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Section C – Mechanics

Part 4: Hydraulics and pneumatics

The following delivery specifications of Wieland-Werke AG form part of the contract.
Any deviating specifications are to be agreed upon between the supplier/contractor and Wieland, and documented.

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This delivery specification deals exclusively with the specialist fields of hydraulics and pneumatics.
Other additional specifications concerning documentation, noise emission, oil selection, environmental protection, occupational safety etc. must be requested as necessary.

Please request additional information on product selection from the author.
The hydraulic plan / pneumatic plan with parts list must be submitted to the purchaser before manufacturing begins. We reserve the right to make changes and additions. Without a written approval note, the equipment shall be considered not approved.

Table of contents

1.	Hydraulics	2
1.1	General system design	2
1.2	Oil tanks	3
1.3	Motor-pump assembly	4
1.4	Valve stands	4
1.5	Piping, screw fittings and fastening technology	4
1.6	Hydraulic equipment selection	6
2.	Pneumatics	9
2.1	Compressed air network	9
2.2	Pneumatic systems – general	9
2.3	Safety engineering	11

Section C – Mechanics**Part 4: Hydraulics and pneumatics**

1. Hydraulics**1.1 General system design****1.1.1 Pressure rise**

Pressure rise rates of more than 10,000 bar/sec are not permissible. To avoid this, soft-switching valves in accordance with Rexroth RD 23183, or directional control valves with switching time control in accordance with Rexroth RD 23351 must be used.

1.1.2 Pressure media

The following pressure media are to be used:

Hydraulic oil HLP 32, HLP 46, HLP-D 32 in accordance with DIN 51524, part 2.

Special media such as rolling oils, HFD etc. must be approved by us.

For a detailed description, please refer to our delivery specifications, section C, part 2.

1.1.3 Oil temperature

Operation without oil coolers should be aimed for, otherwise oil/air heat exchangers with separate cooling (filter) circuit are to be used. The use of oil/water safety heat exchangers requires our approval. The maximum oil temperature must not exceed 65 °C.

1.1.4 Hose lines

Hose lines may only be used where fixed piping is not possible (structure-borne noise, movement sequences). Only hose lines with a steel wire insert are to be used. The hose must be permanently marked with the following information every 50 cm:

* Hose line manufacturer's mark

* Hose line type and nominal diameter

* Quarter and year of manufacture

* Maximum permissible dynamic operating pressure

Hose lines must not be more than two years old at the time of installation, including storage time of the unfitted hose.

In addition, the employer's liability insurance association safety regulations for hydraulic hose lines BGR 237 must be observed. At Wieland, standard hose lines with union nut, metric in accordance with DIN 3870, suitable for screw fittings in accordance with DIN 2353, 24° cone, bore type W in accordance with DIN 3861, other types by agreement.

Hose lines under pressure at frequented locations such as control panels, passageways and pathways must be secured with a retention system, and covered with a spray containment sleeve.

1.1.5 Piping

The execution, as well as a selection of pipe cross-sections, can be found in section 1.5. The cross-sections used must be indicated in the hydraulic plans.

1.1.6 Minimes connections

A sufficient number of M16 x 2 Minimes connections must be provided in the installation. At least every consumer connection and every return line must have a measuring possibility. This must also be observed for valve blocks and marked in the plans.

1.1.7 On components which have to be hydraulically bled, an easily accessible bleeding possibility must be provided by means of a preinstalled Minimes connector; this must be marked in the plans.**1.1.8 Original type designations on devices must not be removed.**

Section C – Mechanics**Part 4: Hydraulics and pneumatics**

1.1.9 Hydraulic power units and valve stands

Power units and valve stands are to be delivered without wiring of the electrical connections and without device plugs. If units are electrically wired by the manufacturer as part of the delivery of a complete machine, our delivery specifications section B – Electrical engineering must be observed; this also applies in respect of the size, arrangement and designation of the terminal box as well as the designation of the terminals.

