Diaphragm accumulator type AC

Product documentation

Operating pressure p_{max}:	350 bar
Nominal volume $V_{0\ max}$:	3.5 dm^3

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1 Overview diaphragm accumulator type AC

Diaphragm accumulators are a type of hydraulic accumulator. They are used primarily for hydraulic damping, as energy stores and for pressure and flow rate equalisation.

In the type AC diaphragm accumulator, and diaphragm separates the compressible gas cushion from the hydraulic fluid. It can be used in many ways as a source of pressure. Because of its size it falls within the scope of the Pressure Equipment Directive 2014/68/EU.

Different installation positions and mounting positions are available. Various different fittings make it simple to integrate the hydraulic accumulator type AC into a hydraulic system.

Diaphragm accumulator type AC

Features and benefits

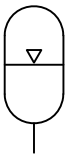
- Compact design
- Option of integration with the HAWE modular system
- Operating pressures up to 350 bar

Intended applications

- Machine tools
- Clamping systems
- Test benches
- Accumulator systems

2 Available versions

Circuit symbol AC



Ordering example

AC 0725 AC 1002	/90 /140	/1A /22	- K 1/4

2.4 "Extension"

2.3 "Connecting thread (oil side)"

2.2 "Gas pre-load pressure p_0 (bar)"

2.1 "Basic type"

2.1 Basic type

Type	Nominal volume $V_{0\ max}$ (dm^3)	Max. permissible operating pressure p_{max} (bar)	Max. permissible pressure ratio p_2/p_0	Max. permissible dynamic pressure difference $p_2 - p_1$	CE mark and declaration of conformity
AC 0725	0,075	250	8/1	150	-
AC 202	0,16	250	6/1	150	-
AC 322	0,32	210	8/1	120	-
AC 603	0,6	330	4/1	150	-
AC 752	0,75	210	8/1	140	-
AC 1002	1,0	210	8/1	140	-
AC 1035	1,0	350	4/1	150	-
AC 1402	1,4	210	8/1	90	●
AC 2001	2,0	100	6/1	65	●
AC 2002	2,0	250	6/1	140	●
AC 2825	2,8	250	6/1	140	●
AC 3503	3,5	350	4/1	150	●

2.2 Gas pre-load pressure

Type	Max. gas pre-load pressure p_0 (bar)
AC 0725	200
AC 202	130
AC 322	130
AC 603	200
AC 752	130
AC 1002	130
AC 1035	200
AC 1402	130
AC 2001	65
AC 2002	200
AC 2825	130
AC 3503	130

DAMAGE
possible values: 0 bar or 20 ... $p_{0\ max}$ bar

see Chapter 6.1, "Layout instructions"

2.3 Connecting thread

Type	Connecting thread	
	Coding	Description
AC 0725	/1A	- G 1/4 A *
AC 202	/1A /2A /2AW /3 /3A	- G 1/4 A - G 3/8 A - G 3/8 A, angle - G 1/2 (internal thread) ** - G 1/2 A
AC 322	/1A /2A /2AW /3 /3A	- G 1/4 A - G 3/8 A - G 3/8 A, angle - G 1/2 (internal thread) ** - G 1/2 A *
AC 603	/1A /2A /2AW /3 /3A	- G 1/4 A - G 3/8 A - G 3/8 A, angle - G 1/2 (internal thread) ** - G 1/2 A
AC 752	/2A /2AW /3 /3A	- G 3/8 A - G 3/8 A, angle - G 1/2 (internal thread) ** - G 1/2 A
AC 1002	/22 /2A /2AW /3 /3A /3AW	- M22x1.5 (internal thread), M33x1.5 (male thread) * - G 3/8 A - G 3/8 A, angle - G 1/2 (internal thread) ** - G 1/2 A (male thread) - G 1/2 A, angle
AC 1035	/1A /2A /2AW /3 /3A	- G 1/4 A - G 3/8 A - G 3/8 A, angle - G 1/2 (internal thread) ** - G 1/2 A
AC 1402	/22 /2A /2AW /3A	- M22x1.5 (internal thread), M33x1.5 (male thread) ** - G 3/8 A - G 3/8 A, angle - G 1/2 A
AC 2001	/3A	- G 1/2 A *
AC 2002	/3A /3AW /4	- G 1/2 A - G 1/2 A, angle - G 3/4 (internal thread) **
AC 2825	/1A /2A /2AW /3 /3A	- G 1/4 A - G 3/8 A - G 3/8 A, angle - G 1/2 (internal thread) M33x1.5 (male thread) ** - G 1/2 A
AC 3503	/3A /4A /4	- G 1/2 A - G 3/4 A - G 3/4 (internal thread) **

* without fittings
** Basic version (without fittings), screwed to the fittings for another connecting thread

DAMAGE

- A = Male thread
- W = Angle

2.4 Extension

For type AC 0725

Coding	Description
Without coding	w/o extension
K 1/4	short extension, 31 mm
L 1/4	long extension, 66 mm

3 Parameters

3.1 General data

Design	Hydraulic accumulator (diaphragm accumulator) to the 2014/68/EU Pressure Equipment Directive All types welded
Surface protection	Painted (2-component paint)
Installation position	Vertical (fluid port at the bottom) or horizontal
Attachment	Directly to the pipe screw connection **DAMAGE** Ensure correct mounting on the pipe screw connection. In the event of strong vibrations, secure the accumulator to prevent it from coming loose.
Gas filling	N_2 only (nitrogen)!
Temperatures	▪ ϑ_{Oil}: -10 °C ... +80 °C for types with NBR diaphragm ▪ ϑ_{Oil}: -35 °C ... +80 °C for types with ECO diaphragm
Hydraulic fluid	Hydraulic fluid, according to DIN 51 524 Parts 1 to 3; ISO VG 10 to 68 according to DIN ISO 3448 Viscosity range: 10 - 300 mm^2/s Optimal operating range: approx. 10 - 35 mm^2/s Also suitable for biologically degradable hydraulic fluids type HEPG (polyalkylene glycol) and HEES (synthetic ester) at operating temperatures up to approx. +70°C.
Diaphragm material	

Type	ECO	NBR
AC 0725	●	
AC 202	●	
AC 322	●	
AC 322/3A		● *
AC 603	●	
AC 752	●	
AC 1002	●	
AC 1035	●	
AC 2825	●	
AC 3503	●	
AC 1402		●
AC 2001		●
AC 2002		●

* also available in ECO upon request (with different dimensions)

Service life	1.2 x 10^9 cycles For all other operating conditions the service life in accordance with PD 5500 Annex C must be observed (Pressure Equipment Directive)

3.2 Weight

Diaphragm accumulator	**Type**	
	AC 0725	= 0.8 kg
	AC 202	= 1.0 kg
	AC 322	= 1.4 kg
	AC 603	= 3.0 kg
	AC 752	= 2.7 kg
	AC 1002	= 3.5 kg
	AC 1402	= 4.2 kg
	AC 1035	= 4.7 kg
	AC 2001	= 4.1 kg
	AC 2002	= 8.4 kg
	AC 2825	= 8.6 kg
	AC 3503	= 13.4 kg
Extension	**Coding**	
	K 1/4	= + 0.06 kg
	L 1/4	= + 0.1 kg

4 Dimensions

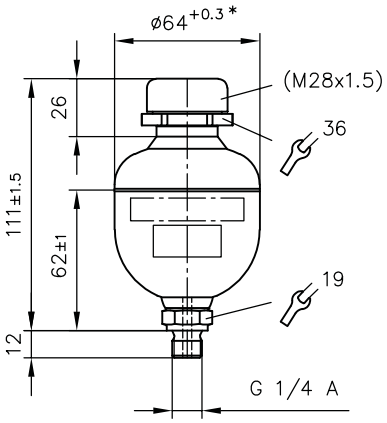
All dimensions in mm, subject to change.

4.1 Diaphragm accumulator

4.1.1 AC 0725

- For variants with male thread (fitting): Fitting seal (included)

AC 0725 /1A



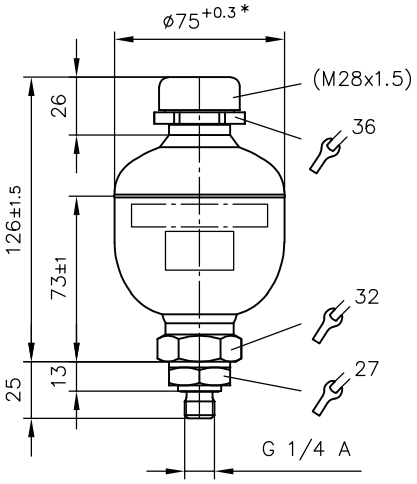
* +1.5 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

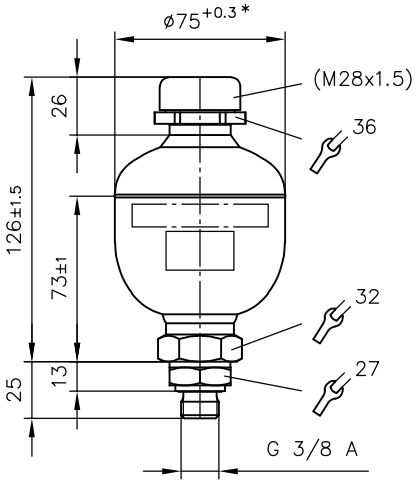
4.1.2 AC 202

- For variants with male thread (fitting): Fitting seal (included)
- For variants with internal thread: without seal (not included). Seal applied by customer.

