastic tanks

Unlike welded steel tanks, customised plastic tanks are usually used when installation space is extremely limited and very lightweight construction is preferred.

See Brochure 7.020 Mobile Machinery Update



Plastic tanks

Customer benefits:

⇨ *Improved component cleanliness,* since plastic tanks are very clean following production

⇨ *Air from oil*, special tank geometry allows rapid and optimal air separation (RMTR)

⇨ *Improved use of existing installation space* due to optimised design (complex, curved designs available)

⇨ *Inexpensive*, since the costs depend on tank volume and not design complexity

⇨ *Clean tank surface,* due to integral baffle designed to prevent fluid spill from the breather filter onto the tank

⇨ *Element does not block,* due to dry air filter element and partial cleaning whenever air is expelled – dust is purged from the filter material

Filters

Our broad filter range offers inline filters (LF, MDF, DF) with various pressure ratings and materials in addition to filler/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 mounted return line elements (RMTR) ensure good distribution of oil flow in the tank, highly effective air separation, thus a reduction in the size of the hydraulic tank. We offer Diesel PreCare filter systems (HDP) designed for diesel filtration in order to ensure smooth operation of the sprayer.

See Catalogue 70.000 - Fluid Filters

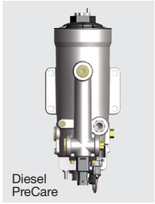
RFM

LF

Optimicron® filter element

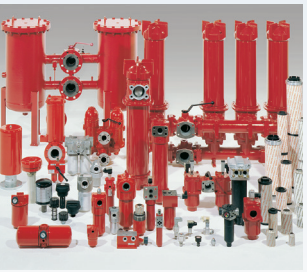
BDE

RMTR



Diesel PreCare

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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