- 1.1.10 All devices (including pressure gauges) must be marked with the function in plain text, e.g. **“open/close chuck jaw”** as well as the component designation from the hydraulic plan and the electrical device identifier. This marking shall be made using engraved plastic or metal plates, fastened to non-removable parts using screws or adhesives.

Example:

Chuck jaw “open” Decoiler WV 058 =D10.L6-Y40.1	Function Valve designation in parts list Electrical device identifier	Chuck jaw “close” Decoiler WV 058 =D10.L6-Y40.2
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1.1.11 Filtration

A sufficiently dimensioned (approx. three times the return flow) return flow filter must be provided in the return flow line. Where proportional valves and cartridge valves are used, a pressure filter must be installed upstream of the valves.

Continuous plants must be equipped with duplex filters.

The filter elements used must be named and marked with plain text. Execution as described in section 1.1.10. Please request additional information on product selection from the author.

- 1.1.12 Depending on the installation location of the power units for the installation, measures must be taken to prevent the pipe system draining during maintenance work, e.g. by using ball valves or non-return valves.

1.2 Oil tanks

must be equipped with

- 1.2.1 Oil level indicator (visual) – over the entire range of the oscillating volume.
- 1.2.2 Oil level monitoring with two signal contacts or analogue for low oil pre-warning and dry running protection.
- 1.2.3 Air filter with electrical clogging indicator and must have a filter grade that is the same as the grade of the main filters.
- 1.2.4 Filler neck with coarse sieve
Alternatively: Combined filling and air filter. Subject to consultation also with thermal contact.
- 1.2.5 For tanks with a capacity of 100 litres or more, there must be a filling possibility via the return flow filter (DN 40 ball valve).
- 1.2.6 If the tank is installed below floor level, a filling line with filter (or via return flow filter on the power unit) must be provided from floor level.
- 1.2.7 An oil drain valve must be arranged in such a way that the oil can be drained without dismantling other components.

Section C – Mechanics**Part 4: Hydraulics and pneumatics**

1.2.8 Temperature monitoring

The oil temperature must be visually discernible.

Two switching points for systems without heating and without cooling for temperature warning and overtemperature (switching points or analogue).

When using a heat exchanger or an oil heater five temperature values analogue.

Specified default setting:

T1 – heating OFF 30 °C, T2 – cooling ON 55 °C, T3 – cooling OFF 45 °C

T4 – temperature pre-warning 60 °C, T5 – overtemperature 65 °C

Other setting values only after consultation and approval.

For simplified installation of items 1.2.1 to 1.2.7, multifunctional units made by Bühler can be used. Please request additional information on product selection from the author.

1.2.9 Oil tanks

For cleaning the oil tank, there must be at least one manway per chamber, on the side. One spare cover plate (approx. 100 x 100 mm) per chamber must be provided in the tank lid. If there is only one chamber, approx. 200 x 100 mm.

The oil tanks must have an internal coating resistant to mineral oil in accordance with DIN 51524 and DIN 51525.

1.2.10 The suction and return spaces in the oil tank must be separated by a moderating plate.**1.2.11 Below the oil tank, an oil catchment tray corresponding to the maximum tank volume must be provided. These must be manufactured and marked in accordance with section 19 of the German Water Resources Act (*Wasserhaushaltsgesetz*, WHG).****1.3 Motor-pump assembly**

Pump arrangement, component installation and wiring

Pump units are to be arranged next to the oil tank if possible and should only be mounted on or submerged in the tank after consultation. On this point, the delivery specifications section C, part 2 must be observed. It is advisable to contact our Proactive Maintenance department in this regard. It is your responsibility to do this.

The suction lines must be fitted with shutoff valves (electrically monitored) and expansion joints. The plant system pressure, as well as any deviating pressure, must be monitored electrically by means of pressure switches. In exceptional cases, subject to consultation, by means of pressure gauges.

The pump must be protected by means of a pump safety block with directional control valves for pressureless startup. The switching-through for pressure buildup must be time-delayed.