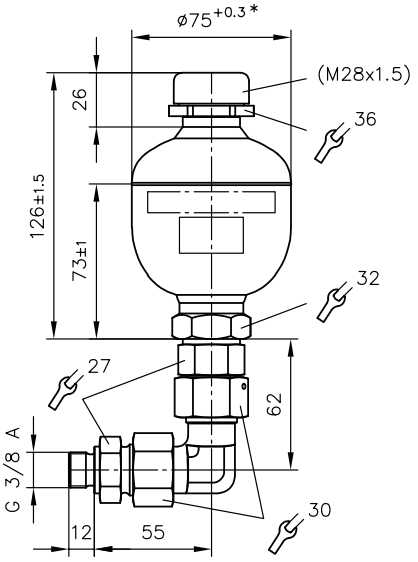
AC 202 /1A



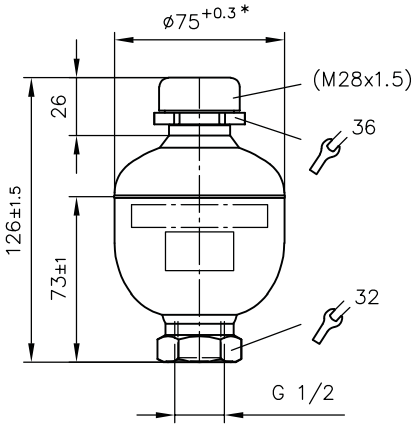
AC 202 /2A



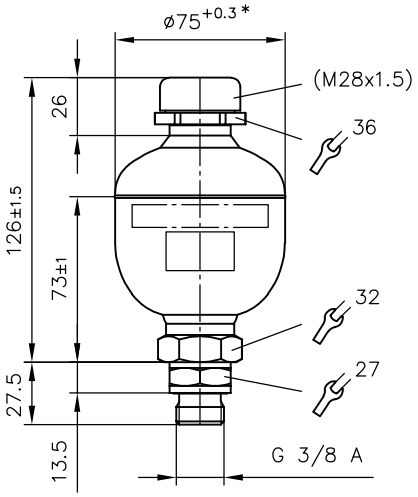
AC 202 /2AW



AC 202 /3



AC 202 /3A



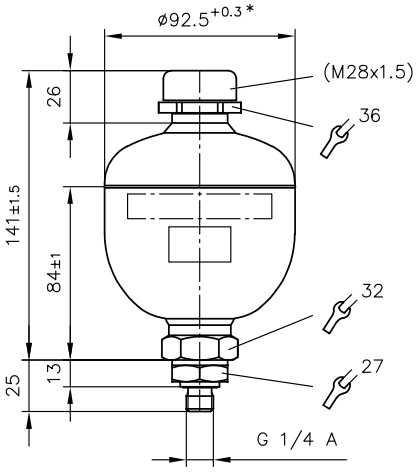
* +1.5 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

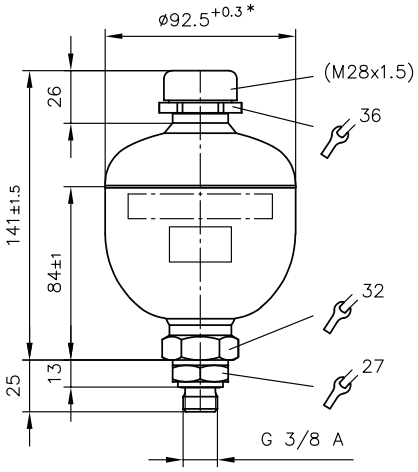
4.1.3 AC 322

- For variants with male thread (fitting): Fitting seal (included)
- For variants with internal thread: without seal (not included). Seal applied by customer.

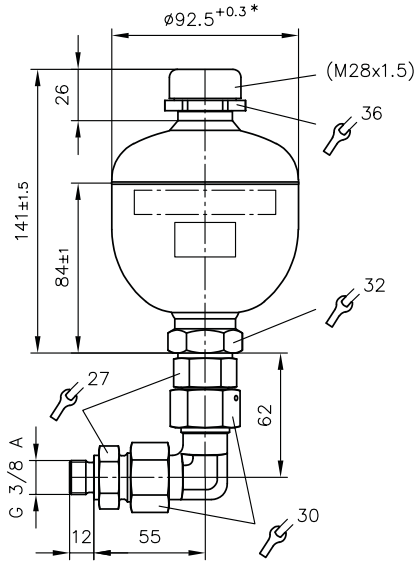
AC 322 /1A



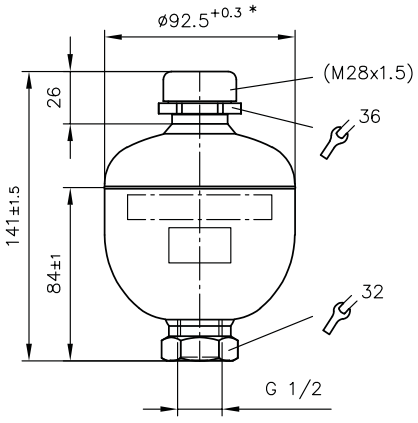
AC 322 /2A



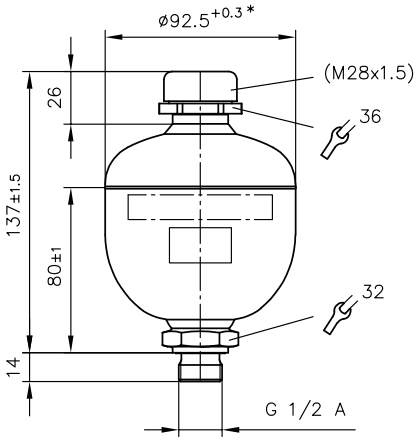
AC 322 /2AW



AC 322 /3



AC 322 /3A



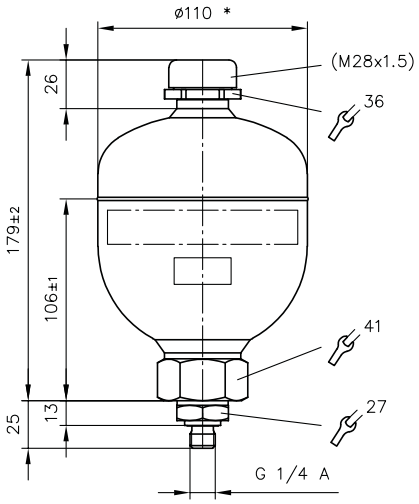
* +1.5 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

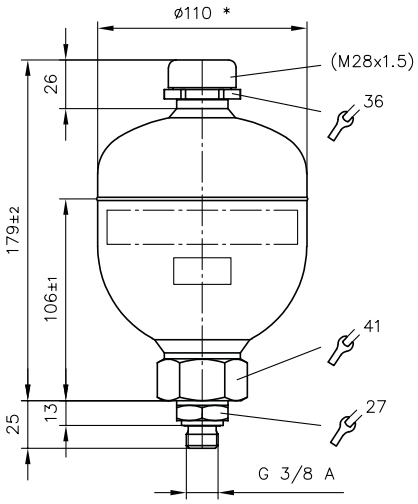
4.1.4 AC 603

- For variants with male thread (fitting): Fitting seal (included)
- For variants with internal thread: without seal (not included). Seal applied by customer.

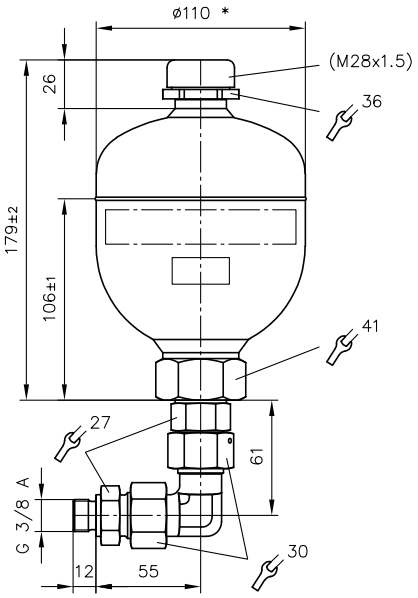
AC 603 /1A



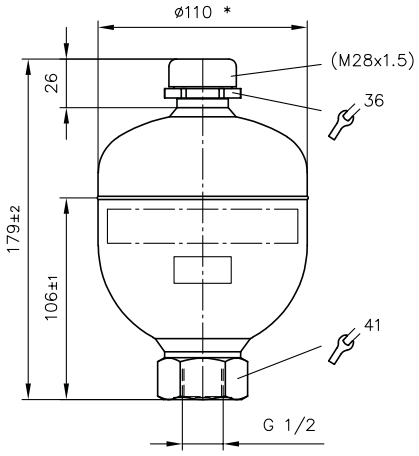
AC 603 /2A



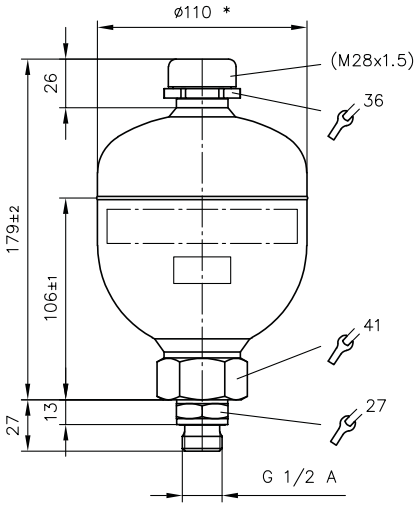
AC 603 /2AW



AC 603 /3



AC 603 /3A



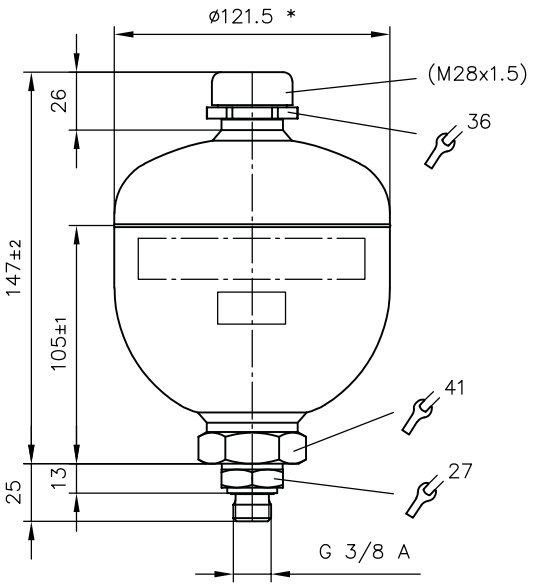
* +1.5 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

