

### 4.1.1 TECHNICAL DATA

**MAX OPERATING PRESSURE (PS):** (carbon steel) 220 - 250 - 350 - 375 bar;  
(stainless steel) upon request

**PRESSURE TEST (PT):** 1.43 x PS

**NOMINAL CAPACITIES:** 0.1 ÷ 1000 litres

**WORKING TEMPERATURE:** - 60 ÷ +150 °C

**COMPRESSION RATIO (Po : P2):**  $(V_0 - V) \cdot P_2 / V_0 \cdot P_0$

**FLUID VISCOSITY RANGE:** 10 ÷ 400 cSt

**RECOMMENDED VISCOSITY:** 36 cSt

**FLUID CONTAMINATION DEGREE:** class 20/18/15 according to ISO 4406/99

**BODY MATERIAL:-** carbon steel pipe painted  
with a coat of rust inhibitor (70µ) RAL 8012  
- nickel coating 25 - 40 µ  
- stainless steel AISI 316L

**FILLING VALVE MATERIAL:**  
- galvanized carbon steel in compliance with Directive 2002/95/EC (RoHS) to resist to corrosion.  
- stainless steel AISI 316L

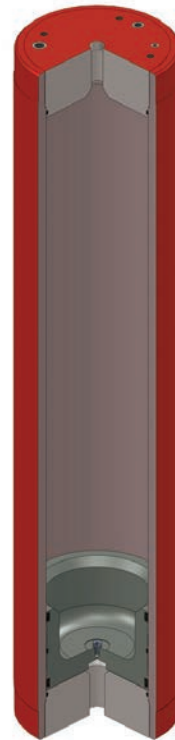
**SEALS MATERIAL:**  
- **P** = Nitrile rubber (NBR)  
- **U** = Polyurethane (HPU)  
- **K** = Hydrogenated nitrile (HNBR)  
- **L** = Hydrogenated nitrile for low temp. (HNBR)  
- **V** = Fluorocarbon (FKM)  
- **T** = Teflon (PTFE)  
- **F** = Low temperature nitrile (NBR)

See Table 4.1c and/or Chapter 1.5

**FILLING VALVE CONNECTION:**  
- 5/8" UNF - M28x1.5

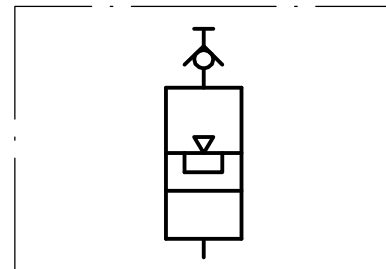
**FLUID PORT CONNECTION:** upon request, see Table 4.1e.

**WEIGHT:** see Table 4.1e



4.1a

### 4.1.2 HYDRAULIC SYMBOL



4.1b

### 4.1.3 PISTON ACCUMULATOR ADVANTAGES

- application solution for versatile choice of diameter and length
- ability to monitor the position of the piston and find out the amount of fluid inside the accumulator
- any mounting position
- various types of profile and material of the seals for every type of application and compatibility with the fluid
- performance greater than the other types of accumulator
- very low permeability of the seals
- aluminium piston for high dynamics
- connections up to 4"
- possibility to plan an intervention in case of loss of the seals as the seals can wear out slowly, not suddenly as could happen with a bladder accumulators.

### 4.1.4 DESCRIPTION

#### Definition and Functionality

The hydropneumatic piston accumulator is a device used to exchange energy using the hydraulic system to which it is connected.

At given moments, it lets energy escaping, then it accumulates it as pressure gas energy and, finally, it readily and integrally replenishes the system on demand, returning to the conditions of receiving again.

The piston accumulator consists particularly of two chambers, one of which is filled with gas under opportune pressure and the second one is connected to the hydraulic circuit.

The gas pressure must be chosen in relation to the conditions of the accumulator work and represents the pre-charge pressure.

#### Constructional features

The piston accumulator consists of a steel cylinder, closed at both ends, in which slides an airtight aluminium piston.

This divides the internal of the cylinder in two chambers, one filled with pre-charge gas and the other with oil or, generally speaking, with fluid from the system (Fig 1).

- **The piston** is made of aluminium in order to have rapid response time and not to generate pressure peaks during rapid cycles. For lighting purposes, it's also provided with cavity, visible in Fig 1, facing the gas chamber in order to increase the accumulation volume. Even the surface in contact with the oil has a concave cavity. The purpose of this cavity is so that the oil pressure acts on almost the entire surface of the piston and not only on one spot when the piston is against the bottom end cover in the oil chamber.

- **Seal between piston and cylinder** is guaranteed by a special multi-ring seals, which constitute the key characteristic elements for the efficiency of the accumulator. This type of seal has allowed the piston accumulator to have essential characteristics regarding air tightness, component longevity and stroking. In fact, the differential pressure necessary to move the piston, which relates directly on the response speed of the accumulator, is contained in moderate values, contrary as occurs in most seals for standard pistons.

The maximum operating temperature with polyurethane seals is 80°C. It is possible to operate at temperatures up to 150°C, using Viton® seals and reduced piston, as the expansion factors of aluminium and steel are

different; it is therefore necessary to compensate the thermal effect. It is also possible to use Teflon® gaskets for low temperatures (lower than -60°C) or for low friction applications.

In piston accumulators, the duration and number of operations carried out without evidence of changes in pressure exceeding 5% of the pre-charge value overcome, without penetration, certain quantities of oil in the gas chamber.

It is usually preferable to assume the change of pre-charge as a parameter for evaluating the longevity of the accumulator as long as this check is carried out rapidly and simply.

Through practical results, obtained by application experience, as well as laboratory tests, it was proved that 1,000,000 operations can be achieved without maintenance or recharge intervention.

- **The cylinder body of the accumulator** is made of low carbon steel, according to the mechanical characteristics of 2014/68/EU.

The internal surface of the cylinder is honed to 0.2 micron of roughness. For special reasons, the cylinder and end covers can either be superficially treated or made of stainless steel.

- **The gas side end cover** is screwed to the cylinder body; the seal is guaranteed by a toroidal gasket, complete with anti-extrusion ring.

In the standard version, this end cap has a threaded seat in which the pre-charged valve is placed.

- **The oil side end cover** is also screwed to the cylinder body and is complete with relative seal.

This end cap has a coupling to connect it to the system, either threaded or flanged, in accordance to the customer requirements. Fig. 1

- All the accumulators manufactured by EPE are tested according to PED standards.

The accumulators are tested at PT pressure which is equal to the maximum working pressure PS, multiplied by 1.43, which allows to verify the absence of defects, which could cause flaws and deformities in the cylinder and in the piston or gas or oil leak from the seals, threaded sections or valve.

The relieve pressure exceeds 1150 bar for model types, designed to work at a maximum pressure of 375 bar.

### 4.1.5 EUROPE MARKET

All hydraulic accumulators are pressure vessels and are subject to the national regulations and directives valid at the place of installation.

Piston accumulator, up to and including 1 litre, must not be CE marked. For piston accumulator type AP, greater than 1 litre, every shipping batch is complete of a conformity declaration and instruction of use and maintenance and/or all documents requested.

All vessel categories (see Table 4.1e) must be protected by means of a pressure relief valve in accordance with Directive 2014/68/EU.

#### 4.1.6 SEALS-TEMPERATURE-LIQUID COMPATIBILITY

When selecting the accumulator variant, pay attention to the following non-binding notes with regard to hydraulic fluid, seal material and the permissive temperature range.