If possible, the coupling must be visible and adjustable via the pump carrier.

1.4 Valve stands

The valves are to be grouped together on valve stands, manifolds, etc. A ball shutoff valve must be installed upstream of the valve stand in the P line and a non-return valve in the T line. An oil leakage catchment tray must be installed under valve stands, manifolds and individual valves. Servo valves and proportional valves mounted directly on the consumer are an exception to this rule. There must be at least one reserve space on each multistation manifold. If reducer plates are used, only those which do not rotate the outlets A-B may be used.

1.5 Piping, screw fittings and fastening technology**1.5.1 Only a precision steel pipe, eddy current tested, phosphated, oiled, continuously marked over the entire pipe length as confirmation of the quality controls carried out, may be used (DIN 2391**

Section C – Mechanics**Part 4: Hydraulics and pneumatics**

EN 10305-4). Colour marking RAL 8001, brown. Preferably hexavalent chromium free pipes, electrogalvanised, but these must not be welded and do not require painting.

Mixing of different pipe qualities is only allowed in special cases and requires prior consultation.

As a guide value for the dimensioning of pipe cross-sections, the following applies:

Pressure lines 6.0 m/s
Return lines 3.5 m/s
Suction lines 1.5 m/s (max.), when using HFD 0.5 m/s.

The pump manufacturer's specifications must be observed.

In case of ambiguity, DIN 24346 applies.

The selected pipe cross-section must be marked on the plans together with the type of pipe installation.

1.5.2 Pipe cross-sections to be used up to 42 mm Ø

Light series: 6x1.5 / 8x1.5 / 10x1.5 / 12x2 / 15x2 / 18x2 / 22x2 / 28x2 / 35x3 / 42x3

Heavy series: 8x1.5 / 10x1.5 / 12x2 / 16x2.5 / 20x3 / 25x3 / 30x4 / 38x5

Pipes from 42 mm Ø and up welded

Pressure lines: SAE flanges

Return lines: DIN flanges PN16

Special regulation for piping work in the foundry:

Only pipe cross-sections of the "heavy series" may be used.

1.5.3 Pipe installation technology and fittings

Walform plus tube fitting system by Walterscheid

Screw fitting in accordance with DIN 2353 metric, exclusively hexavalent chromium free, 24° cone (suitable for bore form W in accordance with DIN 3861). Alternatively or in exceptional cases, subject to consultation and approval, weld-on cones or cutting ring fittings with soft seal, make Bell, type ZET-WD2, or make Ermeto, type E0-2.

1.5.4 Pipe connections to valve subplates are to be executed in Whitworth pipe thread DIN 2999.**1.5.5 The regulations set out in the German Water Resources Act (WHG) must be taken into account when laying and installing pipes. A continuously visible pipe run should be aimed for. Otherwise a leakage monitoring system must be provided.****1.5.6 In the case of bent pipes, the out-of-roundness may not exceed 10% in accordance with DIN EN 13480-4. To avoid excessively deformed bends, a bending mandrel must be used when bending thin-walled pipes and small bending radii.****1.5.7 Pipes must be fastened by means of Stauff clamps or other makes of identical construction, installed with weld plates or mounting rails.**

Standard series Stauff, series TS 11, 14 or 30 with rail nut SM

Heavy series Stauff, series STSV with fastening nut GMV 10/12

Special regulation for pipe fastenings in the foundry:

Exclusively "heavy series" with aluminium clamps.

1.5.8 Welding of bulkhead fittings, and butt-welding or socket welding of pipes requires express consultation and written approval.**1.5.9 Tube bundles and bulkhead fittings must be arranged in such a way that each fitting can be opened or retightened without special tools and without dismantling the pipes in front of it.**

Section C – Mechanics**Part 4: Hydraulics and pneumatics**

1.6 Hydraulic equipment selection

Preferred supplier Bosch-Rexroth

1.6.1 Valve technology in general 350 bar (or 315 bar) series

Directional valves, pressure valves, flow control valves, shutoff valves, sandwich-plate devices and 2-way cartridge valves, installation dimensions according to DIN 24342 can be taken from the Bosch-Rexroth model range. The choice of other manufacturers requires our approval.