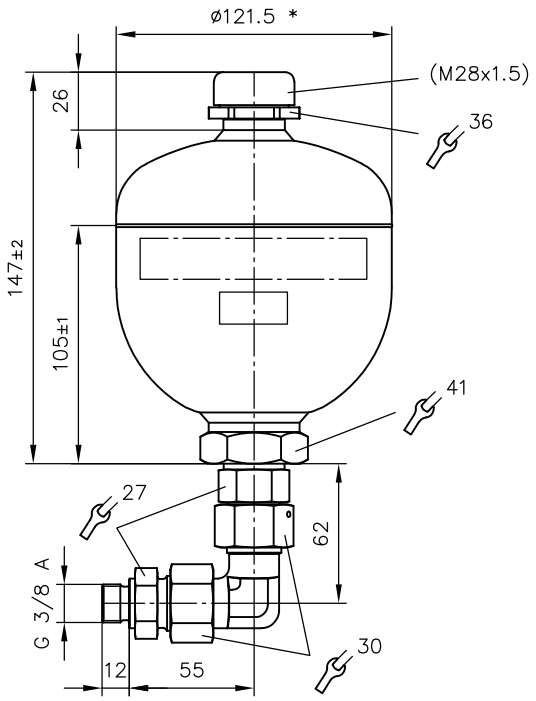
4.1.5 AC 752

- For variants with male thread (fitting): Fitting seal (included)
- For variants with internal thread: without seal (not included). Seal applied by customer.

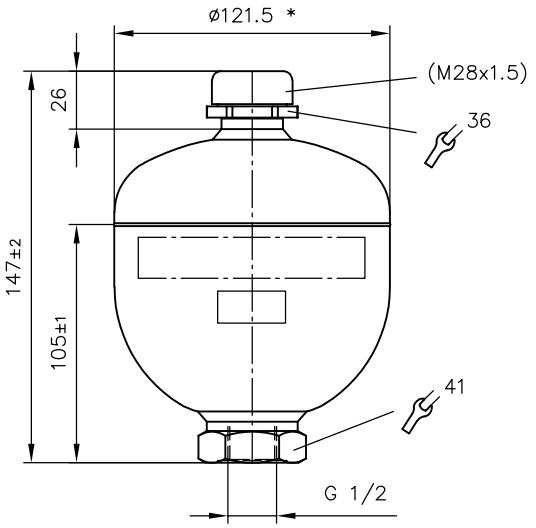
AC 752 /2A



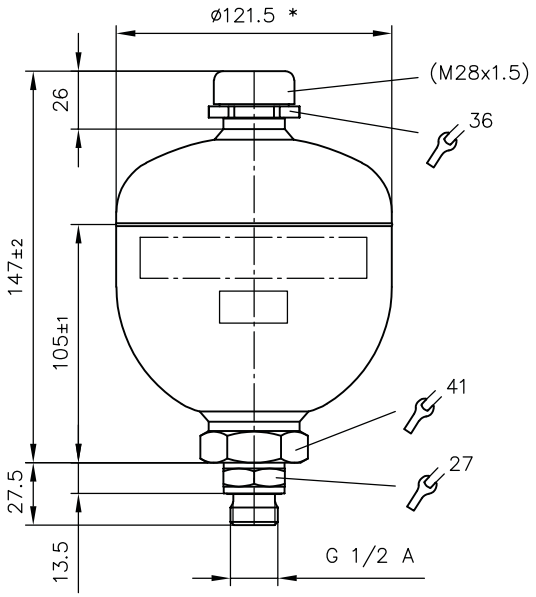
AC 752 /2AW



AC 752 /3



AC 752 /3A



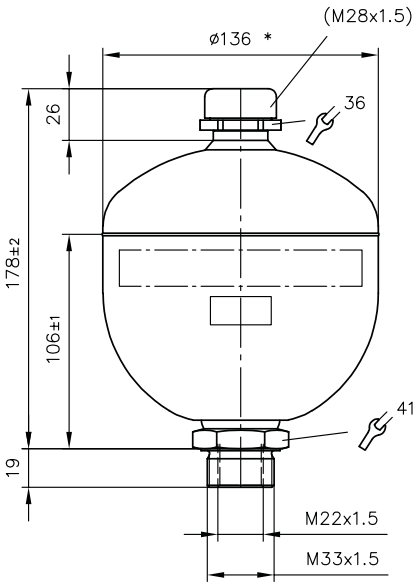
* +2 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

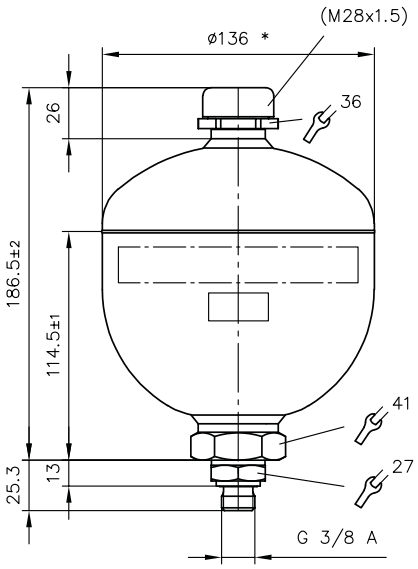
4.1.6 AC 1002

- For variants with male thread (fitting): Fitting seal (included)
- For variants with internal thread: without seal (not included). Seal applied by customer.

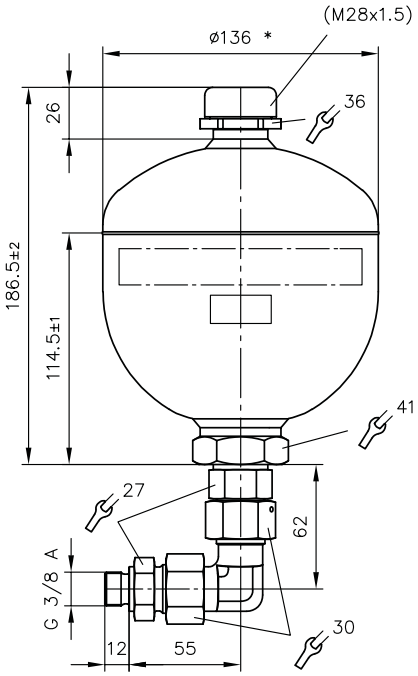
AC 1002 /22



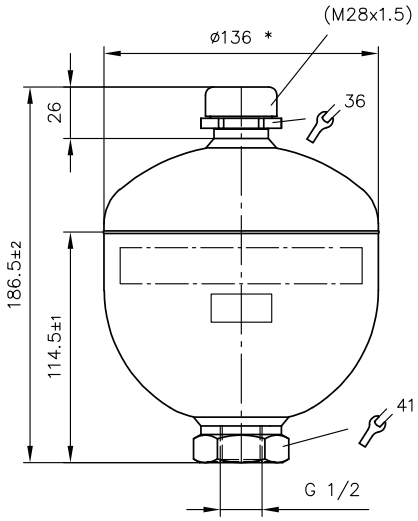
AC 1002 /2A



AC 1002 /2AW



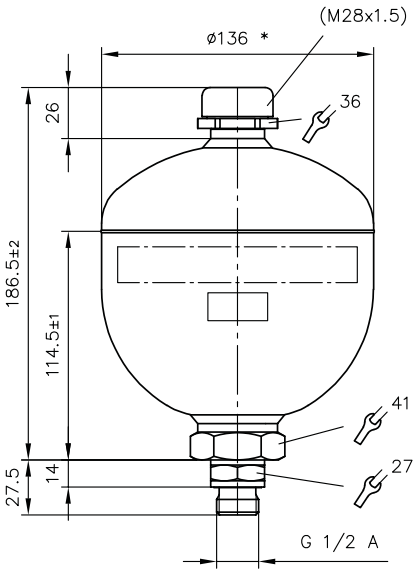
AC 1002 /3



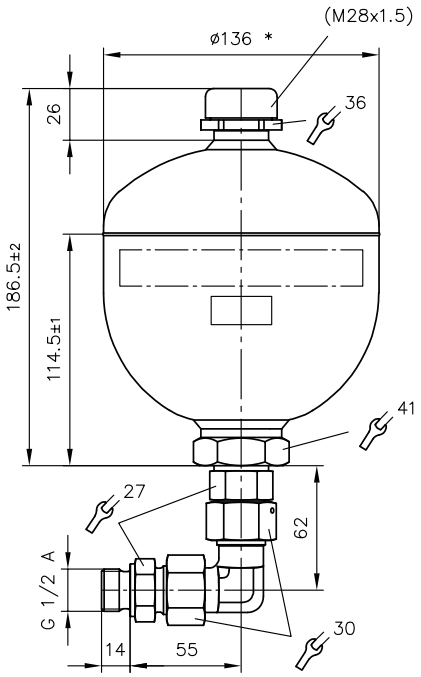
* +3 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

AC 1002 /3A



AC 1002 /3AW



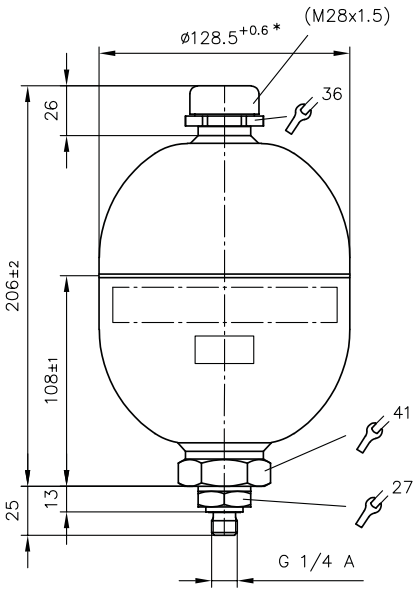
* +3 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

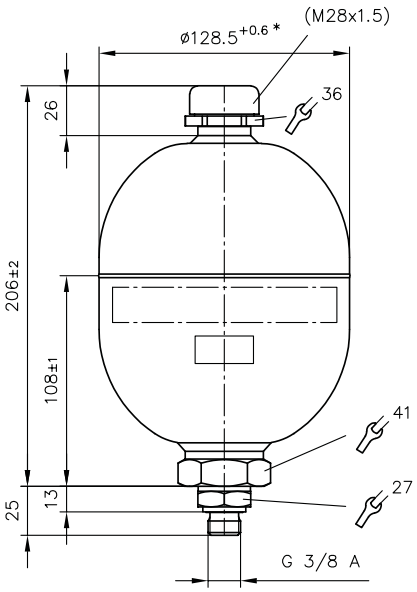
4.1.7 AC 1035

- For variants with male thread (fitting): Fitting seal (included)
- For variants with internal thread: without seal (not included). Seal applied by customer.