Code letter	Polymer	ISO	Temperature range (°C)	Some of the liquids compatible with the polymer
P	Standard nitrile (Perburan)	NBR	-20 ÷ +80	Aliphatic hydrocarbons (propane, butane, gasoline, oils, mineral greases, diesel fuel, fuel oil, kerosene), mineral greases and oils, HFA - HFB - HFC fluids, many dilute acids, alkalis, saline solutions, water, water glycol.
U	Poliuretane	PU	-20 ÷ +80	The same as with standard nitrile + a number of different types of Freon. (This contains less acrylonitrile than the standard and is therefore more suitable for low temperatures but its chemical resistance is slightly lower).
K	Hydrogenated nitrile	HNBR	-30 ÷ +130	The same as with standard nitrile but with excellent performance at high and low temperatures.
L	Hydrogenated nitrile	HNBR	-60 ÷ +130	The same as with standard nitrile but with excellent performance at high and very low temperatures.
V	Fluorocarbon	FKM	-10 ÷ +150	Mineral oils and greases, non-flammable fluids of HFD group, silicone oils and greases, animal and vegetable oils and greases, aliphatic hydrocarbons (gasoline, butane, propane, natural gas), aromatics hydrocarbons (benzene, toluene), chlorinated hydrocarbons (Tetrachloroethylene, carbon tetrachloride), fuel (regular, super and containing methanol), excellent resistance to ozone, weathering and aging.
T	Teflon		-60 ÷ +100	Hot water up to 100°C, glycol-based brake fluids, many acids and bases, salt solutions, polar solvents such as alcohols, ketones and esters, polyglycol-based hydraulic fluids (HFC fluids) and bases of esters of phosphoric acid (HFD-R fluids), silicone oils and greases, Skydrol LD4 and 500B-4, resistance to ozone, aging and weathering.
F	Low temperature nitrile	NBR	-40 ÷ +70	The same as with standard nitrile + a number of different types of Freon. (This contains less acrylonitrile than the standard and is therefore more suitable for low temperatures, but its chemical resistance is slightly lower).

For other hydraulic fluid and/or temperatures, please consult us.

4.1c

## 4.1.7 ORDER CODE

1	2	3	4	5	6	7	8	9	10	9	11	12	13		
AP	100	P	Q	250	C	250	G	4	V		-	8	-	/	30

<p><b>1 Series</b></p> <p>Piston accumulator = <b>AP</b></p>	<p><b>13 Precharge pressure (bar)</b></p> <p>Standard 30 bar = <b>0 ÷ 280 (&lt; PS)</b></p>
<p><b>2 Nominal capacity (litres)</b></p> <p>Ø 60mm = <b>0.1 ÷ 2</b>          Ø 100mm = <b>1 ÷ 10</b>          Ø 180mm = <b>6 ÷ 100</b>          Ø 250mm = <b>30 ÷ 200</b>          Ø 350mm = <b>80 ÷ 400</b>          Ø 520mm = <b>200 ÷ 1000</b></p>	<p><b>12 Variants and accessories</b></p> <p><a href="#">See the table on front page</a></p>
<p><b>3 Caps seal material</b></p> <p>Nitrile rubber (NBR) = <b>P</b>          Fluorocarbon (FKM) = <b>V</b>          Hydrogenated nitrile for low temp. = <b>L</b>          Low temperature nitrile = <b>F</b></p>	<p><b>11 Test and certification</b></p> <p>Factory testing = <b>0</b>          ML (China) = <b>3</b>          PED2014/68/EU (for capacity greater than 1l) = <b>8</b>          EAC Passport (Russia) = <b>11</b>          Algeria passport = <b>12</b>          Standard regulation (NR13) (Brazil) = <b>13</b>          Tunisian passport = <b>14</b></p>
<p><b>4 Piston seals material</b></p> <p>Fluorocarbon (FKM) = <b>V</b>          Teflon (PTFE) = <b>T</b>          Hydrogenated nitrile = <b>K</b>          Poliuretane (HPU) = <b>U</b>          Hydrogenated nitrile for low temp. = <b>L</b>          Nitrile rubber (NBR) = <b>Q</b></p>	<p><b>9 Dimensions of gas side connection</b></p> <p><a href="#">See the table on front page</a></p>
<p><b>5 Max working pressure (bar)</b></p> <p>Ø 60mm = <b>375</b>          Ø 100mm = <b>375</b>          Ø 180mm = <b>250 - 375</b>          Ø 250mm = <b>250 - 350</b>          Ø 350mm = <b>220 - 350</b>          Ø 520mm = <b>220 - 350</b>          (210 only for the version with L connection other pressure related to connections B or U)</p>	<p><b>10 Gas side connection</b></p> <p><a href="#">See the table on front page</a></p>
<p><b>6 Body and caps material</b></p> <p>Carbon steel = <b>C</b>          Nickel coated carbon steel 25 µ = <b>N</b>          Nickel coated carbon steel 40 µ = <b>M</b>          Stainless steel = <b>X</b></p>	<p><b>9 Dimensions of fluid port connection</b></p> <p><a href="#">See the table on front page</a></p>
<p><b>7 Nominal internal diameter</b></p> <p>Ø 60mm = <b>60</b>          Ø 100mm = <b>100</b>          Ø 180mm = <b>180</b>          Ø 250mm = <b>250</b>          Ø 350mm = <b>350</b>          Ø 520mm = <b>520</b></p>	<p><b>8 Fluid port side connection</b></p> <p>Without connection = <b>0</b>          Female thread BSP UNI228 (standard) = <b>G</b>          Female thread BSP with chamfer for = <b>A</b>          Female thread NPT-F) = <b>P</b>          Female thread SAE = <b>S</b>          Female thread metric = <b>M</b>          Holes for flange SAE-3000, metric threads = <b>L</b>          Holes for flange SAE-6000, metric threads = <b>H</b>          Holes for flange ANSI, metric threads = <b>B</b>          Holes for flange UNI, metric threads = <b>U</b>          Holes for flange CETOP - 400, metric threads = <b>C</b>          Special flange = <b>F</b></p>

Special variants upon request

9 Dimensions of fluid port connection Dimensions of gas side connection	
Without connection	= 0
For the type of connection:	
G-A-P-L-H 1/8"	= 1
1/4"	= 2
3/8"	= 3
1/2"	= 4 (std. DN 60)
3/4"	= 5
1"	= 6 (std. DN 100)
1" 1/4	= 7
1" 1/2	= 8 (std. DN 180-250-350)
2"	= 9 (std. DN 520)
2" 1/2	= 10
3"	= 11
3" 1/2	= 12
4"	= 13
S	= Diameter "inch"-Pitch "inch"
Former. 9/16-18 = 9/16-18	
M	= Diameter/pitch
Former. M 22x1.5 = 22/1.5	
B	= Dimension/Rating
Former. 4" ANSI 300 = 4/300	
U	= DN/PN
Former. DN100 PN16 = 100/16	
C	= Diameter "inch"/max pressure "bar"
Former. 3"Cetop 400 = 3/400	
F	= to specify and EPE will assign a number

10 Gas side connection	
Without connection	= 0
Pre-charge valve 5/8"UNF (std)	= V
Pre-charge valve 5/8"UNF (stainless steel)	= VX
Pre-charge valve of M28x1.5	= VM
Pre-charge valve of 7/8"UNF	= V4
Pre-charge valve of 1/4"BSP	= V2
Female thread BSP UNI228 (standard)	= G
Female thread BSP with chamfer for	= A
Female thread NPT-F)	= P
Female thread SAE	= S
Female thread metric	= M
Holes for flange SAE-3000, metric threads	= L
Holes for flange SAE-6000,metric threads	= H
Holes for flange ANSI, metric threads	= B
Holes for flange UNI, metric threads	= U
Holes for flange CETOP - 400, metric threads	= C
Special flange	= F

