



HANSA FLEX

TECHNICAL
INFORMATION
**HYDRAULIC
ACCUMULATORS**

Technical information Hydraulic accumulators

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1. General

The installation, commissioning and maintenance 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.

Hydraulic accumulators (pressure accumulators in hydraulic systems) are pressure vessels in which, depending on the intended purpose, a specific useful volume is stored. This volume of stored liquid can be reintroduced into the system as required without any additional auxiliary energy being necessary.

Hydraulic accumulators basically consist of a liquid part and a gas part with a gas-tight separating element. The liquid part remains connected to the hydraulic circuit with the result that, when pressure increases in the circuit, the gas on the gas-side of the separating element is compressed.

In the same way, if the pressure falls in the circuit, the compressed gas expands and the stored liquid (here hydraulic fluid) is displaced into the circuit again.

Hydraulic accumulators are used for various purposes, e.g.:

- Storage and return of energy
- Pulsation damping
- Leak and volume compensation
- Hydraulic shock absorber / suspension systems
- Shock absorption
- Media separation
- Suction flow stabilisation
- Emergency actuation

2. Safety instructions

The maximum loads (volumetric flows, pressures, forces, temperatures) given in the product documentation must not be exceeded.

The operator (the employer) of the system must ensure that:

- The safety instructions and operating manuals are available and complied with
- The product is used for the intended applications stated in the operating and installation instructions and on the identification plate
- The currently applicable accident prevention and installation regulations are observed
- The permissible operating data and conditions of use are complied with
- Safety devices are used and the prescribed maintenance works are carried out

Please take care to keep the documents accompanying the product safe. They are required for the recurring in-

spections by experts. They also contain the serial number of the accumulator.

Hydraulic accumulators must be made safe against exceeding the maximum allowable working pressure in accordance with the Pressure Equipment Directive 2014/68/EU (PED) by the installation of pressure relief valves.

DIN EN ISO 4413 gives general rules for hydraulic accumulators.

Other important regulations and standards for pressure accumulators:

- Pressure Equipment Directive 2014/68/EU (PED)
- 14th Product Safety Ordinance (14th ProdSV) (German Ordinance on the Safety of Pressure Equipment - DGV)
- DIN EN 14359
- German Industrial Safety Act (BetrSichV)
- TRBS 1111 (currently not in force – continues to be valid as a source of information)

There is no specific requirement to use a safety and isolation block for the operation of hydraulic accumulators. Only within the framework of ordinances and standards are there individual requirements for components that would be found in combination in a safety and isolation block. It is also possible to incorporate these components or functions individually in the system.

However, HANSA-FLEX recommends the use of safety and isolation blocks in order to ensure overpressure protection for a hydraulic accumulator.

Caution! Even hydraulic accumulators that are not included in the systems requiring monitoring in accordance with the German Ordinance on Industrial Safety and Health (German Industrial Safety Act – BetrSichV) and must therefore be considered as work equipment must be protected against non-permitted exceeding of the design parameters or fitted with safety devices.

Legal provisions

Hydraulic accumulators are pressure vessels and are subject to the national regulations or ordinances of the place of use. In Germany, this is the Ordinance on Industrial Safety and Health (German Industrial Safety Act – BetrSichV). In special applications, additional rules and regulations apply as necessary, for example in shipbuilding, aircraft manufacture and mining.

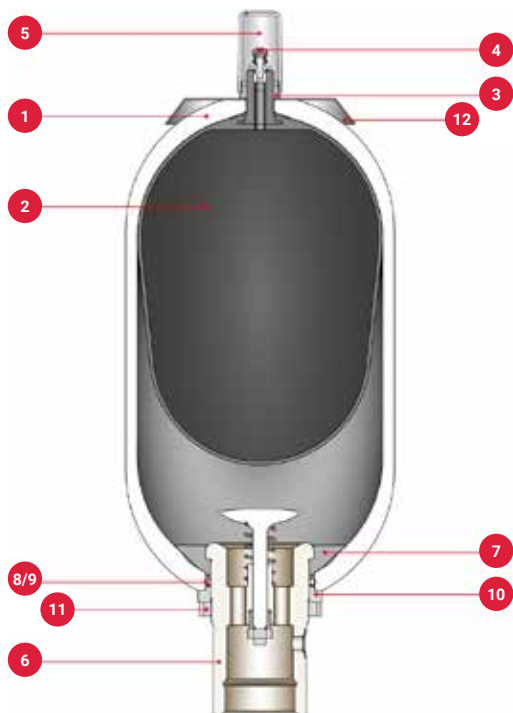
Authorised persons

In accordance with the Ordinance on Industrial Safety and Health (German Industrial Safety Act – BetrSichV), inspections may be performed only by authorised persons. Authorised persons are people who have the required specialist knowledge by virtue of their vocational education and training, professional experience and contemporary work activities.