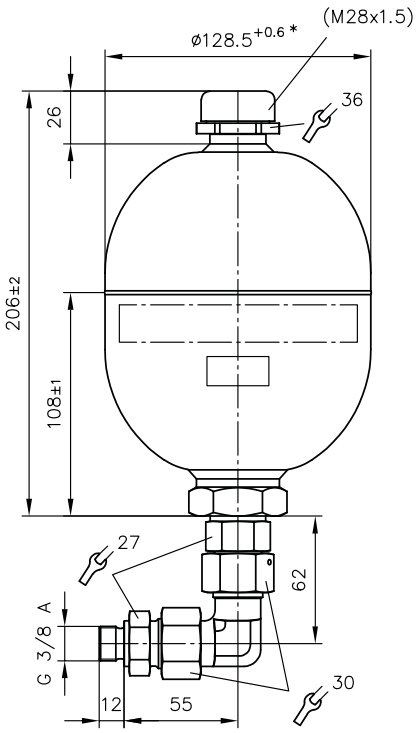
AC 1035 /1A



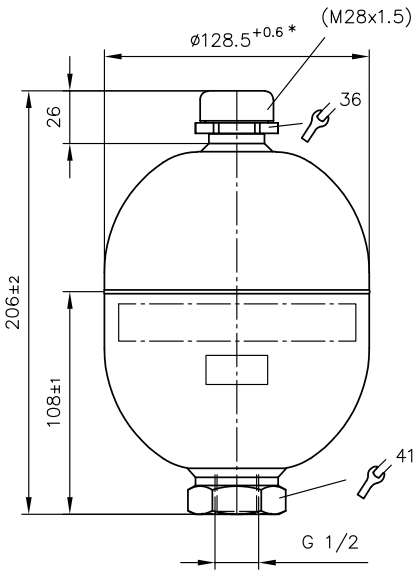
AC 1035 /2A



AC 1035 /2AW



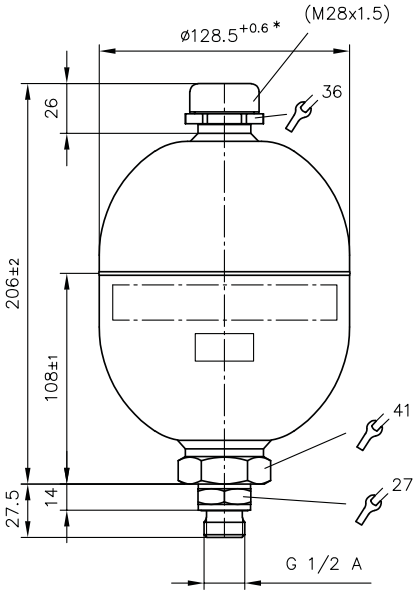
AC 1035 /3



* +2 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

AC 1035 /3A



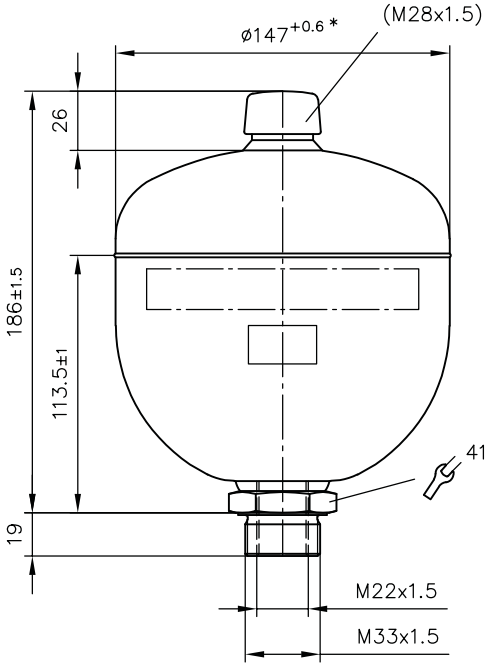
* +2 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

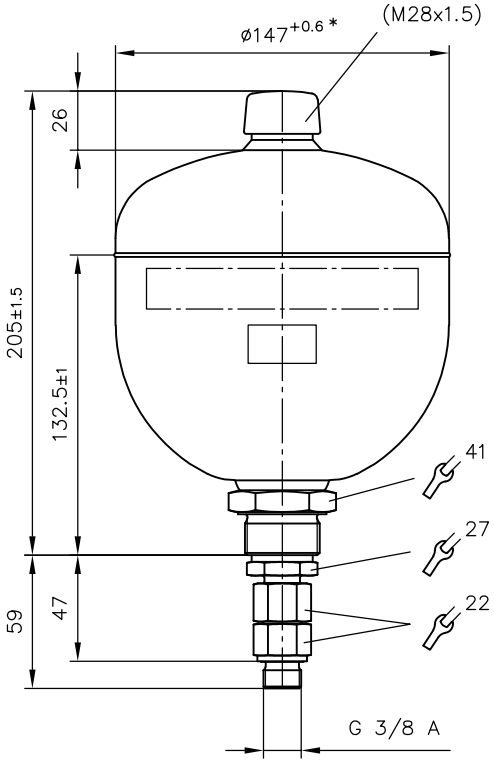
4.1.8 AC 1402

- For variants with male thread (fitting): Fitting seal (included)
- For variants with internal thread: without seal (not included). Seal applied by customer.

AC 1402 /22



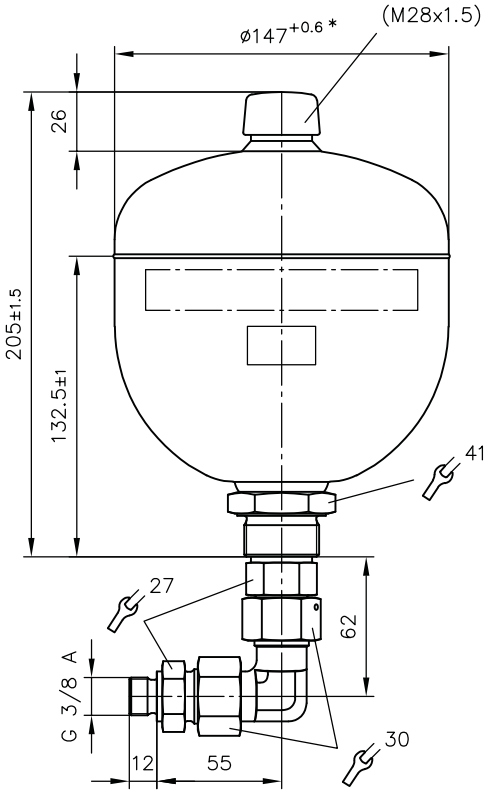
AC 1402 /2A



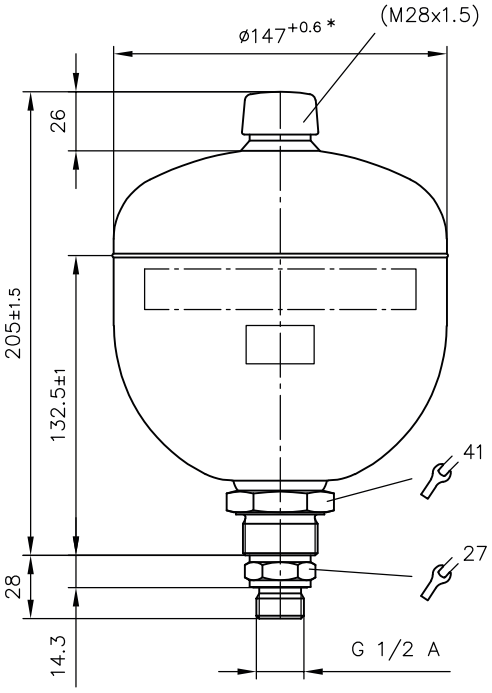
* +2 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

AC 1402 /2AW



AC 1402 /3A



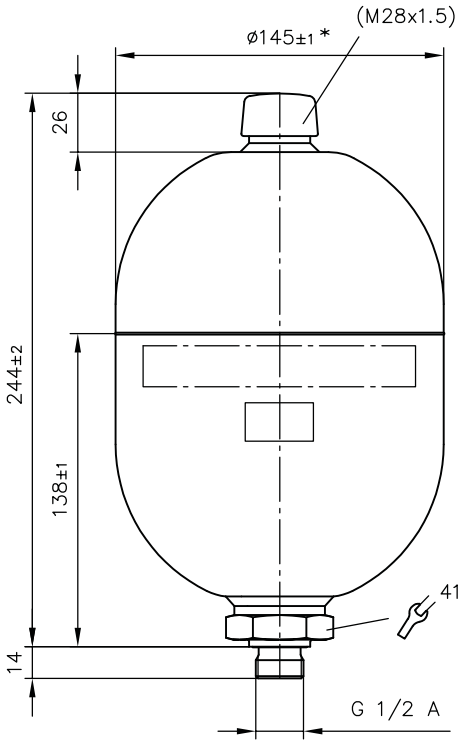
* +2 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