- Directional valves with connection surfaces in accordance with DIN 24340, sheet 2, NG6, NG10, NG16, NG22(25), solenoids 24 V = with manual override and electrical connection via plug connector DIN 43650. Solenoids oil-tight and pressure-tight. Solenoid change without opening the pressure chamber. The use of latching or pulse valves is recommended in order to avoid a continuous energisation of the solenoids.
- Pressure control valves with connection surfaces in accordance with DIN 24340, form D – NG6, NG10, NG20 and NG30.
- Unlockable check valves (anti-drift valves) with connection surfaces in accordance with DIN 24340, form D and leakage oil connection NG10, NG20 and NG30.
- Sandwich plate poppet valves exclusively Wandfluh make.
- Flow control valves with connection surfaces in accordance with DIN 24340, sheet 3, NG6, NG10, NG16 and NG30.

1.6.2 Valves for pipeline installation

- Shutoff valves, load-holding valves
Ermeto, Bell, Heilmeyer & Weinlein (HAWE), Duden, Wandfluh, Gaestra
- Throttle valves and throttle check valves
Hydac, Parker, Rexroth
- Ball shutoff valves
Böhmer, Pister, Rötelmann, Argus, a+r Armaturen
Easily switchable at plant system pressure.

1.6.3 Proportional valves Rexroth make

- Proportional valves with integrated electronics are preferred.
- Proportional valves with external electronics (only after consultation)
Directional valves type 4WRZ.../D3, 4WRE6 and 10 with external electronics and internal control oil. (Designation suffixET), other devices and makes require our written approval. Preferred design with W-spool and shutoff poppet valve.

1.6.4 Servo valves (displacement – pressure)

- Servo valves single-stage
(Rotary slide valves, torque motor control)
Preferably to be used:
 - EMG SV1-10, 300 mA, 40 ohms parallel
 - Schneider HVM 025.027, 300 mA, 59 ohms parallel
- Servo valves two-stage
(Rotary slide valves, torque motor)
Preferably to be used:
 - Herion HDSV2DH 80 mA, 22 ohms parallel
 - Schneider HVM 055-057, 067, 300 mA, 50 ohms parallel
 - Rexroth 4WS2EM6, 4WS2EM10, 30 mA, 40 ohms, serial
 - Moog
- Servo valve for strip edge control
Make EMG SV1-10 (rated flow l/min = 4, 16, 32).

Section C – Mechanics**Part 4: Hydraulics and pneumatics**

1.6.5 Pump technology

The selected pump type must be discussed during the project planning phase. Where they can be used, axial-piston pumps are preferred.

- **Axial-piston pumps**
Bosch-Rexroth (Brueninghaus Hydromatik):
Preferred series A4VSO, A10VSO (with pump safety block, pressureless startup)
Langenberg plant: as above, plus Volvo
- **Radial-piston pumps**
Bosch-Rexroth, WEPUKO-Hydraulik, MOOG (type RKP 16-80 cc per revolution)
Langenberg plant: as above, plus Volvo
- **Vane pumps**
Bosch-Rexroth, type V7 (only after consultation)
- **Gear pumps**
 - a) External gear pumps:
Bosch-Rexroth, Kracht, Sauer-Danfoss (preferred type)
 - b) Internal gear pumps:
Bosch-Rexroth, Bucher, Eckerle (preferred type), Voith-Turbo type IPC
- **Special pump technology**
Subject to prior consultation, the following special assemblies can be used:
 - Make Voith-Turbo
Pump units for variable volume flows
 - Make Siemens
SINAMICS servo pump

1.6.6 Hydraulic motors

Low speed motors (< 50 rpm)

The application must be discussed and agreed with us.

