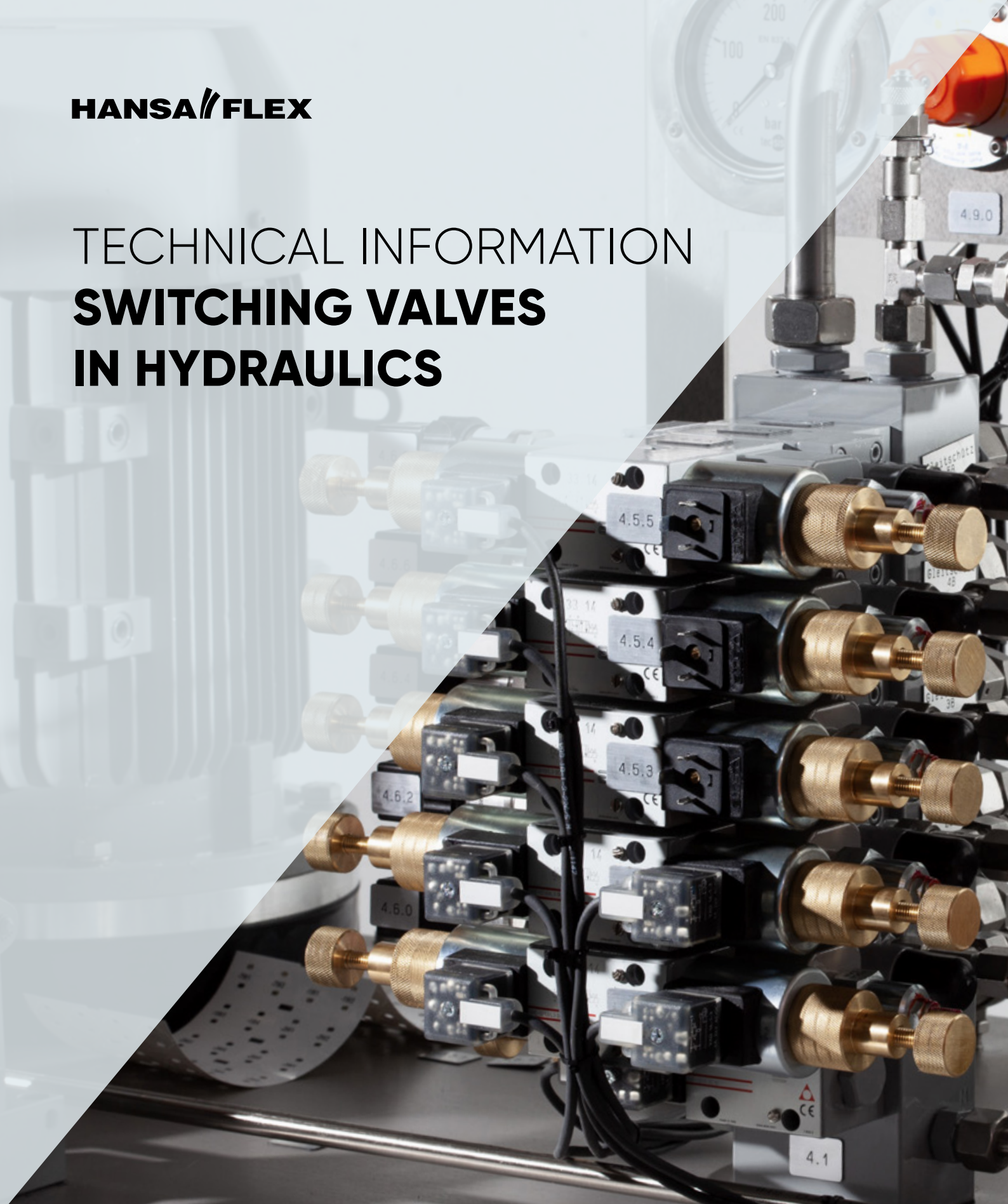


TECHNICAL INFORMATION **SWITCHING VALVES IN HYDRAULICS**



Technical information for switching valves in hydraulics

Table of contents

- 1. General information about switching valves in hydraulics**
- 2. Safety instructions**
 - 2.1 Safety regulations in fluid technology
 - 2.2 Proper use
 - 2.3 Requirements applying to personnel
 - 2.3.1 Qualifications of specialist personnel
 - 2.3.2 Requirements applying to hydraulics maintenance personnel
- 3. Technical information**
 - 3.1 Installation instructions
 - 3.2 Valve types and technical parameters
 - 3.2.1 Valve types
 - 3.2.2 Technical parameters
- 4. Installation, commissioning, servicing**
 - 4.1 General installation and assembly rules for switching valves
 - 4.2 Installation position
 - 4.3 Electrical connection
 - 4.4 Pressure fluid
 - 4.5 Seal materials
 - 4.6 Filtration
 - 4.7 Bleeding
 - 4.8 Servicing
 - 4.9 Storage
- 5. Disposal information**

1. General information about switching valves in hydraulics

The installation, commissioning and servicing of hydraulic systems or their components may be carried out only by suitably qualified personnel and in strict observance of all the relevant safety regulations.

The potential dangers to people and the environment posed by hydraulic systems are very often underestimated in practice.

The wrong choice or improper use of components, hoses, fittings and accessories can compromise the product's functional reliability, causing it to fail and pose a threat of personal injury or material damage.

In extreme cases, violently spraying oil, shearing fittings and ruptured lines can even cause fatal injuries. Exceeding the maximum permissible working pressure must always be avoided.



We therefore expressly recommend that the applicable safety guidelines are strictly observed!

The machine operator (the employer) also bears a particular responsibility.

The machine operator is responsible for:

- Ensuring that all components and parts are used only for their intended purpose
- Scheduled monitoring and systematic inspection by qualified persons
- Detecting and eliminating defects
- Scheduled servicing tasks and replacement of hose lines

This active assumption of responsibility is enshrined in the legal framework. Based on the principles of industrial safety, the German equipment and product safety act, the EU machinery and pressure equipment directives and the ordinance on industrial safety and health, tasks are to be specified further and set out in procedural regulations for those concerned.

The information in this document applies to the following valves in industrial and mobile hydraulic systems that are operated with mineral oil-based hydraulic fluids.