12 Variants and accessories	
Adapter + Burst disk set at xxx bar	= Rxxx
Adapter + Safety valve, type VS224/TX set at xxx bar	= Gxxx
Adapter + Needle Valve of 1/4" BSP	= EG2
Adapter + Stainless steel needle valve of 1/4 BSP	= EG2X
Adapter + Excluding device with full scale pressure gauge of xxx bar	= EMxxx
Adapter + Excluding device of 90° with full scale pressure gauge of xxx bar	= ELMxxx
Flushing with degree of contamination ≤ x	= Fx
75-80 μ thick polyurethane paint with colour to be specified	= Wxxx
Off-shore paint with colour to be specified	= Zxxx
NORSOK System 1 paint with colour to be specified	= K1
NORSOK System 7B paint with colour to be specified	= K7B
Piston in anodized aluminium	= P1
Piston in carbon steel	= P2
Piston in carbon steel with nitreg treatment	= P4
Piston in stainless steel	= PX
Piston with low friction seal	= PB
Checking piston displacement:	
Last 150 mm gas side	
add no. of magnetic switches	= Bx
(i.e. No.2 magnetic switch = B2)	
Last 300mm gas side	
add no. of magnetic switches	= Cx
(i.e. No.2 magnetic switch = C2)	
Last 700mm gas side	
add no. of magnetic switch	= Dx
(i.e. No.2 magnetic switch = D2)	
Gas side exit rod with indicator	
add no. of micro switch	= Ux
(i.e. No. 3 micro switch = U3)	
Fluid side exit rod with indicator	
add no. of micro switch	= Sx
(i.e. No. 3 micro switch = S3)	
Potentiometric internal transducer	= TP
Magnetostrictive transducer with output 4-20 mA=	= T4 o T20
4 mA with piston pre-charged	
with nitrogen and without oil	= T4
20 mA with piston pre-charged	
with nitrogen and without oil	= T20
This transducer must be coupled with the outer stainless steel pipe, therefore you should add the letter A (i.e. AT4)	= A
It can be also coupled with other control devices (See Chapter 4.1.9) as:	
WT...	
UT...	
ST...	
Magnetic switches mounted on SS pipe	= A...
Ultrasonic transducer	= TU
Magnetic flag indicator	= W
other variants upon request	

4.1.8 DIMENSIONS

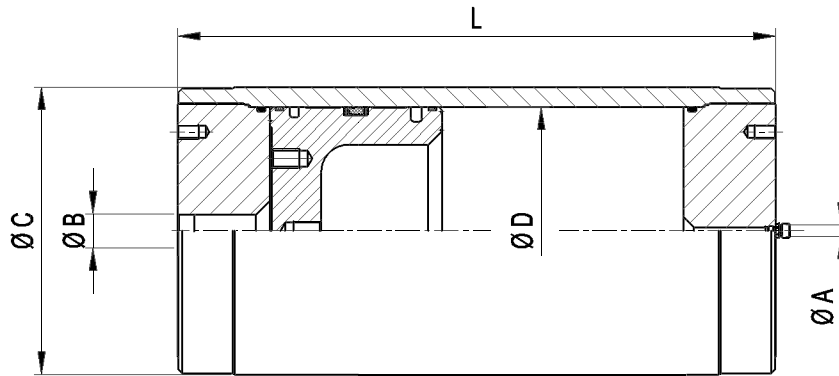


Fig. I

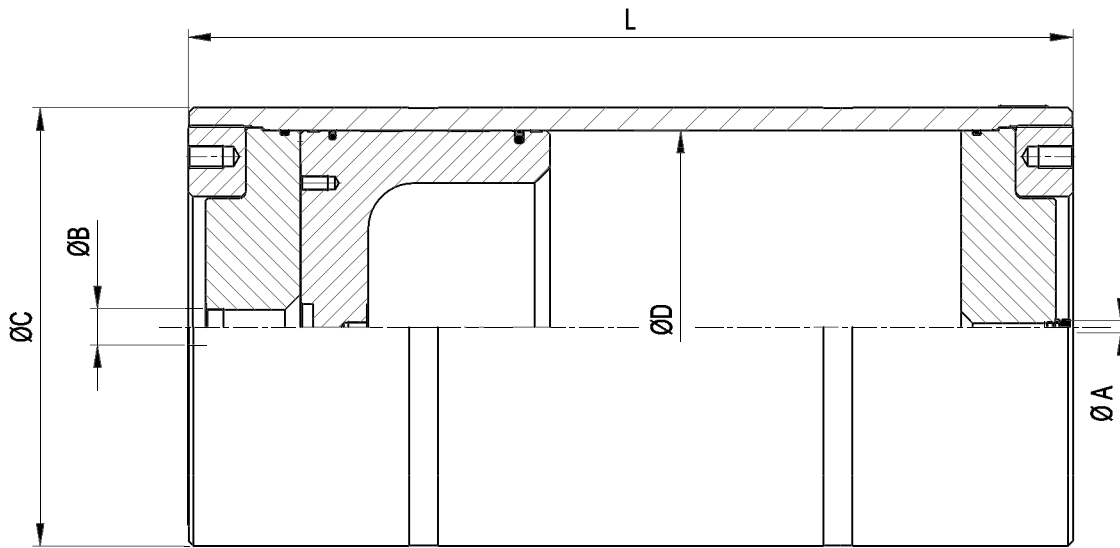


Fig. II

4.1d

Accumulator type APXXX Ø bore (ØD)	Fig	Effective fluid volume liters	Gas capacity liters	Working pressure bar	Ped category for the liquids of group 2	Maximum differential pressure bar*	ØA	ØB	ØC mm	ØD mm	L mm	Weigh Kg									
												220 bar	250 bar	350 bar	375 bar						
60	I	0,25	0,3	375	Art III (III)	300	Pre-charge valve 5/8" UNF	1/2" BSP	80	60	219			5,9							
		0,5	0,55								307			7,8							
		1	1,05		484								10,4								
		1,5	1,55		669								13,5								
		2	2,05		837								17								
100	I	1	1,1	375	II	300	Pre-charge valve 5/8" UNF	1" BSP	130	100	308			21,1							
		1,5	1,6								372			23,8							
		2	2,1								435			26,5							
		2,5	2,6								500			29,5							
		3	3,1		562								31,9								
		4	4,1		690								37,3								
		5	5,1		818								42,7								
		6	6,1		945								48,2								
		8	8,1		1200								59								
		10	10,1		1455								69								
180	I	6	7	250	IV	180,5	Pre-charge valve 5/8" UNF	1 1/2" BSP	210	180	542	83		97,3							
		8	9								620	93,6		105,0							
		10	11								698	94,2		112,7							
		15	16								895	108,1		132,1							
		20	21								1092	112,6		151,5							
		25	26	1288	136,7							170,8									
		30	31	1485	150,9							190,2									
		40	41	1878	179,2							228,9									
		50	51	2270	207,4							267,5									
		60	61	2665	235,8							306,5									
		80	81	3450	294,4							383,6									
		250	II	30	33						250	IV	180,5	Pre-charge valve 5/8" UNF	1 1/2" BSP	298	250	983	229,6	302,3	
				40	43													1188	258,3	346,2	
50	53			1388	283,3	389,0															
60	63			1593	315,0	432,9															
80	83			1998	317,7	519,5															
100	103			2408	429,1	607,3															
120	123			2818	486,5	695,5															
150	153			3428	571,9	825,5															
180	183			4038	657,3	966,1															
350	II	100	108,5	220	IV	165	Pre-charge valve 5/8" UNF	1 1/2" BSP	406	350	1552	643,1		772,5							
		120	128,5								1762	698,4		841,5							
		150	158,5								2072	780,0		942,6							
		180	188,5								2382	861,4		1036							
		200	208,5	2592							916,6		1212,6								
		250	258,5	3112							1053,4		1282,7								
		300	308,5	3632							1190,2		1452,7								
		400	408,5	4682									1806,7								
520	II	200	226,5	220	IV	165	Pre-charge valve 5/8" UNF	2" BSP	584	520	1570	1141,3		1581,5							
		250	276,5								1806	1230,1		1737,4							
		300	326,5								2041	1318,2		1891,2							
		350	376,5								2276	1407,7		2046,2							
		400	426,5								2511	1495,4		2200							
		500	526,5	2982							1672,1		2508,7								
		600	626,5	3453							1849,1		2818								
		800	826,5	4395							2204,2		3437,5								
		1000	1026,5	5337							2558,0		4056								

**4.1e**

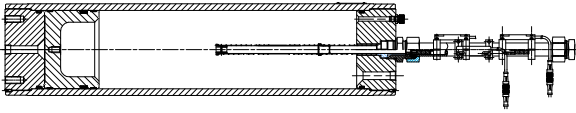
\* The maximum differential pressure is the maximum allowable difference between the maximum pressure and the minimum working pressure (P2-P1) to have an infinite accumulator (greater than 2,000,000 cycles).

