

Part number:

HYDROMA

HYDRAULICKÉ SYSTÉMY

**HIDROMA
SYSTEMS**

UKŁADY HYDRAULICZNE

HYDROMA

ГИДРАВЛИЧЕСКИЕ СИСТЕМЫ



Construction: carbon steel body

Capacity: 0,05 ÷ 4 litres

Pressure: up to 350 bar

OPERATING PRINCIPLE

One of the main tasks of the hydraulic accumulators is to accumulate a certain quantity of fluid under pressure from a hydraulic system and return all or part of it to the system when required: for this reason they are considered pressure vessels and must be sized for the maximum operating pressure, taking into account the acceptance standards applicable in the country of installation.

Accumulators with separation element between the fluid side and the gas side, that are normally pre-loaded with nitrogen, are used in most hydraulic systems.

Depending on the type of separation element, the accumulator takes its name: the WAs are membrane accumulators.

The maintenance free membrane accumulators type WA cannot be repaired, since they have been specially designed for high production, low cost applications, for which it is more practical and convenient to replace rather than repair the equipment.

These accumulators consist of two cups made of high-strength steel and welded with electron beam.

The U-shaped membrane separates the gas side from the fluid side. Membranes are available in nitrile rubber NBR, epichlorohydrin (ECO) and nitrile rubber for low temperatures – 40 °C. A suitable button made of high-resistance material closes the hole on the fluid side when the accumulator is precharged, to avoid the extrusion of the membrane.

The gas valve is available in a standard version M28x1.5 with allen locking screw and sealing washer in rubber-metal (for the pre-charge you must use the precharge and control equipment DP100), in the (special) version with small valve 5/8" UNF (for the pre-charge you must use the precharge and control equipment DP200), while in the version with factory fixed precharge and electrowelded closing plug the precharge pressure value cannot be controlled and/or modified.

The fluid coupling is available in the standard threaded connections listed in the table, in male or female versions and in the version with double thread for a quick, safe, inexpensive anchoring via the external thread and fastening ring nut (optional, see chapter 14), as well as a suitable female connection.

Compared with others, these accumulators have a high energy yield, as they have a higher energy density (energy content/mass): this feature is due to the spherical shape of the accumulator body. WA-type membrane accumulators can be installed in any position.



USE SECTORS

The maintenance free membrane accumulators type WA are used for the most varied applications in the industrial, machine tools, mobile and agriculture industries.



APPLICATIONS

- Energy reserve in systems with intermittent operation for power reduction of the pump
- Energy reserve for emergencies, such as in case of failure of the motor-pump assembly or power outage
- Compensation for losses due to leakage
- Pressure compensator (balance)
- Vibration damping in the case of periodic oscillations
- Volume compensation in the event of changes in pressure and temperature
- Hydraulic spring for the suspensions on vehicles
- Shock absorption in case of mechanical impact.

ADVANTAGES

- Compact product
- Quick and easy installation
- High life cycle
- High energy efficiency
- High compression ratio, max 8 : 1
- Fast response time (less than 25 ms)
- Operation also with low lubricating power fluids
- Good tolerance to dirt (contaminants present in the fluid)
- Reduced weight
- Low cost

Maintenance free welded membrane accumulators/dampeners

TECHNICAL SPECIFICATIONS

Maximum pressure	100 - 140 - 210 - 250 - 280 - 300 - 350 bars	
Nominal capacity	0,05 - 0,16 - 0,35 - 0,5 - 0,75 - 1 - 1,4 - 2 - 3 - 3,5 - 4 litres	
Materials	Body	Painted carbon steel RAL 9004 (opaque) (resistance to salt spray 250 hours)
		on request: resistance to salt spray 500 hours
		on request: AISI 316L
	Membrane	NBR (Perbunan)
		ECO (Epichlorohydrin)
		NBR -40 °C
		Others on request
	Precharge valve	M28x1,5
		Electrowelded plug with factory fixed precharge
5/8"UNF valve (on request)		
Operating temperature with membrane	NBR: -15 ÷ +80 °C	
	ECO: -30 ÷ +120 °C	
	NBR -40: -40 ÷ +70 °C	
Precharge at 20 °C	Pressure value on request (± 5% with minimum ± 3 bar) with Nitrogen: N ≥ 99.9% volume, O ₂ ≤ 50 Vpm and H ₂ O ≤ 30 Vpm	