If other pressure fluids are used, please observe the information given in the specific data sheets provided by the component manufacturer and in the associated operating instructions.

- Pipeline installation valves
- Cartridge valves
- Cetop solenoid-controlled valves
- Monobloc valves
- Rotary spool valves



Accidents are avoided and trouble-free operation of the hydraulic system is ensured by observing the provisions of this technical information and the manufacturer's operating instructions.

The manufacturer's operating instructions must be kept in the direct vicinity of the hydraulic system in a place known and accessible to the operator and the maintenance personnel and be readily available at all times. They must be read and understood by the maintenance personnel and by a person nominated by the operator to assume responsibility for the tasks. These actions must be documented.

The references to standards and regulatory guidelines in the product group information correspond with the state of knowledge applying at the time of creation of this technical information.

2. Safety instructions

Numerous safety-relevant codes of conduct must be observed by servicing and maintenance personnel when working with the various types of hydraulic components.

Among these, the most important safety measures are summarised in the *"Five-finger rule of fluid technology"*.

Only spare parts approved by the manufacturer of the hydraulic system should be installed or used as replacement parts.



Observe the manufacturer's requirements given in the operating instructions.

2.1 The five safety rules in fluid technology

1. Disconnect the energy supply
2. Secure against reconnection
3. Depressurise the system, including any pressure accumulators, lower or support raised loads, dissipate residual energy
4. Check that the system is depressurised
5. Prevent hazards from neighbouring (linked) systems



In the event of an emergency, malfunction or other irregularity, the danger area must be made secure against uncontrolled entry, the responsible specialist personnel informed and the fire safety precautions specific to that location observed.

Ensure that "emergency kits" are available in case of leaks.

(Observe the safety data sheets provided by the manufacturer of the hydraulic fluid).

3.1 Proper use

Hydraulic components are designed by the manufacturer for the production, transmission, control or regulation of energy and signals using the volumetric flow of oil. The hydraulic components may be operated only with a pressure fluid in accordance with DIN 51524. Other pressure fluids are referred to separately in the manufacturer's operating instructions.