4.1.9 AC 2001

- For variants with male thread (fitting): Fitting seal (included)

AC 2001 /3A



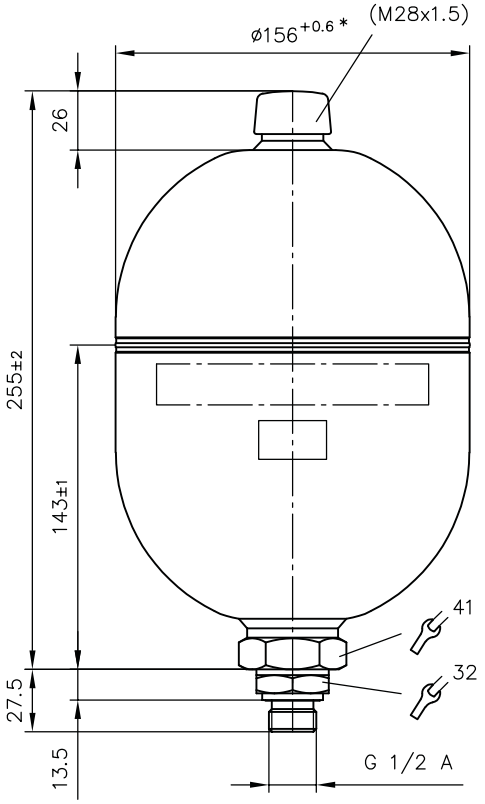
* +2.5 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

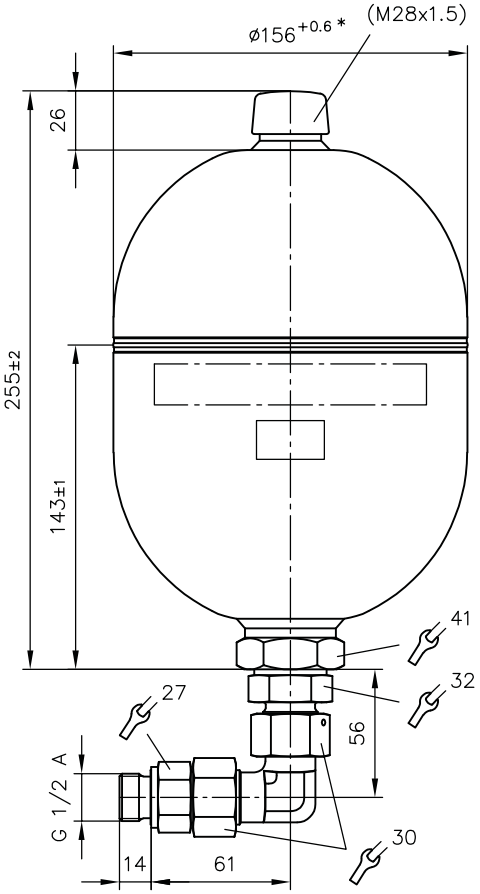
4.1.10 AC 2002

- For variants with male thread (fitting): Fitting seal (included)
- For variants with internal thread: without seal (not included). Seal applied by customer.

AC 2002 /3A



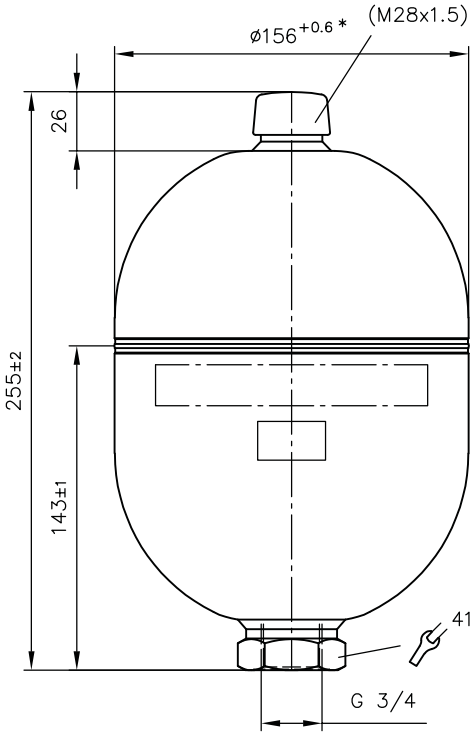
AC 2002 /3AW



* +2 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

AC 2002 /4



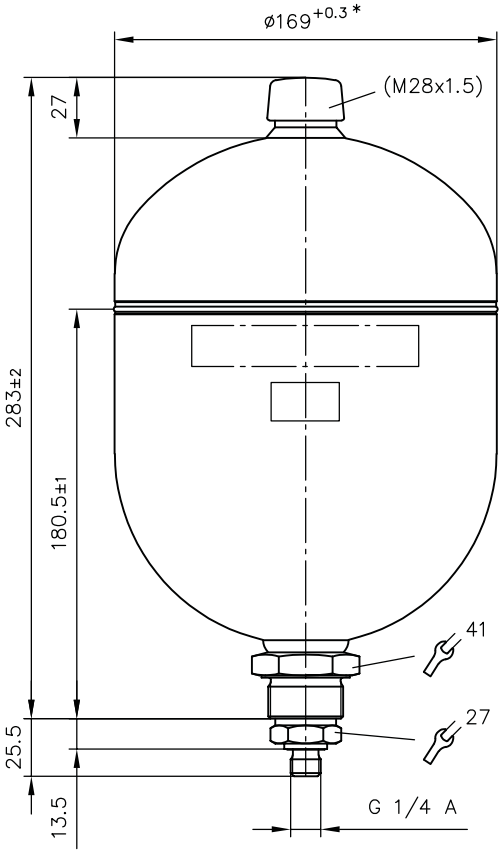
* +2 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

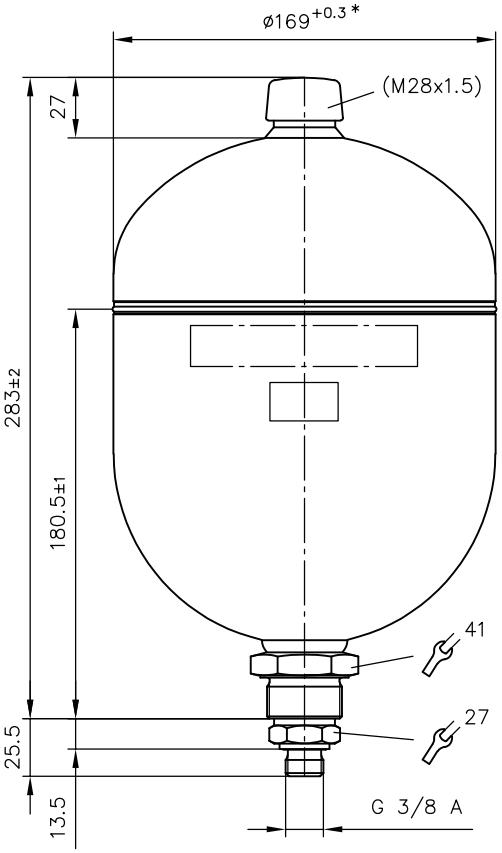
4.1.11 AC 2825

- For variants with male thread (fitting): Fitting seal (included)
- For variants with internal thread: without seal (not included). Seal applied by customer.

AC 2825 /1A



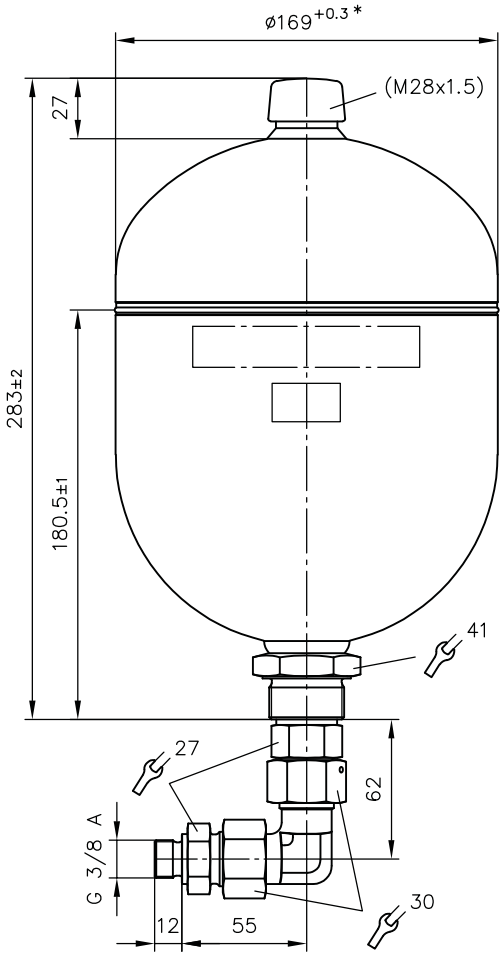
AC 2825 /2A



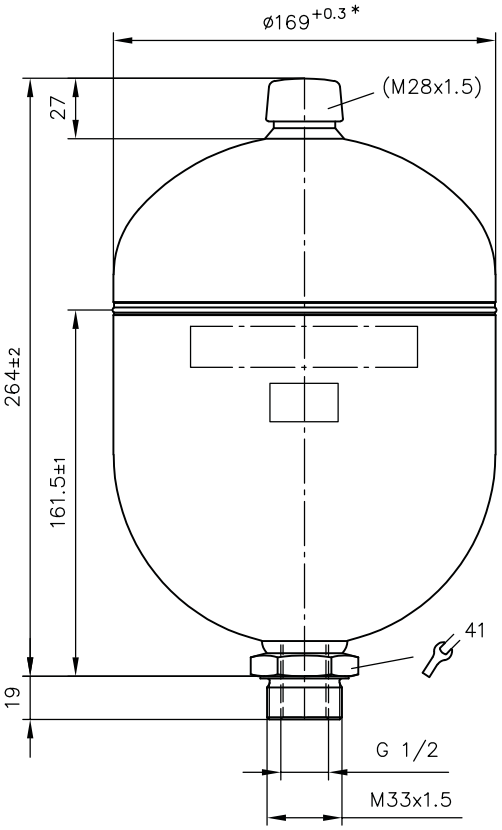
* +3 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