3. Technical information

3.1. Construction

Bladder accumulator



Designation	Material
1 Vessel body	Steel
2 Bladder	NBR
3 Retainer nut	Steel
4 Gas-side valve	Stainless steel
5 Protective cap	PA6
6 Oil-side valve	Steel
7 Split ring	Steel/elastomer
8 O-ring	Elastomer
9 Support ring	PTFE
10 Spacer ring	Steel
11 Slotted nut = threaded ring	Steel
12 Identification plate	Aluminium

Diaphragm accumulator



Designation	Material
1 Housing	Steel
2 Diaphragm	Elastomer
3 Gas filling connection	Steel
4 Clamping ring	Steel
5 Diaphragm disc	Plastic
6 Fluid connection	Steel

3.2. Installation instructions / assembly

Bladder accumulator

- Bladder accumulators should be installed vertically or, under certain conditions, horizontally, with the fluid valve at the bottom.
- Vertical installation with the fluid valve at the top must be avoided.
- Bladder accumulators must be adequately secured and fastened in place because of their high self-weight and the acceleration forces additionally created in the bladder accumulator by the hydraulic fluid.
- Bladder accumulators should always be installed on a bracket with a rubber ring and secured against overturning with a clamp!
- Bladder accumulators must be fastened in place such that they are securely held in the event of a pipeline break or shaking under operating conditions.

Diaphragm accumulator

- Diaphragm accumulators with a volume greater than 2.0 litres must be adequately secured in place because of the high self-weight and the acceleration forces additionally created in the hydraulic accumulator by the hydraulic fluid.
- The accumulator must be fastened in place such that it is securely held in the event of a pipeline break or shaking under operating conditions.
- Suitable clamps must be used.
- A diaphragm accumulator can be installed in any desired position. A clearance of 200 mm must be allowed above the gas connection for testing and filling equipment.
- Diaphragm accumulators should be filled on the gas-side at a maximum precharge pressure of 130 bar, to prevent serious damage of the diaphragm.
- Diaphragm accumulators (even those with $V < 1$ litre) must be protected against excess pressure in accordance with the Pressure Equipment Directive 2014/68/EU (PED).

Gas filling and fastening in place

Hydraulic accumulators must be filled only with nitrogen grade 4.0 (N₂ 99.99 % by Vol.).

The accumulator must be fastened in place in such a way that any forces caused, for example by vibrations or accelerations due to operating conditions, can be safely absorbed. In the case of more than one fastening point, imposed strains due to operating conditions, deformations or temperature expansion in the structure must be avoided.

HANSA-FLEX can provide appropriate fastening clamps for this purpose.

3.3. Technical parameters

The standard range of hydraulic accumulators supplied by HANSA-FLEX have the following parameters:

Bladder accumulator

Volume	1 – 50 ltr.
Transport filling	Approx. 2 bar
Working pressure	Max. 350 bar
Materials	Carbon steel
Media	HFC, HLP, HFD, ...
Temperature	-15 °C to +80 °C
Installation position	Preferably vertical, gas-side top
Oil/gas valve	Carbon steel
Fluid connections	Internal or external thread G
Bladder (elastomer)	NBR
Approval	PED 2014/68/EU, ASME, ML China, NR13, EAC, GL, ABS, BV, DNV, Canada, CCS, LRS, RINA

Diaphragm accumulator

Volume	0.075 - 3.5 ltr.
Transport filling	Approx. 2 bar
Working pressure	Max. 350 bar
Materials	Steel
Media	Fluid group 2 PED 2014/68/EU (mineral oil-based)
Temperature	-40 °C to +80 °C
Installation position	Preferably vertical, gas-side top
Pressure vessel	Welded
Oil/gas valve	Carbon steel
Fluid connections	Internal thread G1/2" - G3/4"
Bladder (elastomer)	NBR, ECO
Approval	PED 2014/68/EU

4. Maintenance/ inspections

The scheduled intervals for recurring inspections are specified in the BetrSichV (or the corresponding national regulations in the country of use). The operator must ensure that the systems requiring monitoring are inspected on a recurring basis for their safe condition with respect to their operation. Inspections must be carried out by an approved inspection body (ZÜS) or an authorised person (bP) qualified to perform these inspections.