\*\* Flow rate measured using mineral oil with viscosity of 36 cSt at 50°C and ΔP = 5 bar

## 4.1.9 PISTON POSITION INDICATOR

### 4.1.9.1 LAST PISTON POSITION SWITCH

“B...” (No. OF MAGNETIC SWITCH)  
 “C...” (No. OF MAGNETIC SWITCH)  
 “D...” (No. OF MAGNETIC SWITCH)



4.1f

The electrical magnetic switch usually monitors the max. charged condition of the piston accumulator.

It can, however, also permit the control of the piston position of the last 150 mm (B), or 300 mm (C) or 700 mm (D) when the accumulator is full of oil.

The limit switch consists of the switching rod with a permanent solenoid, which is not connected to the piston and can only achieve a limited stroke, and an anti-magnetic housing and two or more switches.

The switch is reset by a spring or the force of gravity.

Vertical mounting is preferable due to the friction and possible wear and tear in the rod guide.

The maximum piston velocity must not exceed 0.5 m/s over the stroke range of the limit switch.

#### Data of the magnetic switch:

- Output function: **normally open**
- Operat. Temperature: **-25°C + 75°C**
- Connection: **cabl 300 mm in PVC**

#### Electric data character:

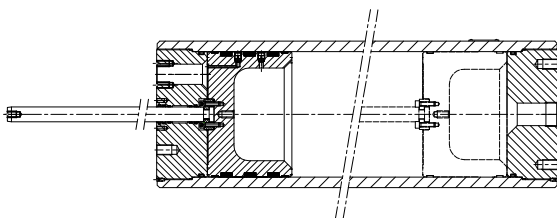
- Max switch. voltage contact: **220 – 1500 V**
- Max switch. current contact: **1 – 3 A**
- Max switch. power contact: **60 – 120 VA**

#### General Character:

- Prot. Degree: **IP67**

You can require the intrinsically safe version for hazardous areas. For this type you should add **Ex** to the order code after the number of the magnetic micro-switches.

### 4.1.9.2 EXIT ROD “S” OR “U”



4.1g

The exit rod permits the position of the piston to be monitored over the whole stroke (visual indications). It consists of the piston rod, which is

fixed to the piston, and what is known as the trip cam which activates the limit switches. The position of the piston can be monitored at any point, by using the potentiometric transducer T....

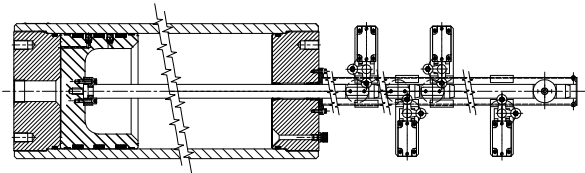
This device is mainly used to switch the pump on and off.

Usually, the piston rod protrudes from the accumulator on the fluid side to (S) or the gas side (U).

On the protruding piston rod version, the hydraulic connection will be on the side if the size of the end cap does not permit otherwise.

The protruding piston rod works in any mounting position. There must however be sufficient space available for the piston to move in and out. The maximum piston speed must not exceed 0.5 m/s over the whole stroke.

### 4.1.9.3 EXIT ROD AND MECHANICAL SWITCH “S....” (No. OF SWITCH) OR “U....” (No. OF SWITCH)



4.1h

On the exit rod type U or S, you can install mechanical micro-switches. On the standard version are installed mono-stable micro-switches with an exchanging contact. When using a number greater than or equal to three micro-switches, normally are required the bistable double contact ones, so it should be better to indicated the letters B and/or C in the order code after the necessary micro-switches amount:

B = bistable micro-switches

C = bistable micro-switches with double exchanging contact

#### Data of the mechanical switch:

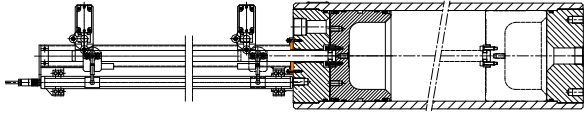
- Rated operational voltage
- Rated impulse withstand voltage
- Switching overvoltage
- Conventional enclosed thermal current
- Conditional short circuit current
- Protective device
- IP code
- Pollution degree

#### Wiring:

- Use a lead wire less than 0.75 mm<sup>2</sup>
- Use a cable from 6 to 9 mm in O.D.
- Do not connect the terminal directly, use crimp terminals and tighten them according to a torque of 0.2 to 0.29 N • m. (when connecting NO side, use a crimp terminal with insulation cover).
- Connect a ground terminal. Do not connect the ground terminal directly, use crimp terminals and tighten them according to a torque of 0.39 to 0.59 N • m.
- Only the lead wire may be connected to a terminal.



### 4.1.9.4 EXIT ROD WITH EXTERNAL TRANSDUCER POSITION AND MECHANICAL SWITCH "S....T4" OR "T20" OR "U....T4" OR "T20"



4.1i

In addition to the micro-switches on the exit rod, you can mount a position transducer with an output  $4 \div 20\text{mA}$  or  $20 \div 4\text{mA}$  in order to monitor continuously the entire piston stroke. With the accumulator fully pre-charged with nitrogen and completely charged with oil if you want a 4mA output, you should order the version T4, while, for 20mA, you must order the T20 version.

#### Technical data:

- Output signal: analogue
- Output: potential-free
- Output current:  $4 \dots 20\text{ mA}$  or  $20 \dots 4\text{ mA}$
- Charge resistance:  $\leq 500\text{ Ohm}$
- System resolution:  $\leq 0,2\mu\text{A}$
- Hysteresis:  $\leq 4\mu\text{m}$
- Reproducibility: system resolution/min.  $2\mu\text{m}$
- Frequency of reading position:  $f$  standard =  $1\text{ kHz}$
- Maximum deviation from linearity:  $\pm 100\mu\text{m}$  up to a nominal length of  $500\text{ mm}$ ,  $\pm 0.02\%$   $500$  up to a nominal length of  $4000\text{ mm}$
- Temperature coefficient: current output:  $[0.6\mu\text{A}/^\circ\text{C} + (10\text{ ppm}/^\circ\text{C} \times P \times I/L)] \times \Delta T$
- Working voltage:  $24\text{ VDC} \pm 20\%$
- Current absorption:  $\leq 150\text{mA}$
- Protected against reverse polarity: yes
- Protection against overvoltage: zener protection diodes
- Dielectric strength:  $500\text{ V}$  (earth against vessel)
- Working temperature  $-40 \dots +85^\circ\text{C}$
- Storage temperature:  $-40 \dots +100^\circ\text{C}$

#### Pins:

#### Output signal

- 1 = yellow =  $4 \dots 20\text{ mA}$  -  $20 \dots 4\text{ mA}$
- 2 = grey =  $0\text{ V}$  output
- 3 = pink =  $10 \dots 0\text{ V}$
- 5 = green =  $0 \dots 10\text{ V}$

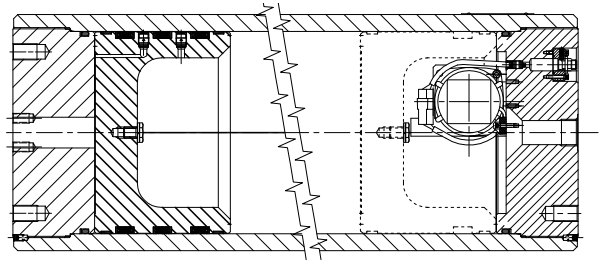
#### Working voltage

- 6 = blue = GND
- 7 = brown =  $+24\text{ VDC}$
- 8 = white = GND

You can require intrinsically safe version for hazardous areas. For this type you should add

Ex. to the order code after the number of the magnetic micro-switches.