AC 2825 /2AW



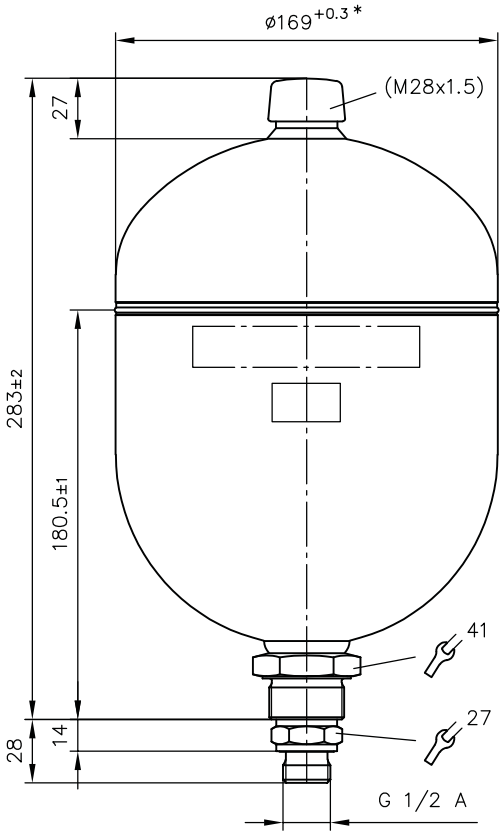
AC 2825 /3



* +3 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

AC 2825 /3A



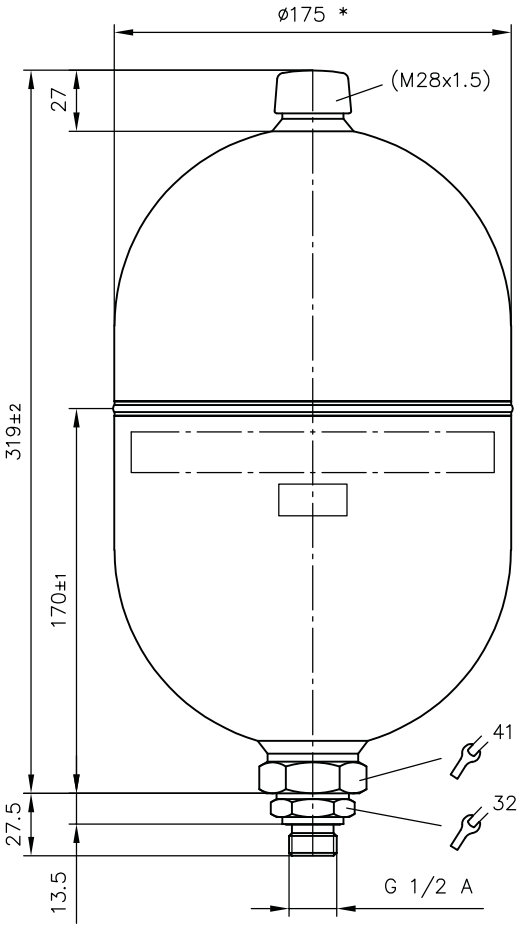
* +3 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

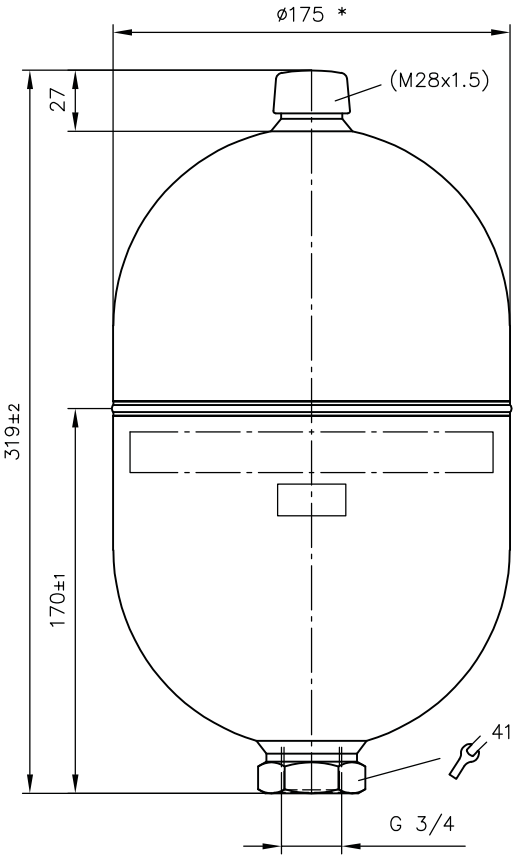
4.1.12 AC 3503

- For variants with male thread (fitting): Fitting seal (included)
- For variants with internal thread: without seal (not included). Seal applied by customer.

AC 3503 /3A



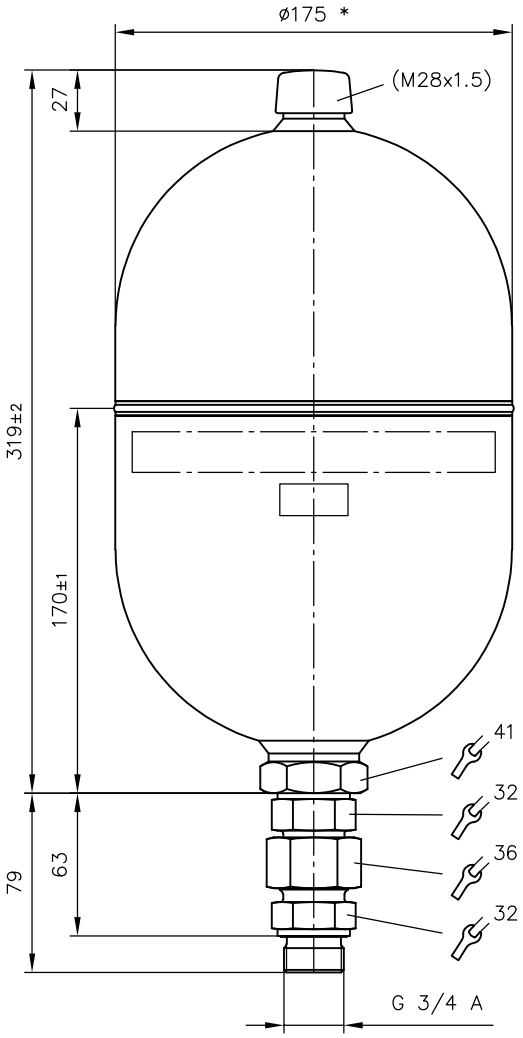
AC 3503 /4



* +4 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

AC 3503 /4A

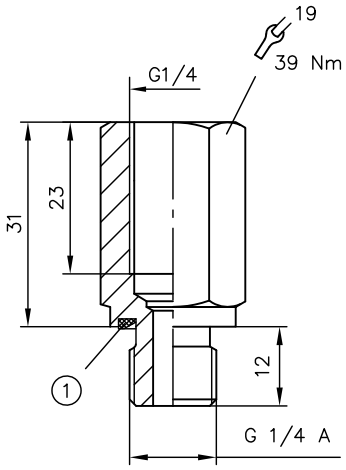


* +4 on weld seam

see Chapter 6.2, "Accessories, spare and individual parts"

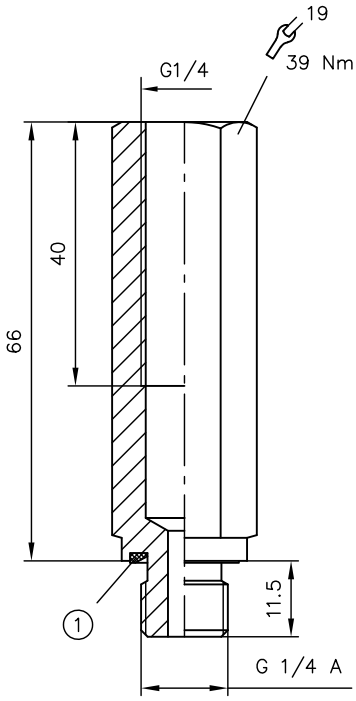
4.2 Extension

K 1/4



1 Fitting seal G 1/4 NBR 85 Sh A

L 1/4



1 Fitting seal G 1/4 NBR 85 Sh A

5 Installation, operation and maintenance information

Observe the document B 5488 “General operating instructions for assembly, commissioning, and maintenance.”

5.1 General notes

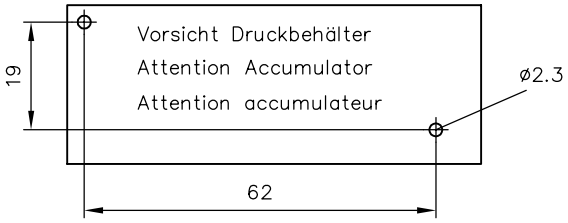
The hydraulic accumulators are subject to the Pressure Equipment Directive 2014/68/EU.

According to Article 3 of the Pressure Equipment Directive 2014/68/EU the following hydraulic accumulators require a declaration of conformity as well as a CE mark:

- Hydraulic accumulator with a volume > 1 litre and p · V > 50 bar · litre (section 1.1 a, fluids of group 2)
- Hydraulic accumulator with p · V > 10,000 bar · litre (section 1.1 b, fluids of group 2)

Operation is only allowed within the permissible values. The hydraulic accumulator must only be installed, maintained and repaired by authorised and trained personnel; these tasks are governed by national regulations. In Germany, through the Betriebssicherheitsverordnung (BetrSichV) Industrial Safety Regulation In the EU through the EU Directive 2009/104/EC.