- Hydraulic components may be operated only in a technically fault-free condition.
- Hydraulic components may not be modified or altered without discussion with the manufacturer.
- The conditions relating to connection and use and the performance data defined in the manufacturer's operating instructions must be observed.
- Attached lead seals and safety labels must not be removed or damaged.
- Safety components such as end limit switches must not be disabled.
- The servicing and maintenance intervals specified in the operating instructions must be observed.
- Specialist personnel under the influence of drugs or medication that affects their reactions must not install, maintain or repair hydraulic components

2.3 Requirements applying to personnel

2.3.1 Qualifications of specialist personnel

Specialist personnel are described as persons who, on the basis of their specialist training, knowledge and experience, can assess and properly carry out the tasks given to them.

The specialist personnel are familiar with all the relevant standards and dangers associated with their duties.

2.3.2 Requirements applying to hydraulics maintenance personnel

Maintenance includes the full scope of the measures necessary to preserve the functional state of the system or recover the functional state in the event of a malfunction.

According to DIN 31051, maintenance comprises the following individual measures:

- **Inspection** (determination and assessment of the actual state)
- **Servicing** (preservation of the required state)
- **Repair** (recovery of the required state or the long-term securing of the required state)

Requirements applying to inspection personnel:

- They must have been instructed in the relevant activities
- No specialised hydraulic knowledge required
- Knowledge of the particular hazards associated with hydraulic components

Requirements applying to servicing personnel:

- They must have been instructed in the relevant activities
- Specialised hydraulic knowledge required
- Knowledge of the particular hazards associated with hydraulic components

Requirements applying to repair personnel:

- They must be trained hydraulic specialists
- The repair personnel must have knowledge of the functioning and construction of hydraulic components
- Ability to read and interpret hydraulic circuit diagrams,
- Interpret and categorise circuit symbols
- Read and interpret functional block diagrams
- Understand the complete hydraulic system and partial systems
- Understand the functions of the complete machine and how they interact with the hydraulic system



Note:

Work on electrical components may be carried out only by an electrical specialist in accordance with the electrical engineering regulations.

1. Technical information

3.1 Installation instructions

In order to ensure the safety of the operating personnel and the integrity of the hydraulic system, the following installation instructions must be observed when performing installation and servicing tasks on switching valves in accordance with the safety instructions (see point 2.).

- **Observe the manufacturer's instructions:**
Read and follow the manufacturer's installation and operating instructions. These documents contain important information about the specific valves, such as their installation, sealing, tightening torques and the conditions of use.
- **Protective clothing:**
Wear suitable personal protective equipment (e.g. gloves, protective glasses) to protect you from possible hazards
- **Pressure release:**
The hydraulic pressure in the system must be fully released before installing or servicing the valve. (Observe point 2.1.) This prevents accidents caused by sudden movements or leaks.
- **Cleanliness of the hydraulic oil:**
Ensure that the hydraulic oil is clean and free of contaminants. Contaminants can adversely affect the functioning of the valve and lead to damage. The required cleanliness codes can be found in the manufacturer's installation and operating instructions.
- **Seals and O-rings:**
Before installation, check the seals and O-rings for damage and wear. Defective seals can lead to leaks and accidents.
- **Installed position:**
Install the valve in the position recommended by the manufacturer. Certain installation positions may influence the functionality of some valves.
- **Visibility of the operating elements:**
Ensure that all the operating elements of the valve are clearly visible and easily accessed to allow safe operation. Ensure that no electrical wires are damaged during the valve installation.
- **Tools and equipment:**
Use only the recommended tools and equipment for the valve installation. Using incorrect tools can cause damage or dangerous situations.
- **Tightening torques:**
Observe the specified tightening torques for threaded connections on the valve and at the ports in order to avoid leaks and damage. Ensure that the hydraulic lines are correctly connected. Use the correct connection elements.
- **Visual inspection, pressure and function tests:**
After installation, check for any damage to the valve and its threaded connections. Then carry out a pressure test to determine whether the system is leak-tight and is functioning correctly.



Perform regular servicing tasks and inspections after installation to ensure that the hydraulic system is functioning correctly.
This allows potential problems to be discovered in good time.