HANSA-FLEX recommends the following based on §16 of the BetrSichV:

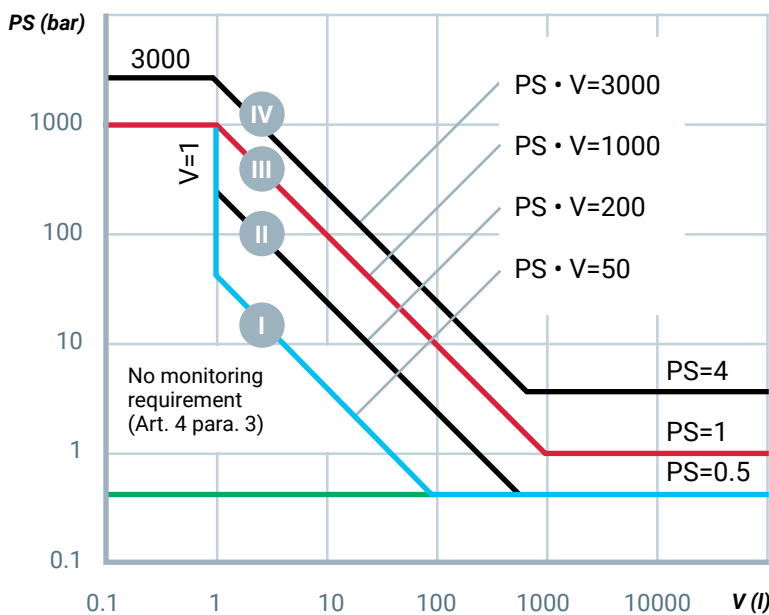
- External inspection every 2 years
- Internal inspection every 5 years
- Pressure inspection after 10 years at the latest (depending on the number of load cycles)

4.1. Recurring inspections

The operating manual, manufacturer’s documentation for the machine or the hydraulic accumulator, the operator’s records of the inspection before commissioning (putting into service) and the general risk assessment must be made available for the recurring inspections. The manufacturer’s information about the recurring inspections must be observed.

All hydraulic accumulators classified as categories I (unless installed in a machine) to IV in accordance with the PED are systems requiring monitoring and must undergo specified recurring inspections in accordance with BetrSichV. The recurring inspections are subject to the provisions of §§ 15-17 of the BetrSichV.

The recurring inspections of hydraulic accumulators of category I (unless installed on a machine) to IV in accordance with the PED, must include, among other things, checks to verify that the hydraulic accumulator still has the CE marking and the operating manual is available as well as that the equipment still has the safety devices fitted and that they are correctly set.



In the recurring inspection, it must also be checked that the assumptions for the next inspection interval still apply. The design pressure PS of the hydraulic accumulator is not the determining factor in specifying the inspections; instead it is determined by the allowable working pressure PB made safe by the safety equipment. If the working pressure of the hydraulic accumulator changes after commissioning, then in certain circumstances this may change the inspection requirements, e.g. a repeated “inspection before commissioning”.

Figure 1: Chart 2 in accordance with Annex II of the PED for vessels for gases (also superheated liquids) of fluid group 2 with inspection responsibilities for the recurring inspection (§15 BetrSichV)

4.2. Inspection by the approved inspection body (ZÜS)

For hydraulic accumulators in categories III and IV in accordance with the PED and with a pressure-volume coordinate point above the red line (see Fig. 1), the recurring inspection must be performed by an approved inspection body (ZÜS).

For the pressure equipment mentioned above, the internal inspections in accordance with the table in paragraph 5 §15 of the BetrSichV are to be performed at least every 5 years and the strength inspection at least every 10 years. The interval between internal inspections can be extended to 10 years in accordance with Annex 5 No. 2 paragraph 1 of the BetrSichV if the fluid group 2 fluids used are liquids or gases that have no corrosive effect on the pressure-carrying walls.

This is to be checked on a case-by-case basis.

The recurring strength inspection normally takes the form of a liquid pressure test at a pressure of at least 1.3 times the allowable working pressure (see TRBS 1201-2). In the case of new hydraulic accumulators in accordance with the PED, the test pressure can be a factor of 1.43 times the allowable working pressure providing that the manufacturer of the hydraulic accumulator has carried out the initial pressure test using this test pressure factor. As a rule the following applies: with the recurring liquid pressure test, the test pressure may not be higher than the test pressure applied by the manufacturer for the initial inspection.

Please note: For more information on the performance of the recurring inspection see TRBS 1201-2.

The internal inspection consists of a visual inspection of the internal walls of the hydraulic accumulator and the safety-relevant equipment. If possible, the manufacturer of the hydraulic accumulator should give recommendations, which must be taken into account by the inspector.

Surface cracking inspection using a dye penetration test or magnetic powder inspection is not recommended as worthwhile for piston accumulators because the running surface of the hydraulic accumulator must be made free of residual material again on reassembly after the inspection. This leaves only an ultrasound test. If an internal inspection of the hydraulic accumulator is impossible due to the dimensions, then a pressure test would be a suitable alternative. Depending on the size of the hydraulic accumulator, in certain circumstances the existing hydraulic accumulator could be replaced with the new one.

An external inspection is required only on pressure equipment at risk of overheating. This does not apply to hydraulic accumulators.