The gas pre-load pressure must be checked at regular intervals.



NOTE

Before beginning a repair, relieve the system of hydraulic pressure. A corresponding warning sign (HAWE order number 7788 022 (4708 4258-00)) must be attached in an easily visible place on or near the hydraulic accumulator.

No modifications of any kind (mechanical, welding or soldering work) may be made to the accumulator.

Only original spare parts are allowed to be used.

5.1.1 Safety instructions

Further information on the technical version of accumulator systems is provided by DIN EN ISO 4413. To summarise, there must be a facility to release the accumulator pressure on the fluid side when servicing is carried out (drain valve and pressure gauge for monitoring purposes). The accumulator must have its own safety valve (component approved certified valve). This must limit any momentary overpressure to 10 % of the highest permissible pressure. In addition, a warning stating “Caution – pressure to be released from accumulator before removal” must be affixed.

5.1.2 Legal provisions

Hydraulic accumulators are pressure vessels within the meaning of the European Pressure Equipment Directive 2014/68/EU. For hydraulic accumulators, the regulations that apply at the installation location must be adhered to before commissioning and during operation. The operator holds sole responsibility for compliance with the existing regulations. The supplied documents must be kept in a safe place; they will be needed for recurring inspections.

5.1.3 Transportation and storage

CAUTION

Risk of injury due to incorrect transportation

Risk of minor injury.

- Comply with the relevant regulations on transportation and safety.
- Wear protective equipment.

NOTE

Accumulators must be stored in a cool, dry place and protected from direct sunlight.

Dirt must be prevented from entering the accumulator.

If the accumulator is stored over a longer period, it is advisable to reduce the gas pre-load pressure to approx. 10 bar to prevent deformation of the sealing element or separator.

5.2 Intended use

This product is intended exclusively for hydraulic applications (fluid technology).

The user must observe the safety measures and warnings in this document.

Essential requirements for the product to function correctly and safely:

- ► All information in this documentation must be observed. This applies in particular to all safety measures and warnings.
- ► The product must only be assembled and put into operation by specialist personnel.
- ► The product must only be operated within the specified technical parameters described in detail in this document.
- ► All components must be suitable for the operating conditions when using an assembly.
- ► The operating instructions for the components, assemblies and the specific complete system must also always be observed.

If the product can no longer be operated safely:

1. Remove the product from operation and mark it accordingly.
   ✓ It is then not permitted to continue using or operating the product.

5.3 Assembly information

The product must only be installed in the complete system with standard and compliant connection components (screw fittings, hoses, pipes, fixtures etc.).

The product must be shut down correctly prior to disassembly (in particular in combination with hydraulic accumulators).

DANGER

Sudden movement of the hydraulic drives when disassembled incorrectly

Risk of serious injury or death

- ► Depressurise the hydraulic system.
- ► Perform safety measures in preparation for maintenance.

5.3.1 Installation and commissioning

Installation

WARNING

Risk of injury due to stored pressure escaping in an uncontrolled manner.

Risk of serious injury or death.

- Prior to all maintenance work, release the pressure in the hydraulic system.

Installing the accumulator

1. Fit the accumulator to the bracket supplied for this purpose, if possible route the gas connection for the system upwards.
2. Fit the required shut-off, drain and safety valves between the accumulator and the hydraulic system. The easiest way to do this is probably using a 'safety block' that contains all the above components.

Primary filling

DANGER

The product will explode if used or filled incorrectly.

Serious injury or death.

- The accumulator of the product must be suitable for the maximum operating pressure, filling pressure and temperature range of the operating conditions.
- Only use suitable filling and testing devices.

Primary filling of the accumulator

1. Ensure that the accumulator is suitable for the operating conditions with regard to max. operating pressure, filling pressure and temperature range.
2. Gas filling: Gas filling valve M28x1.5 mm with protective cover

Type DFM filling device for diaphragm accumulators

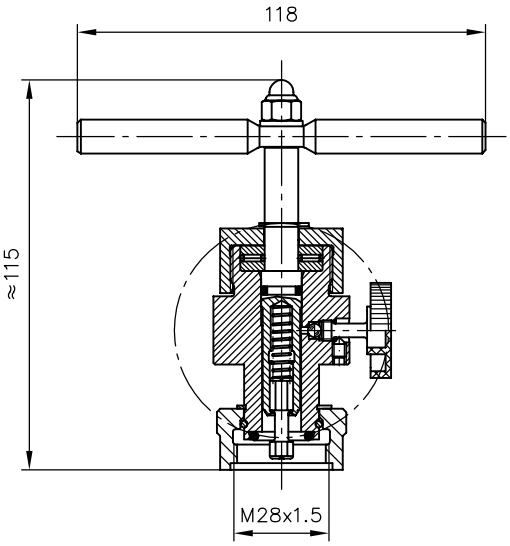
NOTE

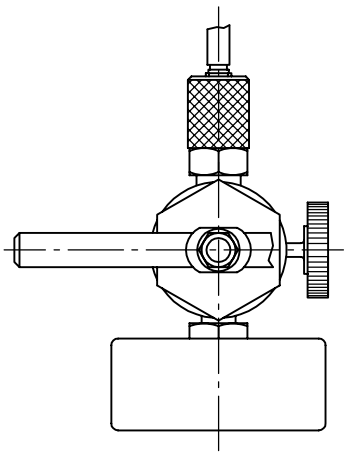
Order numbers for the filling and testing device, see Chapter 6, "Other information"

The purpose of the DFM filling device is to check and change the gas filling pressure of diaphragm accumulators with a M28x1.5 gas connection and an M8x10 gas filling screw with hexagon socket. The scope of delivery includes a case 210x230x80 and a pressure gauge. Since diaphragm accumulators are pressure vessels and subject to the European Pressure Equipment Directive (see there for exceptions), it must be ensured that the safety required therein, in particular the prevention of overpressure, is achieved. Since when filling is being performed from a nitrogen bottle with 200 bar or 300 bar bottle filling pressure, that pressure can be significantly higher than one of the following values,

- permissible operating gauge pressure of the diaphragm accumulator
- permissible gas filling pressure of the diaphragm accumulator
- permissible gauge range of respective pressure gauge

measures must be taken against overpressure. It is therefore advisable to entrust testing and filling tasks only to specialist staff, and under no circumstances to use any sort of adapter to connect the filling device directly to the nitrogen bottle, but instead to use a bottle pressure reducer. For connection to such bottle pressure reducers, hoses with connection nuts G 1/4 and G 1/2 DIN EN 560 are required.





Filling instructions

DANGER

The product will explode if used or filled incorrectly.

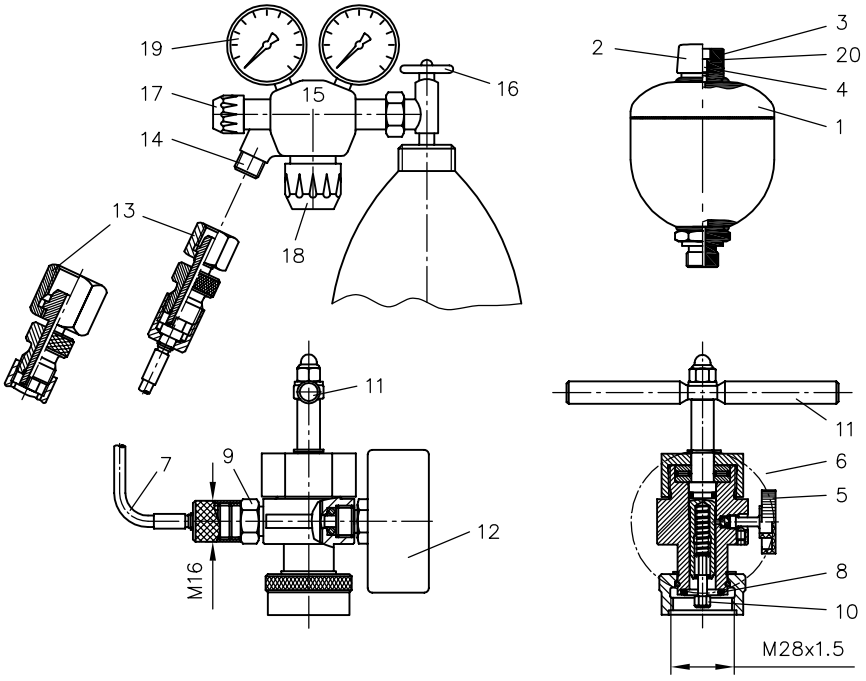
Serious injury or death.

- The accumulator of the product must be suitable for the maximum operating pressure, filling pressure and temperature range of the operating conditions.
- Only use suitable filling and testing devices.