3.2 Valve types and technical parameters

3.2.1 Valve types



The choice of the correct valve type depends on the specific requirements of its use, the desired functions, the available space, the servicing requirements and the cost.

A number of different valve types together with their specific functions and uses are listed below.

- **Monobloc valves** - compact and integrated, ideal for simple applications

Monobloc valves consist of a single block in which all the required functions are integrated. They normally have several ports and control valves in a compact housing. Due to their compact design and various integrated functions, such as pressure and flow regulation as well as directional control, they find frequent application in mobile hydraulics. They are particularly noted for being easy to install. Adding further control valves into a configured monobloc valve is impossible or possible only to a limited extent.

- **Pipeline installation valves** – flexible and modular, for direct installation in pipelines

Pipeline installation valves are designed to fit in a compact housing and are intended exclusively for installation in hose lines and pipelines. Pipeline installation valves are available in many forms, including check, shut-off, flow, pressure and directional valves. Flexible in application, they are easy to install into existing hydraulic systems and are thus an efficient way of modification. Because of their form of construction, pipeline installation valves require more installation space in the case of more complex systems and therefore are frequently used in simpler mobile and stationary hydraulic systems.

- **Cartridge valves** - space-saving and compact, ideal for complex control blocks

Cartridge valves (also known as slip-in or logic valves) are compact and can be used in various types of housings. They are normally used in modular systems where several valves can be arranged together in a block to save space. Therefore, they are frequently used in complex systems in mobile and industrial hydraulics. They are available in many variants, including check, shut-off, flow, pressure and directional valves. Electrical, mechanical, pneumatic and hydraulic actuation are all possible. They can be quickly and easily replaced in the block, thus avoiding disassembly of the whole system. Adding further control valves into a configured cartridge valve is impossible or possible only to a limited extent.

- **Cetop valves** – standardised and modular, good for retrofitting where the system permits

Cetop valves are designed to meet the CETOP standard (Comité Européen des Transports et d'Opérations). They are modular and can be assembled in different configurations as single sections on base plates into a control block or stacked arrangement. Available in many variants, including check, shut-off, flow, pressure and directional valves, Cetop valves are actuated electrically, mechanically, pneumatically or hydraulically and find frequent use in stationary hydraulic systems.

- **Rotary spool valves** – simple valves with high flow rates

Rotary spool valves use a pivoting spool (rotary spool) to control the flow between different ports. They are compact in construction and can control hydraulic fluid flow in various directions. They are used to regulate flow as well as to change the direction of flow. Because of their specific internal construction, these valves are normally hand actuated. They find frequent use in simple mobile hydraulic systems.

3.2.2 Technical parameters

The following parameters are important in choosing the correct valve:

Nominal diameter (DN):

The diameter of the valve connection that determines the maximum flow.

Maximum pressure (p_{max}):

The maximum working pressure for which the valve is designed (given in bar, psi or MPa). Attention! Some valves have different maximum working pressures for their various ports P or T. This must be considered in particular when installing valves in series.

Flow rate (Q):

The maximum flow rate that the valve can allow through at a specific pressure loss, typically expressed in l/m.

Oil viscosity:

The viscosity range in which the valve works effectively, normally expressed in cSt (centistokes) or mm²/s.

Temperature range:

The permissible temperature range given for the operation of the valve in °C. Two different permissible temperature ranges need to be considered: one for the pressure fluid and the other for the ambient temperature.

Pressure surges:

Information about the opening and closing behaviour of the valve with particular reference to sudden changes in pressure.

Sealing performance:

The ability of the valve to prevent internal leaks both in the closed and in the open state.

Materials:

The materials used for the housing, seals and other components that influence the ability to withstand pressure, the chemical resistance and thus the service life of the valve.

Actuation:

The type of actuation (e.g. electrical, pneumatic, hydraulic, mechanical) and the actuation force required.

Installation type:

The specific dimensions and geometric requirements for installation of the valve into the system. (Refer to point 3.2.1)

Service life:

The expected service life (switching cycles) of the valve in defined operating conditions.