4.3. Inspection by an “authorised person” in accordance with TRBS 1203 No. 3.2

For hydraulic accumulators in category I as well as for hydraulic accumulators in categories II and III with a working pressure of a maximum of 1 bar, i.e. for hydraulic accumulators with a pressure-volume coordinate point between the blue and red lines (see Fig. 1), a recurring inspection must be carried out by an authorised person in accordance with TRBS 1203 No. 3.2.

Recurring internal inspections and recurring strength inspections are also required for category I hydraulic accumulators, provided they are not installed in machines and therefore do not fall under the exclusion of the application of the PED, and for category II hydraulic accumulators in accordance with the PED. The operator must state the scheduled intervals for the inspections at the time of commissioning.

The inspection intervals given in the table in §15 para. (5) of the BetrSichV are intended only to be guidance values for hydraulic accumulators of categories I and II in accordance with the PED.

The operator determines the inspection intervals based on the manufacturer's information and his experience of the operating conditions. The recurring inspection must be carried out by an authorised person. Further information about the strength inspections and the test pressure can be found in TRBS 1201-2.

4.4. Hydraulic accumulators “in accordance with PED Art. 4 para. 3”

Hydraulic accumulators in accordance with Art. 4 para. 3 of the PED, i.e. with a pressure-volume coordinate point between the green and blue lines (in the range 0.1 L and 1 L volume below the red line, see Fig. 1) are not pressure systems requiring monitoring.

These hydraulic accumulators are considered work equipment according to the BetrSichV. However, the operator must specify the appropriate protective measures based on a risk assessment and, if necessary, have an inspection in accordance with § 3 para. 3 of the BetrSichV by an instructed person (e.g. an inspection carried out by the operator on each working day) and, if necessary, inspections in accordance with §10 of the BetrSichV carried out by an authorised person in accordance with TRBS 1203 No. 2.

5. Information about transport and disposal

5.1. Transport

Hydraulic accumulators are classified in UN3164 as dangerous goods, irrespective of their level of filling.

In accordance with special regulation SV 594, these accumulators are not subject to the regulations of the Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) provided certain specific requirements are fulfilled.

In accordance with SV 594, the following items that have been manufactured to the regulations of the country of origin, filled and packed in strong external packaging are not subject to the regulations of the ADR:

- UN 3164: Items under pneumatic or hydraulic pressure that have been over-dimensioned in terms of force-transfer, deformation stiffness or manufacturing standards for the forces from the internal pressure of the gas.

The ADR packing instruction P200 states the following with respect to the filling pressure:

- The receptacles shall be closed and leakproof so as to prevent escape of the gases.
- Pressure receptacles must not in any circumstances be filled above the limit approved in the following regulations. For compressed gases, the working pressure may not be greater than two-thirds of the test pressure of the pressure receptacle. The internal pressure at 65 °C must not exceed the test pressure under any circumstances.

This means that hydraulic accumulators are not subject to the regulations of the ADR when shipped by road transport, provided that:

- The nitrogen filling pressure p_0 is no more than 2/3 of the test pressure
- A suitable, strong outside packaging is used
- In the case of bladder accumulators, the gas valve should be particularly well protected

Caution! The accumulator must be empty (i.e. not filled) for air transport!

5.2. Storage

Hydraulic accumulators must be stored in cool and dry conditions, ideally in the horizontal position. They must not be exposed to heat or flame.

Hydraulic accumulators must be stored such that they cannot slide out of position and that any possible damage in particular to the gas valve is prevented.

If hydraulic accumulators have been stored for more than 5 years, then all the elastomeric components must be replaced before commissioning the accumulator.

If a hydraulic accumulator has been stored for more than 2 years, then as part of commissioning, a new internal inspection must be performed by a Notified Body / approved inspection body (ZÜS).

It is not recommended that hydraulic accumulators with a nitrogen precharge pressure p_0 are stored for a long period of time.

5.3. Disposal

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.

Mark any hydraulic accumulators that are no longer to be used or are to be permanently put aside to prevent reuse.

When disposing of hydraulic accumulators, the following points must be observed:

Caution! Danger of bursting due to excessive pressure inside the gas-charged pressure vessel caused by the effect of heat! Risk of injury and fire!

- Observe the procedures and safety instructions in the operating manual.
- Before disposal, ensure that the gas filling pressure in the accumulator has been released. The gas filling pressure can increase due to the effect of heat.
- Check the pressure accumulator once more for residual pressure before removing the oil valve.
- If necessary, relieve the gas filling pressure before taking the accumulator apart.
- Empty the accumulator completely.
- Disassemble bladder accumulators into their individual components to allow them to be taken for recycling.
- Dispose of the bladder and the steel components separately.
- Remove the gas filling screw from diaphragm accumulators.