Radial piston motors

Bosch-Rexroth, Düsterloh, Pleiger

1.6.7 Hydraulic cylinders

The selection of cylinders must be discussed with the Wieland project manager in the planning phase, specifying the manufacturer and type, and must be approved in writing.

The connection dimensions of the cylinders must conform to ISO DIN 6020/1+2, ISO DIN 6022, DIN 24336. Connections exclusively with Whitworth pipe thread. For control tasks, special low-friction seal sets must be used (servo quality). The cylinder design must be described in the documentation by means of a sectional drawing and parts list.

After installation, there must be an easily accessible deairing possibility. One possibility is to implement this with a Minimes connection, for example.

1.6.8 Measuring devices

- **Pressure gauges**
Glycerine pressure gauges with housing Ø 63, 100 and 160 mm are to be used.
The operating pressure must not exceed 80% of the scale value.
Pressure gauge shutoff valves (do not use valves with built-in pressure gauge)
Manufacturer selection: Hydac, Norgren, Rexroth
- **Pressure switches**
 - Make HYDAC type EDS 348-5-xxx—000 (xxx = suffix for pressure range)
2 switching outputs, 1 analogue output 4-20 mA,
Mounting exclusively make Hydac, type ZBM 210, part no. 6011511
 - Make HYDAC type EDS 8446-2-xxx-x00 (xxx = suffix for pressure range)
2 switching outputs, mounting: Hydac ZBM 8100, part no. 3546757Pressure switch devices are to be connected via Minimes lines or directly with shutoff fitting.
Other installation types only after consultation.

Section C – Mechanics**Part 4: Hydraulics and pneumatics**

- **Temperature monitoring and temperature switches, make HYDAC**
Make HYDAC type ETS 388-5-150-000, 2 switching outputs, 1 analogue output 4-20 mA
Associated sensor Pt100, sleeve TFP100.
Mounting exclusively make HYDAC, type ZBM 210, part no. 6011511.
Alternative: Temperature monitoring integrated into level monitoring (see next point).
- **Tank monitoring make BÜHLER**
(Break contact element open when empty, in some cases with temperature monitoring)
Please request type selection from the author.

Not included in the selection list:

External installation Level switch with 2 switching contacts.
- Type NS 25/15 AM with SK661 item no. 20019999
Specification L1 = switching point

Please note:

The vent filter integrated into the Nivovent can only be used as a filling filter for minimal refill quantities. A filling option via the return flow filter or an additional filling filter must be provided.

1.6.9 Accumulator systems

The technical codes AD 2000 and TRB 300 must be observed. The legal consequences of non-compliance shall be borne by the system supplier.

- Bladder and diaphragm accumulators: Bosch, Hydac
- Piston accumulators: Hydac, Roth Hydraulik (formerly Bolenz & Schäfer)
- Type-tested safety valves: Hydac, Rexroth

Each accumulator system must be designed with a safety and shutoff block with electrical relief and be marked accordingly. Exceptions must be justified and agreed upon.

1.6.10 Filter technology

Optionally Filtration Group (formerly Mahle), or Hydac

Please request additional type selection for pressure filters, return flow filters and filter monitoring systems from the author of this specification.

Filter fineness standard 10 my

Servo valves, proportional valves and filter for control oil with a filter rating of min. 6 my, alternative 3 my.

a) Pressure filters

Without bypass, with visual electrical clogging indicator and switching suppression up to 30/35 °C clogging signal at 75% and at 100%.

Filter monitoring with differential pressure switch (manufacturers mentioned above)

b) Return flow filter

With bypass, with visual electrical clogging indicator and switching suppression up to 30/35 °C, clogging signal at 75% and at 100%.