Functional principle:

Valve type with reference to pressure, flow, shut-off or directional valves, (if applicable, special types of valve or proportional control valves).



All values, characteristic curves and information about the technical parameters must be taken from the specific product data sheets of the component manufacturer and the associated operating instructions.

4. Installation, commissioning, servicing

4.1 General installation and assembly rules for switching valves

Before the valve is installed, the type designation of the valve must be compared with that in the documentation of the hydraulic system or the order.

The hydraulic system must be flushed clean to meet the manufacturer's required minimum cleanliness codes.



Please note!

It is important to achieve the highest level of cleanliness of the valve base and the mounting plate. The mounting surfaces must be dry and oil-free.

Use only lint-free cloths or special paper for cleaning.

Other points to observe:

- Clean working environment
- Secure the installation site (e.g. protect oil containers from external contaminants)
- Clean the connecting ends of pipes and hose lines before installation
- Use seamless precision steel tubes in accordance with DIN 2391
- Mounting screws must have the dimensions and strength classes given in the data sheet and the specified torque must be observed.
- In the case of more than 4 mounting screws, the middle screws must be tightened first. Do not tighten the screws using powered tools if oil-free assembly cannot be avoided. Only in this way can an adequate seal be achieved.
- Sealing rings for the connection holes must correspond with the dimensions given in the data sheet.
- The surface quality of the mounting surface must comply with the manufacturer's requirements
- Use permitted sealing materials only
- Ensure adequate future working space (e.g. for the installation, replacement of solenoids and connection plugs)
- Fluid transfer filters must have at least the filter fineness of the filters presently used in the hydraulic system
- During flushing processes, all the filters (filter elements) must be checked at short intervals
- Keep oil containment mats or oil binding agents available in the immediate working area
- Dispose of oil-containing operating materials in the containers labelled for that purpose

4.2 Installation position

Directional valves should preferably be installed horizontally.

Valves without a spring-centralised control piston or with a downward-orientated solenoid may be subject to malfunctions or may not perform as well as indicated in the data sheet.

4.3 Electrical connection

Terminal assignments and examples of circuits can be found in the manufacturer's data sheet or the hydraulic system documentation.

4.4 Pressure fluid

Observe the recommendations in the manufacturer's data sheet and the pressure and temperature ranges!

In general the following pressure fluids can be used:

- Mineral oil (HL, HLP) in accordance with DIN 51524 suitable for NBR and FKM seals
- Biodegradable pressure fluids in accordance with VDMA 24568
 - HEPG (polyglycols) Suitable only for FKM seals!
 - HEES (synthetic esters) Suitable only for FKM seals!
 - HETG (rape seed oils) Suitable for NBR and FKM seals

Other pressure fluids on request!

4.5 Seal materials



Check the seal materials!

FKM seals (Viton) must be used for certain pressure fluids (see point 4.1.4) and for operating temperatures **in excess of 80 °C**.

4.6 Filtration



Please observe the maximum permissible level of contamination of the pressure fluid given in the manufacturer's data sheet

Other points to observe:

- Use a filter with a clogging indicator
- The permissible differential pressure at the filter element must not be exceeded
- Ensure extreme cleanliness during the replacement of a filter element!
- Use only lint-free cloths or special paper for cleaning

4.7 Bleeding

Solenoid-operated directional control valves with a switching time delay or proportional functions must be bled of air. In order not to detrimentally affect functionality, the tank line should be prevented from running at reduced pressures e.g. by the use of suitable precharging valves.

4.8 Servicing

Switching valves are normally maintenance-free. However, seals undergo an ageing process depending on the conditions of use and the operating hours. Seals should be replaced when necessary and in accordance with the provisions of point 4.5.

4.9 Storage

For longer periods of storage (longer than about 6 months), the valve housing must be filled with corrosion protection oil and sealed. The place of storage must be dry, dust-free and free of corrosive vapours.

5. Disposal information

Hydraulic oil, hydraulic hose lines, hydraulic components and electronic components or devices may not be thoughtlessly placed in the ordinary refuse; they must be collected and disposed of in accordance with the applicable waste disposal regulations. The national requirements of the respective country and, if appropriate, the information given in the safety data sheets must be observed.