Gas filling: Gas filling valve M28x1.5 mm with protective cover

Filling the accumulator:

1. Check the unpressurised state of the diaphragm accumulator (1) on the fluid side. Unscrew the protective cover (2) from the gas connection (3) M28x1.5. Carefully loosen the gas filling screw (4) by approx. 1/4 revolution using a 6 mm hex key.
2. Close the drain screw (5) on the filling device (6) by screwing it in to the stop.
3. Screw the filling device (6) with a hose (7) on to the gas connection (3) of the diaphragm accumulator (1) (during this process check that the O-ring (8) is present and that it is seated correctly in its guidance groove) and connect the hose connection (13) to the discharge port (14) of the pressure reducer (15) (the bottle valve (16) and shut-off valve (17) are still closed)
4. Then slowly open the bottle valve (16) and set the desired gas filling pressure using the adjuster (18) and the pressure gauge (19) to monitor the value. Open the shut-off valve (17).
5. Engage a hexagon L-wrench (10) in the hexagon socket of the gas filling screw (4) and turn the handle (11) back and forth, slowly releasing it anti-clockwise so that gas can flow through. Keep the shut-off valve (17) open long enough and allow nitrogen to flow through long enough until the pressure gauge (12) displays the desired gas filling pressure. Close the shut-off valve (17) and bottle valve (16) again and wait until the temperature in the diaphragm accumulator (1) has equalised. If the pressure rises, open the drain screw (5) to allow it to fall to the desired value, then close it again. If the pressure drops, repeat the filling process.
   If the gas pressure is now at the desired value:
6. Use the hexagon L-wrench (10) to close the gas filling screw (4) again by screwing it in the clockwise direction. Open the drain screw (5) and allow nitrogen to escape from the filling device.
7. Unscrew the filling device (6) from the diaphragm accumulator. Tighten the gas filling screw (4) to 20+5 Nm and screw the protective cover (2) back on to the gas connection (3) M28x1.5.



5.4 Operating instructions

Observe product configuration and pressure/flow rate.

The statements and technical parameters in this document must be strictly observed.
The instructions for the complete technical system must also always be followed.

DAMAGE

- ► Read the documentation carefully before usage.
- ► The documentation must be accessible to the operating and maintenance staff at all times.
- ► Keep documentation up to date after every addition or update.

CAUTION

Overloading components due to incorrect pressure settings.
Risk of minor injury.

- Pay attention to the maximum operating pressure of the pump and the valves.
- Always monitor the pressure gauge when setting and changing the pressure.

Purity and filtering of the hydraulic fluid

Fine contamination can significantly impair the function of the product. Contamination can cause irreparable damage.

Examples of fine contamination include:

- Swarf
- Rubber particles from hoses and seals
- Dirt due to assembly and maintenance
- Mechanical debris
- Chemical ageing of the hydraulic fluid

DAMAGE

New hydraulic fluid from the manufacturer may not have the required purity.
Damage to the product is possible.

- ► Filter new hydraulic fluid to a high quality when filling.
- ► Do not mix hydraulic fluids. Always use hydraulic fluid that is from the same manufacturer, of the same type, and with the same viscosity properties.

For smooth operation, pay attention to the cleanliness level of the hydraulic fluid (cleanliness level see Chapter 3, "Parameters").

Additionally applicable document: D 5488/1 Oil recommendations

5.5 Maintenance information

Check regularly (at least once a year) by visual inspection whether the hydraulic connections are damaged. If external leakages are found, shut down and repair the system.

Clean the surface of the device regularly (at least once a year) (dust deposits and dirt).

5.5.1 Replacing the USIT ring (20)

If there is a suspicion of damage or leakage is found, the USIT ring (20) must be replaced; for this purpose the gas filling pressure must be fully relieved (mostly after a very long period of use and/or if there are large pressure differences in the flow of filling gas). To relieve the pressure undertake the first 3 steps for the gas pressure filling check and then open the drain screw (5) until the pressure gauge (12) displays the value zero. After the filling device (6) has been unscrewed, the gas filling screw M8x12 (4) (part number 6005 0413-00) can be fully unscrewed and the USIT ring (20) (part number 6097 2305-00) can be replaced with a new one. During this process, ensure that the sealing surface is clean and undamaged. After the gas filling screw (4) has been screwed in again, the filling process can be started as described in Chapter 5.3, "Assembly information" for a gas filling pressure change from zero to the desired value.

5.5.2 Testing the gas filling pressure

1. Release diaphragm accumulator (1) on the fluid side and check the unpressurised state. Unscrew the protective cover (2) from the gas connection (3) M28x1.5. Carefully loosen the gas filling screw (4) by approx. 1/4 revolution, using a 6 mm hex key (hexagon L-wrench to ISO 228-1).
2. Close the drain screw (5) on the filling device (6) by screwing it in to the stop.
3. Screw a filling device (6) **without** a hose (7) on to the gas connection (3). During this process check that the O-ring (8) is present and that it is seated correctly in its guidance groove.

> **NOTE**
> The check valve (9) incorporated in the hose connection is effective only when the hose (7) has been unscrewed.

4. After the filling device (6) has been screwed on, engage a hexagon L-wrench (10) in the hexagon socket of the gas filling screw (4) and turn the handle (11) back and forth, slowly releasing it anti-clockwise so that gas can flow through into the filling device (6). (Explanation: When the filling device (6) is fully screwed on, the gas filling screw (4) cannot be fully unscrewed from the threaded hole. When a connection is unscrewed the gas flows through a slot which creates a path to the atmosphere. This also can act as a pressure release warning device if the connection is released inadvertently, since the escaping gas makes a hissing noise). The pressure of the gas can be read at the pressure gauge (12). Once it has reached a stabilised state at room temperature it represents the available gas filling pressure.
   If the gas pressure is now at the desired value:
5. Use the hexagon L-wrench (10) to close the gas filling screw (4) again by screwing it in the clockwise direction. Open the drain screw (5) and allow nitrogen to escape from the filling device (6).
6. Unscrew the filling device (6) from the diaphragm accumulator (1). Using a hex key, tighten the gas filling screw (4) to 20+5 Nm and screw the protective cover (2) back on to the gas connection (3) M28x1.5.

> **NOTE**
> - Each test sequence causes a small loss of gas filling pressure due to the internal volume of the filling device.
> - It is possible to carry out a gas filling pressure check on the fluid side.

6 Other information

6.1 Layout instructions

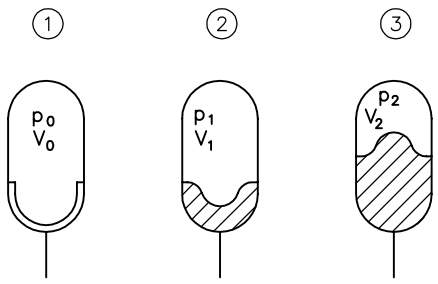
General layout instructions

Max. permissible operating pressure

The max. permissible operating pressure (p_{max}) is the maximum pressure that may be applied to the accumulator.

State variables

- p_0: Gas filling pressure
- p_1: min. operating pressure
- p_2: max. operating pressure
- V_0: accumulator's effective volume
- V_1: Gas capacity at p_1
- V_2: Gas capacity at p_2
- ΔV: delivered or received usable oil volume between p_1 and p_2



1 Accumulator empty
The nitrogen-loaded diaphragm assumes the accumulator's inner contour. The valve disc seals the fluid port, preventing damage to the diaphragm.

2 Accumulator at lower operating pressure
Attention, a small quantity of fluid should always remain in the accumulator to prevent damage to the diaphragm ($p_0 < p_1$).

3 Accumulator at upper operating pressure
Volume change ΔV between position at lower and at upper operating pressure corresponds to the usable fluid volume: $\Delta V = V_1 - V_2$

Gas pre-filling pressure p_0 (reference values)

- When acting as a pressure reservoir around 90 % of the lower operating pressure
- When acting as pulse damping around 60 % of upper operating pressure
- Taking account of the influence of temperature

$$p_{1,T1} = p_{0,T0} \cdot \frac{(T_1 + 273)}{(T_0 + 273)}$$

e.g. filling pressure p_0 at 90 bar with ambient temperature T_0 of 20 °C

- With the ambient temperature changing to T_1 = 40 °C you get $p_{1\ min}$ = 96.14 bar
- With the ambient temperature changing to T_1 = -10 °C you get $p_{1\ min}$ = 80.78 bar

State change

The compression and expansion processes in a diaphragm accumulator are governed by the laws of polytropic changes of gas state. These are divided into:

- Isothermal change during slow processes (polytropic exponent n = 1), e.g. when used for oil leakage compensation)
- Adiabatic change during rapid processes (polytropic exponent n = 1.4, applies to nitrogen), e.g. when used as a damping element

Calculating V_0

$$V_0 = \frac{\Delta V}{\left(\frac{p_0}{p_1}\right)^{\frac{1}{n}} - \left(\frac{p_0}{p_2}\right)^{\frac{1}{n}}}$$

(reference value: V_0 = 1.5 ... 3 x ΔV)

Application examples

Accumulators are used for:

- storing pressure energy
- boosting pump delivery flow
- improving the system efficiency
- damping pulsations in the hydraulic system
- compensating for pressure fluctuations due to temperature changes
- compensating for any internal leakage that might occur

6.2 Accessories, spare and individual parts

For reference to spare parts and fastening clips see HAWE Hydraulik interactive contact map.

6.2.1 DFM filling and testing device

Type	Display range of the pressure gauge (bar)	Upper limit for perm. operating gauge pressure (bar)
DFM-400	0 - 400	250

6.2.2 Fittings

see also Chapter 2.3

Type	Fitting								
	1A	22	2A	2AW	3	3A	3AW	4	4A
	Connecting thread								
	G 1/4 A	M22x1.5 M33x1.5 (internal)	G 3/8 A	G 3/8 A Angle	G 1/2 (internal)	G 1/2 A	G 1/2 A Angle	G 3/4	G 3/4 A
AC 0725	x								
AC 202	●		●	●	x	●			
AC 322	●		●	●	x	x			
AC 603	●		●	●	x	●			
AC 752			●	●	x	●			
AC 1002		x	●	●	x	●	●		
AC 1035	●		●	●	x	●			
AC 1402		x	●	●		●			
AC 2001						x			
AC 2002						●	●	x	
AC 2825	●		●	●	x	●			
AC 3503						●		x	●

x Can be connected, no fittings required

6.2.3 Extension

Coding	Order coding
K 1/4	6920 210 a
L 1/4	6920 210 b

With fitting seal G 1/4 NBR

References

Additional versions

- Valve bank (nominal size 6) type BA: D 7788
- Miniature accumulator type AC: D 7571
- Piston type accumulators, type HPS: D 7969 HPS

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