Filter monitoring with backpressure switch (manufacturers mentioned above)

c) Ventilation filter

Filtration Group: size PI 0126 MIC to PI 0185 MIC

Hydac: series BF 5 to BF 72

Filter monitoring with underpressure switch (manufacturers mentioned above)

1.6.11 Heat exchanger

- Coupling cooler: KTR Kupplungstechnik, Hydac
- Oil/air heat exchanger: Funke (= Längerer & Reich or Modine), Hydac, Bühler
- Oil/water heat exchanger: Make Funke, Bühler subject to consultation

Section C – Mechanics

Part 4: Hydraulics and pneumatics

(Safety heat exchanger = double tube)
 Langenberg plant: Make Behr

2. Pneumatics

2.1 Compressed air network

The installation of a compressed air network in our plant requires consultation with our energy supply department.

After the contract is awarded, but at the latest when the pneumatic plans are approved, we must be informed of the consumption data of a compressed air system.

Compressed air quality: dry, low-oil air

Network pressure:

Ulm plant	Pe = 5.0 bar
Vöhringen plant	Pe = 5.0 bar
Langenberg plant	Pe = 4.0-6.0 bar
Villingen plant	Pe = 5.0 bar

Where compressed air couplings are used for standard applications, exclusively safety couplings with pressure relief may be used.

Exclusively make CEJN eSafe series 320, DN7.6

Special sizes and special applications must be discussed with the author of this specification.

2.2 Pneumatic systems – general

2.2.1 Valve stands are to be delivered without wiring of the electrical connections and without device plugs. If units are electrically wired by the manufacturer as part of the delivery of a complete machine, our delivery specifications section B – Electrical engineering must be observed; this also applies in respect of the size, arrangement and designation of the terminal box as well as the designation of the terminals.

2.2.2 The original type designation on the devices must not be removed.

2.2.3 Regarding the size, arrangement and designation of the terminal box as well as the designation of the terminals, timely coordination with our electrical planning department or the supplier of the electrical equipment is required.

2.2.4 All devices must be marked with the function in plain text, e.g. **“open/close chuck jaw”** as well as the component designation in the pneumatic plan and the electrical device identifier. This marking shall be made using engraved plastic or metal plates, fastened to non-removable parts using screws or adhesives.

Example:

Chuck jaw “open” Decoiler WV 058 =D10.L6-Y40.1	Function Valve designation in parts list Electrical device identifier	Chuck jaw “close” Decoiler WV 058 =D10.L6-Y40.2
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2.2.5 A solenoid-actuated main control shutoff valve must be provided upstream of each pneumatic control. Systems in which this would negatively impact on safety (accident prevention regulations) are an exception.

The control of this function must be coordinated with us in any case, since parts of air networks are switched off at times in our company.

Section C – Mechanics**Part 4: Hydraulics and pneumatics**

2.2.6 System readiness (pressure) must be monitored by means of electronic pressure switches.

2.2.7 Piping and screw fitting technology

- Permissible pipe Ø: 6-10-12-15-18-22-28-35-42
- The following steel pipes are used:
Always scale-free, primed and painted RAL 5009, blue, after completion
Precision steel tube in accordance with DIN EN 10305-1
Steel tubes, seamless, black in accordance with DIN EN 10220
No painting necessary when using stainless steel tubes 1.4571, in accordance with DIN EN 10210-2 or DIN EN 10219-2
Hexavalent chromium free tubes (CF tubes), but these must not be welded
- Screw fittings with cutting ring, soft seals and Whitworth pipe thread DIN 2999
Make Bell, type ZET-WD2 or make Ermeto type E02
Pipes to be fastened using Stauff plastic or aluminium clamps.
The use of plastic tubing with outside diameter within the limits of CETOP RP 54P and special pneumatic quick-connect fittings (metal versions) is permitted. Main supplier Festo series NPQM, alternatively Norgren series Pneufit.

Wherever possible, tubes must be held in place with clamps and laid in guide tubes or conduits. Only in exceptional cases and after consultation with zip ties.

2.2.8 Device selection valves

Please request additional information on product selection from the author.

- **Directional valve, electrically or pneumatically actuated**

The use of latching or pulse valves is recommended in order to avoid a continuous energisation of the solenoids.

The installation of ISO valves on subplates is to be preferred, other types and inline valves are to be agreed on a case-by-case basis.