### 4.1.9.5 WIRE TENSION MEASUREMENT SYSTEM TP



4.1j

Using the wire tension measurement system, the position of the piston can be determined by means of a cable which is fixed to the piston. The cable is attached to a wheel, which is tensioned by a spring. This wheel alters an electrical resistance via an attached rotary potentiometer during the piston movement.

This resistance is converted by a transducer into an electrical signal, so that it can be processed directly by a PLC system. The signal is supplied through the end cap via a pressure-tight cable gland.

Alternatively, various digital display units and transmitters can be connected. The max. pressure must not exceed  $375\text{ bar}$ .

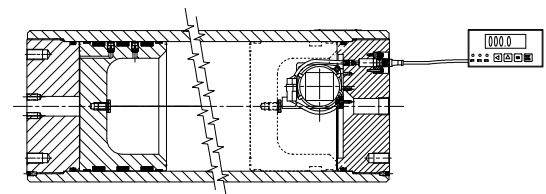
The piston acceleration is limited to certain values according to measurement system forces, approx.  $7 \dots 30\text{ g}$ , and is limited to a max. speed of  $0.5\text{ m/s}$ . The measurement system is not suitable for rapid volume changes. The piston should preferably be mounted with the gas-side at the top.

The cable tension measurement system can only be fitted to the gas-side of the piston accumulator.

#### Technical data

- Working temperature:  $-20^\circ\text{C} + 80^\circ\text{C}$
- Strength:  $10\text{ kOhm}$
- Linearity:  $\pm 0,25\%$

### 4.1.9.6 DISPLAY OR ELECTRONIC CARD



4.1k

#### DISPLAY

To convert the output signal of  $10\text{ kOhm}$ , you should install a display type 5714D that, in addition to provide local indication of the position (in mm or litres), converts the signal from the potentiometer to  $4\text{-}20\text{mA}$ . Moreover on the device you can set 2 intervention thresholds (relays) on the whole piston stroke. Order code: 5714D.

#### Technical data:

- Inlet
- Strengthening:  $10\ \Omega \dots 100\text{ k}\Omega$

**Output**

Display, digit/type: 4 digits / LED  
 Display, digit height LED/LCD: 13.8 mm/  
 MA, signal range /min. range: 0...20 mA / 16 mA  
 Relays: 2 x SPDT, AC: 500VA

**Approvals**

UL: UL 508  
 Det Norske Veritas, Ships & Offshore: Stand. F. Certification 2.4

**Features:**

Power supply: universal AC/DC  
 2-wire power supply: >15 VDC  
 Programmable: FKP/PCF  
 Ambient temperature: -20...+ 60°C  
 Supply voltage, uni. AC/DC: 21.6...253V /19.2... 300V  
 Consumption: 3.5 W  
 Insulation voltage, test/op.: 2.3 kVAC/250VaC  
 Response time: < 400 ms/<1 s  
 Base accuracy. MA: < ± μA  
 Protection degree, front: IP65  
 Assembly: panel of 48x96 mm  
 Otherwise, you can use an electronic card for DIN rail mounting for signal conversion from potentiometric to 4 to 20mA + 2 relays. Order code: converter 4116. Mini front indicator: 4501

**ELECTRONIC CARD****Technical data:****Inlet**

r.lin., measurement range / min. range: 0....10000Ω

**Output**

MA, signal range /min. range: 0...20mA / 16mA  
 Ma, max. charge: 20 mA / 800Ω  
 V, signal range /min. range: 0....10VDC/ 0.8 VDC  
 Relais: 2 x SPST, AC:500 VA

**Approval**

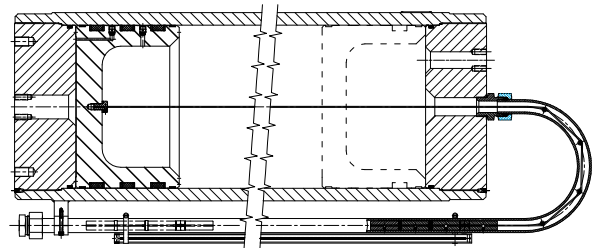
UL: UL 508  
 FM: AIS/1/2/ABCD/IIC  
 Det Norske Veritas, Ship & Offshore: Stand.f. Certification 2.4

**Features**

Power supply: universal AC/DC  
 Reference voltage/ power supply 2 wires: - / 16 VDC  
 Insulation: inlet/output/power supply  
 Channels: 1

**Technical features**

Programmable: FKP/PCF  
 Ambient temperature. -20...+ 60°C  
 Supply voltage, uni. AC/DC: 21.6...253V /19.2... 0.300V  
 Consumption: 2.5 W  
 Insulation voltage: 2.3 kVAC/250VAC  
 Unit to be programmed: 4501 front indicator (to be ordered separately)  
 Response time: < 400 ms  
 Signal dynamics, inlet: 24 bit  
 Base accuracy, mA: < ± μA  
 Assembly: DIN bar

**4.1.9.7 MAGNETIC FLAG INDICATOR W**

4.11

With the magnetic flags indicator, the position of a piston can be determined by the colour (white/red) of a set magnetic flags which turn when the piston moves and which are visible externally.

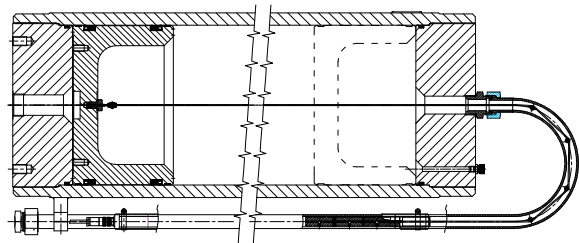
A non-magnetic tube is fitted to the piston accumulator containing a cable, one end of which is fastened to the gas side of the piston and the other end is attached to a magnet.

Along the length of the piston accumulator, it is also fitted a housing which contains red/white magnetic flags.

When the magnet moves up or down its tube, the flaps turn to their opposite colour to indicate the piston's position.

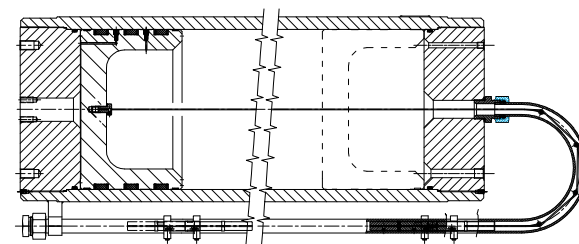
When the piston moves towards the gas side, the indicator moves to the direction of the oil-side.

The maximum piston speed must not exceed 0.5 m/s. Piston accumulators with magnetic flag indication must only be installed vertically, gas-side at the top.

**4.1.9.8 EXTERNAL MAGNETOSTRICTIVE TRANSDUCER MOUNTED ON STAINLESS STEEL PIPE "AT4" OR "AT20"**

4.1m

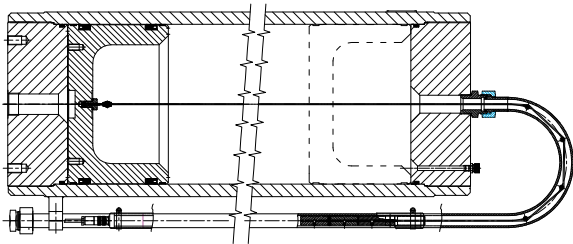
For technical data, see Chap. 4.1.9.4

**4.1.9.9 MAGNETIC SWITCH MOUNTED ON STAINLESS STEEL PIPE "A (No. OF MAGNETIC SWITCH)"**

4.1n

For technical data, see Chap. 4.1.9.1

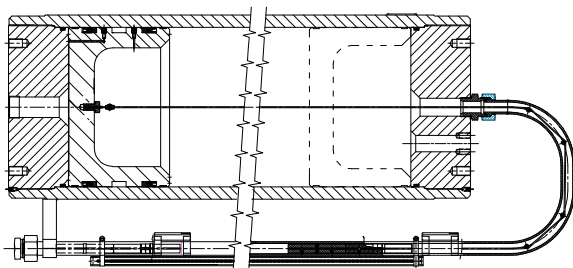
#### 4.1.9.10 EXTERNAL MAGNETIC TRANSDUCER POSITION AND MAGNETIC SWITCH "A..." (No. OF MAGNETIC SWITCH T4 or T20) MOUNTED ON STAINLESS STEEL PIPE