- ISO valves series 1, 3 and 4

Preferred make **Festo**, alternatively Norgren

Mounting interface surface in accordance with ISO 5599/1, CNOMO solenoid 30 mm in accordance with EN 175301-803 form A

- ISO valves series 02 (18 mm) ISO 15407-1

Preferred make Festo series VSVA, alternatively Norgren series V 40

Mounting interface surface in accordance with VDMA 24563, electrical plug connector ISO 15217, form C

- **Valve terminals**

Make Festo:

- Type VTSA-ISO 02 / size 18 mm
Subject to consultation and express approval
- Type VTSA-ISO 1 / size 42 mm
- Type 10 CPV / size 10 and 14
- Type VTUS size 25
- Type VTUG size 14 (multi-pin)
- Type MPA (subject to consultation)

- **Directional control valve, manually or mechanically actuated**

Preferred Festo, alternatively Norgren

- **Valves with pushbutton, plunger, roller-lever actuation**

- Preferred Festo, alternatively Norgren

- **Throttle valves**

Section C – Mechanics**Part 4: Hydraulics and pneumatics**

- Preferred Festo, alternatively Norgren

- **Ball shutoff valves**

Böhmer, Pfister, Rötelsmann, Argus

Proportional valves

Make Norgren	Type VPPC10BC411KE000 4-20 mA
	Type VPPC10BC111KE000 0-10 V
	Type VP50, no. 4095812.9000.024.00
Make Festo:	Type MPPE 3-1/4-6-420
	Type MPPES 3-1/4-6-420

2.2.9 Measuring devices

- **Pressure gauges**

Devices with DIN dimensions must be used. The operating pressure must not exceed 80% of the scale value.

- **Electronic pressure switches**

Make HYDAC:

- Type EDS 348-5-016-000 part no. 907916
Mounting exclusively make HYDAC type ZBM 310, part no. 6011511
- Type EDS 8446-2-025-000 part no. 920770
Mounting HYDAC ZBM 8100 part no. 3546757

2.2.10 Service units and pressure regulators

(Regulators, filters, without lubricators – The use of lubricators must be agreed.)

Please request additional information on product selection from the author.

Preferably devices made by Norgren and Festo should be used (filter fineness min. 40 µ).

If precision control is required, please consult us.

A manual shutoff valve must be provided upstream of each service unit.

For systems that can make dangerous movements in the event of an emergency stop, a startup and venting valve must be provided.

- **Device selection Norgren**

Excelon	72 series	3/8", 1/4"
Olympia Plus	64 series	1/2"
Olympia Plus	68 series	1" - 1½"

Please contact the author for details of preassembled service units and associated item designation.

- **Device selection Festo**

Exclusively D series, metal (Mini 1/4", Midi 3/8" and 1/2" and Maxi 1")

Series	MS 6 (1/4" and 1/2")
	MS 12 subject to consultation

2.2.11 Compressed air cylinders

The installation dimensions of the cylinders must conform to ISO 15552 and 6432.

Preferred suppliers: Leibfried, Festo, Norgren

2.3 Safety engineering

Any pneumatic circuit shall be designed and constructed in accordance with the latest safety regulations as set out in the Machinery Directive 2006/42/EC and applicable standards.

During the verification in accordance with EN ISO 13849-1 the performance level is determined; the valve design shall be validated and documented in accordance with EN ISO 13849-2.

Section C – Mechanics**Part 4: Hydraulics and pneumatics**

The following valves are approved for use in the design and implementation of safety functions. All valves can achieve performance level “e”, category 4. Please agree the sizes with us in each case.

- Safety function “**safe pressurisation and depressurisation**”
Norgren 3/2 safety valve series SCVA (not SCVA 10)

- Safety function “**safe reversing**”
Norgren 5/2-way safety valve
 - Electrical solution: Series XSZ-V
 - Pneumatic solution: XSZ-4420 series in conjunction with an XSHC04 two-hand control unit.