4.1o

For technical data, see Chap. 4.1.9.1 and 4.1.9.4

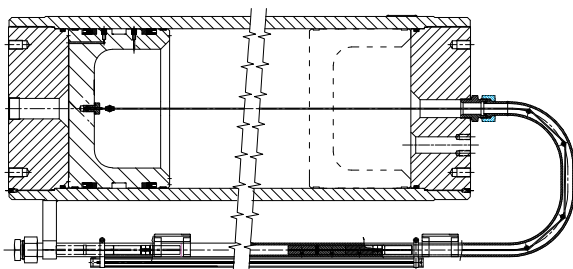
#### 4.1.9.11 MAGNETIC FLAG AND MAGNETIC SWITCH "W..." (No. OF MAGNETIC SWITCH) MOUNTED ON STAINLESS STEEL PIPE



4.1p

For technical data, see Chap. 4.1.9.1 and 4.1.9.7

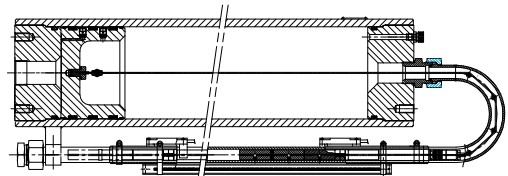
#### 4.1.9.12 MAGNETIC FLAG INDICATOR AND MAGNETIC TRANSDUCER "W T4 or W T20" MOUNTED ON STAINLESS STEEL PIPE



4.1q

For technical data, see Chap. 4.1.9.4 and 4.1.9.7

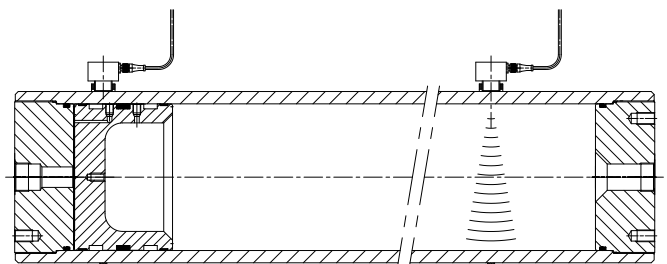
#### 4.1.9.13 MAGNETIC FLAG, EXTERNAL MAGNETIC TRANSDUCER POSITION AND MAGNETIC SWITCH "W..." (No. OF MAGNETIC SWITCH) "T4" or "T20" MOUNTED ON STAINLESS STEEL PIPE



4.1r

For technical data, see Chap. 4.1.9.4 and 4.1.9.7

#### 4.1.9.14 ULTRASONIC TRANSDUCER



4.1sa

The ultrasonic sensor identifies the position of piston in the accumulator. The ultrasonic procedure is harmless compared to methods based on radiation sources.

The retrofitting of cylinders can be carried out even in mounted condition. The integration of the system is feasible without interruption of ongoing operations. The installation of ultrasonic sensors is easy. No mechanical extension at pistons are needed. No sealing problems due to holes in the piston accumulator wall occur.

High safety of the system is guaranteed through a permanent couple and function control. A signal is always available.

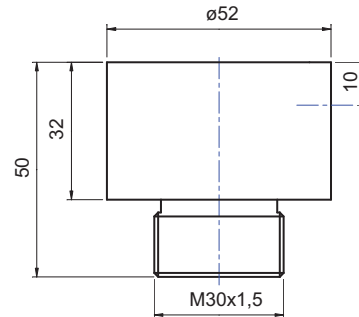
Using compact sensors with active sensor electronics leads to a very high interference resistance and allows a reliable operation in rough industrial environments.

The most important features of the system are:

<b>Measurement principle:</b>	contactless ultrasound-pulse-echo-system, no contact between sensor and piston, no constructional changes at the piston accumulator.
<b>Fastening at the piston accumulator:</b>	installation at the desired position with fastening clamp with fitting panel and thread M30X1,5
<b>Accuracy:</b>	static $\pm 1$ mm from the middle of sensor
<b>Piston accumulator dimensions</b>	inner diameter (mm) 100÷800 outer diameter (mm) 130÷950
<b>Hydraulic fluid:</b>	Mineral oil(HL,HLP),HFA,(HFB), HFC, HFD, water,viscosity 15....100 cSt. purity 20 $\mu$ m.

<b>Voltage supply:</b>	18...30VDC, max.80 mA, undulation 10% undervoltage recognition, inverse-polarity protection, overvoltage protection.
<b>Switching output:</b>	PNP/NPN, max. switching current 60 mA with max switching voltage 30 VDC.
<b>Connectors:</b>	sensor pin and socket connector M12; cable 4-pin without shielding. Brown: positive operating voltage 18...30 VDC Blue: negative operating voltage (GND) Black: switching output White: synchronisation
<b>Coupling:</b>	at the piston accumulator with coupling medium
<b>Sensor cable length:</b>	2 or 5m respectively with right-angle plug.
<b>Switching point display:</b>	integrated LED in the right-angle plug. (green, yellow)
<b>Temperature range:</b>	piston type accumulator temp.: -20 ... +80 °C Ambient temperature: -20 ... +60 °C Storage temperature: -40 ... +85 °C

<b>Housing:</b>	IP67, oil-resistant, aluminium anodized, H x Ø 50x52 mm, thread M30X1,5
<b>Regulation:</b>	Protection Type DIN EN 60529:1991 + A1:2000 EMC active: DIN EN 61326-1:2006 EMC passive: IEC61000-4-2, -3, -4, -5, -6



Attention: The range of working temperature is further restricted by the absolute viscosity.

4.1sb

#### 4.1.10 ACCESSORIES

For clamps, see Chap. 7  
For safety blocks, see Chap. 9  
For pre-loading and charging set, see Chap.11  
For pulse damper adapters, see Chap. 12.1

#### 4.1.11 SPARE PARTS CODE

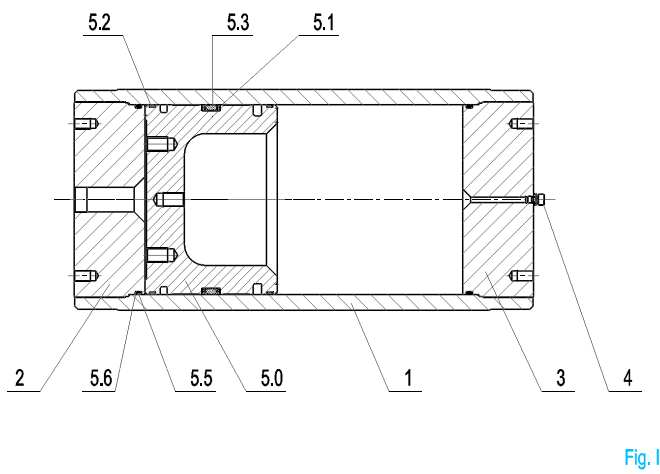


Fig. I

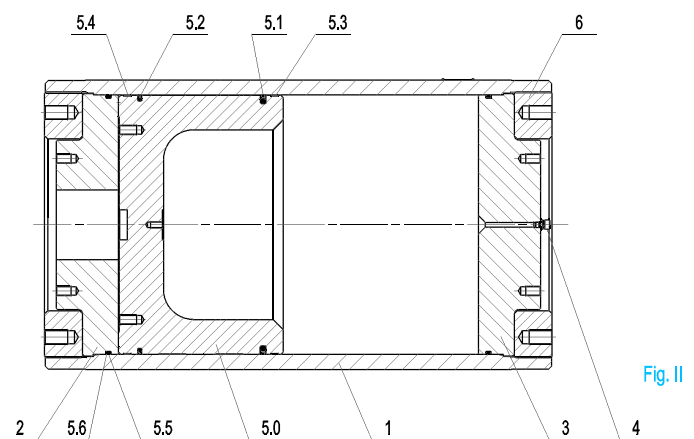


Fig. II

4.1t

Pos.	Spare parts	Cylinder diameter	Fig.	Group code	Q.ty	Part description	Type / Code	
1	Not supplied as spare parts						Accumulator cylinder	-
2							Oil side cap	
3							Gas side cap	
4				V 2072 ** / *	1	Gas filling valve 5/8" UNF	-	
5.1	Accumulator gasket set	60	I	B2471 *** / ****	-	-	-	
5.2					2	Gasket	B11500 - U	
5.3					2	Piston guide	B11389 - T	
5.5					2	O - ring	0010R6200 - *	
5.6					2	Anti-extrusion ring	0011P8329 - *	
5.0	Piston gasket set				1	Piston	C11495 - 1 - A	
5.1		-	-	-				
5.2		2	Gasket	B11500 - U				
5.3	2	Piston guide	B11389 - T					
5.1	Accumulator gasket set	100	I	B2406 *** / ****	2	Anti-extrusion ring	B11522-D	
5.2					1	Gasket	B11518 - *	
5.3					2	Piston guide	B11523 - T	
5.5					2	O - ring	0010R185 - *	
5.6					2	Anti-extrusion ring	0011P8341 - *	
5.0	Piston gasket set				1	Piston	C11496 - 2 - A	
5.1		2	Anti-extrusion ring	B11522-D				
5.2		1	Gasket	B11518-*				
5.3	2	Piston guide	B11523 - T					
5.1	Accumulator gasket set	180	I	B2407 *** / ****	2	Anti-extrusion ring	B11528- D	
5.2					1	Gasket	B11524-*	
5.3					2	Piston guide	B11526 - 2 - T	
5.5					2	O - ring	0010R228 - *	
5.6					2	Anti-extrusion ring	0011P8439 - *	
5.0	Piston gasket set				1	Piston	C11497 - 13 - A	
5.1		2	Anti-extrusion ring	B11528-D				
5.2		1	Gasket	B11524-*				
5.3	2	Piston guide	B11526 - 2 - T					
5.1	Accumulator gasket set	250	II	B2551 *** / ****	1	Gasket - gas side	0015GK753-250-*	
5.2					1	Gasket - oil side	0015GK41-250-*	
5.3					1	Piston guide gas side	0014KKT-250-TC	
5.4					1	Piston guide oil side	0014K75-250-RP	
5.5					2	O - ring	0010R8925 - *	
5.6	2	Anti-extrusion ring	0011P8447 - *					
5.0	Piston gasket set				1	Piston	C11498 - 13 - A	
5.1		1	Gasket - gas side	0015GK753-250-*				
5.2		1	Gasket - oil side	0015GK41-250-*				
5.4		1	Piston guide gas side	0014KKT-250-TC				
5.3		1	Piston guide oil side	0014K75-250-RP				
5.1	Accumulator gasket set	350	II	B2555 *** / ****	1	Gasket - gas side	0015GK753-350-*	
5.2					1	Gasket - oil side	0015GK41-350-*	
5.3					1	Piston guide gas side	0014KKT-350-TC	
5.4					1	Piston guide oil side	0014K75-350-RP	
5.5					2	O - ring	0010R81300 - *	
5.6	2	Anti-extrusion ring	0011P8455 - *					
5.0	Piston gasket set				1	Piston	C11499 -13 - A	
5.1		1	Gasket - gas side	0015GK753-350-*				
5.2		1	Gasket - oil side	0015GK41-350-*				
5.3		1	Piston guide gas side	0014KKT-350-TC				
5.4		1	Piston guide oil side	0014K75-350-RP				
5.1	Accumulator gasket set	520	II	B2557 *** / ****	1	Gasket - gas side	0015GK753-520-*	
5.2					1	Gasket - oil side	0015GK41-520-*	
5.3					1	Piston guide gas side	0014KKT-520-TC	
5.4					1	Piston guide oil side	0014K75-520-RP	
5.6					2	O - ring	0010R82000 - *	
5.6	2	Anti-extrusion ring	0011P8469 - *					
5.0	Piston gasket set				1	Piston	D11962 - 3 - A	
5.1		1	Gasket - gas side	0015GK753-520-*				
5.2		1	Gasket - oil side	0015GK41-520-*				
5.3		1	Piston guide gas side	0014KKT-520-TC				
5.4		1	Piston guide oil side	0014K75-520-RP				
6	Not supplied as spare parts						Thread ring	-

\* Gasket material    \*\* Component material    \*\*\* Gasket material - caps    \*\*\*\* Gasket material - piston

### 4.1.12 REPAIR TOOL

The sleeve equipment to re-assemble the piston accumulators is necessary every time an accumulator needs to be disassembled for maintenance

(For example, when replacing piston seals) and then re-fit the piston into the accumulator.

#### 4.1.12.1 ORDER CODE

Nominal diameter	Sleeve order code	
	Simple sleeve with screw	
60	11555	/
100	11556	/
180	11557	2483
250	11558	2484
350	11559	2485
520	11554	2486

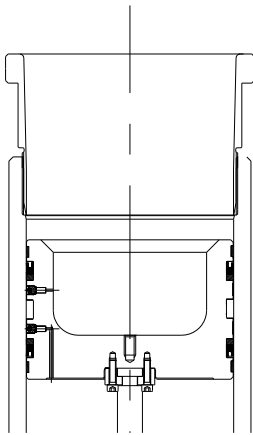


Fig. Simple slee

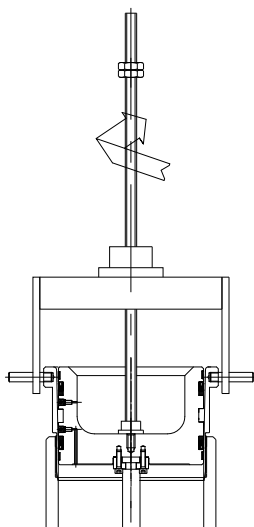


Fig. Sleeve with screw

### 4.1.13 COMMISSIONING AND MAINTENANCE

#### Installation

Piston accumulators are delivered pre-charged with nitrogen at a pressure of 30 bar or at value of pressure required at time of order.

The pre-charge value is also on the nameplate of the accumulator. Depending on the size and quantity ordered, the piston accumulators are shipped in boxes, in cartons, on pallets or wooden boxes on request. Unless otherwise required, certificates and documentation are provided together with the accumulators.

#### Handling

The original packaging is suitable for handling and general storage.

Where necessary, you should use suitable lifting equipment to support the weight of the accumulators.

However protect from impact, the packaging and handle it with care.

#### Storage

During storage in the warehouse, leave the product in its original packaging, keeping it away from heat sources and naked flames. The storage temperature should be between +10 and +40°C.

After six years of storage, it is essential to proceed with the replacement of all elastomeric parts before the commissioning.

#### Marking on the nameplate of the accumulator

With reference to the PED 2014/68/EU classification, Article 3, Paragraph 3 and / or risk categories I or II depending on the volume and maximum working pressure, the accumulator indicates the following data:

- Logo, name and country of the manufacturer
- Month/year of production
- Product code
- Serial number
- Maximum PS pressure and PT test pressure in bar
- Min. and max. TS working temperature in Celsius
- Volume V in litres
- Group of fluids allowed (II)
- CE marking (for volume greater than 1 litre) with the identification number of the notified body
- Pre-charge pressure in bar

#### It is strictly forbidden to:

- weld, rivet or screw any item of the accumulator
- engrave or permanently stamp the surfaces of the accumulator shell and / or carry out other operations that could affect or change the mechanical properties of the accumulator
- use the accumulator as a structural element: it should not be subjected to stresses or loads
- change the data of the nameplate and / or accumulator without the permission of the manufacturer
- use a (dangerous) fluid of Group 1 with equipment designed and manufactured for fluids of Group 2.

#### Installation

Before installation, you must perform a visual check to verify that the accumulator has not suffered any damage during shipping / handling.

Verify that the requested type matches with what stamped on the nameplate. We recommend using the accumulator with a suitable security valve (see Chapter 8) or a security block type BS (see Chapter 9). This

4.1v

4.1z

device provides user and equipment protection against possible damage caused by pressure surges and also makes the maintenance of the accumulator easier, facilitating the interception and the discharge.

Provide for a space of 200 mm above the gas pre-charge valve to allow access to and control of the pre-charge equipment (see Chap.11.1).

The accumulators type AP may be installed in any position from horizontal to vertical (preferably with the pre-charge valve at the top), and the nameplate must be visible.

Proceed to the assembly so that no abnormal force affects the pipes connected directly or indirectly to the accumulator, so we recommend the use of supporting components and also fastening (please see Chapter 7) to avoid the transmission of vibrations.

If are not used EPE safety blocks, make sure that the accumulator is connected to the hydraulic circuit by suitable connection devices.

Make sure the fluid is compatible with the seals installed. Check that the max. allowed accumulator pressure is equal to or greater than that of the hydraulic circuit and that the temperature during operation is maintained within the range expected.

Make sure the fluid does not contain contaminants and/or abrasive.

### Pre-charge of nitrogen

Normally, the piston accumulators are delivered pre-charged with pressurized gas. The pre-charge of gas can be controlled and / or adjusted before or after installation of the accumulator in the hydraulic circuit.

For the pre-charge, use only industrial dry nitrogen with a purity of min. 99%. It is important to use the nitrogen from a bottle equipped with a pressure reducing valve (see Chap.11.3).

Use the EPE pre-charge and charging set type PC to check the charging pressure required, and adjust if necessary.

If the pre-charge pressure is lower than required, connect the charging hose on one side and the other side connect it to the nitrogen bottle or to the pressure reducer. Slowly fill the nitrogen in the accumulator until reaching a pressure slightly higher than that set value (+ 10 ÷ 15%).

Close the bottle and remove the charging hose from the pre-loading set; wait until the gas temperature has stabilized (2 hours) and calibrate the pressure, discharging the excess gas.

Make sure that the gas valve is not subject to losses and, if necessary, use soap and water. Tighten the protective caps manually.

### Hydraulic pressurization

- Check that the pre-charge pressure is adequate for the application
- Ensure that the hydraulic pressure never exceeds the max. allowed pressure (PS) shown on the accumulator shell.

To avoid this risk, use a safety device (see Chap. 9).

### Maintenance

Accumulators must be regularly examined, checked for general condition and maintained on a periodic basis. The frequency and extent of inspection required will depend on application. Epe recommends to check the accumulator after one year, whichever occurs first.

### Examination

Shall consist of visual check of the physical integrity of the equipment and, where applicable, a functional test.

Repair kits are available for all accumulator models; replacement of the piston seals is generally the only maintenance operation required.

Replacement of other seals on end caps and the gas valve is also recommended. Periodic checking of the pre-charge pressure will provide early warning of deteriorating piston seal performance.

If pre-charge pressure is low, check also for gas valve and/or end cap seal leakage.

Allowing for temperature difference, if any, the pre-charge pressure will rise if fluid collects in the gas side and will drop if gas leaks into the fluid side or past gas end cap seals.

It is suggested to carry out a check a week after the installation and thereafter once every three months or at intervals determined by the Manufacturer.

### Disassembling AP piston accumulators removing the accumulator from a hydraulic system

- Shut down the hydraulic system and make sure that the hydraulic pressure at the accumulator is zero. In this condition, the piston will be bottomed at the hydraulic end.

- Remove the mounting screws or release the clamp(s) and remove the accumulator from the hydraulic system. Threaded holes in the hydraulic cap may be used to connect the lifting equipment or a rape may be used around the tube.

If a gas bottle is connected to the accumulator, make sure that it is discharged before disconnecting the accumulator.

### Disassembling an AP accumulator



Gas pressure should always be discharged before the disassembly of an accumulator AP. Those accumulators have the oil and gas end caps threaded into the pipe. Always remove the gas cap first – identifiable by the gas valve or by a gas bottle connection.

- Place the accumulator horizontally and hold it down with a strap wrench or in a vice.

When disassembling the larger accumulators, it is recommended to work with the accumulator in the vertical position.

- Unscrew the gas valve. Remove and discard the O-ring.

- To remove the gas end cap, fit screws into the tapped holes in the cap, then, using a long bar working against screws, unscrew the cap from the tube. When removing the end caps from the larger accumulators, it is recommended that the weight of the cap is supported by a hoist and sling.

- Remove the O-rings and parbak ring from the gas end cap, taking care

not to damage the grooves.

- Repeat the two last steps for the hydraulic end cap.
- Remove the piston by pushing it away from the hydraulic end with a soft-faced bar. Never try to remove the piston by applying compressed air to the opposite end.
- Remove the seals from the piston and the PTFE bearing rings

### Cleaning

Thoroughly clean and dry the metal parts and clean the bore of the tube with clean, lint-free cloth.

### Inspection

Inspect the piston for cracks, burrs around O-ring grooves, or damage. Examine the bore of the tube for scratches or scoring, using a lamp. Inspect the end caps for damaged threads or burrs on O-ring grooves.

### Reassembly



Coat all internal parts with clean hydraulic fluid before reassembly. In order to protect the piston seals and for ease assembly purposes, the use of a loading sleeve is recommended – details of a suitable loading sleeve can be provided by Epe. To minimize the risk of damage to the piston and seals, it is recommended that the replacement piston assembly should be installed with the accumulator pipe positioned vertically.

### Piston



- Lubricate and fit new seals and PTFE bearing rings. For inserting the piston into the body, the weight of the piston must be supported with a rape, taking care not to damage the seals or to introduce contamination when the piston enters the loading sleeve.
- Lubricate the piston and insert it, plain end first, into the loading sleeve positioned at the gas end of the pipe.
- Using a **clean** hammer and block, tap the piston into place



### End Caps







The O-ring and parbak ring, fitted to the accumulator end caps, have a flat face and a concave face to allow the ring and the parbak ring seating correctly.

#### Hydraulic end cap



#### Gas end cap



- Lubricate and install a new parbak ring in the groove in the hydraulic end cap, with its concave surface facing the inner end of the cap.
- Lubricate and fit a new O-ring on the concave face of the parbak ring.
- Lubricate the threads of the end cap and insert them into the pipe, facing the plain (hydraulic) side of the piston. Care should be pay not to scrape the O-ring over the pipe threads.
- Tighten the end cap using a bar against the screws threaded into the holes of the cap. When fully tight, the end cap will abut against the chamfer leading into the honed bore; extreme tightness is not required as sealing is achieved by the O-ring. The cap should not protrude beyond the end of the accumulator pipe by more than 1mm.

- Repeat the instructions above for the hydraulic gas end cap. The gas end cap, when fitted, will face the dished side of the piston.
- For accumulators with a gas valve, lubricate and fit a new O-ring to the gas valve, thread the valve into the gas end cap and torque tighten to 30 + 5 Nm. Refit the gas valve cap.

#### Installation



Remount the accumulator and connect it to the hydraulic system, then pre-charge it.

#### Pre-charge

- Screw the pre-charge PC equipment on the gas valve.
- Connect the equipment to the nitrogen bottle or to the pressure reducer with the charging hose.
- Slowly enter the nitrogen in the accumulator until reaching a pressure slightly higher than the set value (+ 10 ÷ 15%).
- Close the bottle and remove the charging hose from the PC equipment.

- Wait until the gas temperature has stabilized (2 hours).
- Calibrate the pressure discharging the excess gas.

#### Demolition and recycling of the accumulator

Before accumulator demolition or recycling, you should always discharge completely the pre-charge pressure and remove the gas valve.

If you need, proceed decontaminating in relation to the fluid used prior to demolition.

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