TECHNICAL DATA

Type	Rated volume [lt]	Effective volume [lt]	Max pressure* (in carbon steel) [bar]	Max dynamic Delta P P ₂ - P ₁ [bar]	Max compress. ratio P ₂ :P ₀	Max flow** [l/min]	Ped category (for liquids in Group 2)	Weight [kg]
WA 0,05	0,05	0,07	210	120	6:1	10	Art.3 Par.3	0,5
WA 0,16	0,16	0,17	210 250	120	6:1	10	Art.3 Par.3	0,9
WA 0,35	0,35	0,35	100	100	6:1	40	Art.3 Par.3	1
		0,41	210 250	140				1,8
WA 0,5	0,5	0,58 0,59	100	140	8:1	40	Art.3 Par.3	1,6
			140					2,4
			210 300					2,8
WA 0,75	0,75	0,77 0,77 0,81 0,72 0,75	100	120	6:1	40	Art.3 Par.3	2,0
			140					3,2
			210	150	4:1			3,4
			250	150	8:1			3,2
			280	150	4:1			5,2
350	150	6:1	5,2					
WA 1	1	1,00 1,10 0,95	210	140	4:1	40	Art.3 Par.3	4,0
			250	150	8:1			4,8
			280	140	4:1			4,5
WA 1,4	1,4	1,42 1,49 1,38	100	80	6:1	80	Cat. II	3,6
			140					5,5
			250	140	6:1			8,5
WA 2	2	2,00 2,05	140	60	4:1	80	Cat. II	6
			250	140				6,6
WA 3	3	3,15 3,15 2,85	210	140	4:1	120	Cat. II	8,1
			250					10,8
			350	180				14,6
WA 3,5	3,5	3,55 3,55 3,50	210	140	4:1	120	Cat. II	8,9
			250					12,1
			350					16,6
WA 4	4	4,00 4,00	210	140	4:1	120	Cat. II	9,9
			250					13,4

* Maximum pressure calculated according to EN 14359 (for the pressure values in agreement with other standards, please contact SAIP)

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

*** Maximum differential pressure permissible (pressure difference between the maximum operating pressure P₂ and the minimum operating pressure P₁) in order to have an infinite life cycle (greater than 2.000.000 cycles).



Construction: carbon steel body

Capacity: 0,05 ÷ 4 litres

Pressure: up to 350 bar

COMPATIBILITY OF MEMBRANES / TEMPERATURE / FLUID

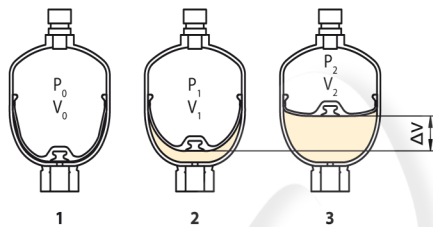
1	Nitrile rubber NBR	-15 ÷ +80 °C	Suitable for aliphatic hydrocarbons (propane, butane, gasoline, oils, mineral greases, diesel fuel, fuel oil, kerosene), mineral greases and oils, fluids HFA - HFB - HFC, many diluted acids, saline solutions, water, glycol water.
1C	Nitrile rubber for low temperatures NBR	-40 ÷ +70 °C	Fluids compatibility as for standard nitrile + various types of freon. (Has lower content of acrylonitrile than the standard and is therefore more suitable for work at low temperatures, but the chemical resistance to the different liquids is slightly lower).
8	Epichlorohydrin ECO	-30 ÷ +120 °C	Suitable for mineral oils and greases, aliphatic hydrocarbons (propane, butane and gasoline), silicone oils and greases, water at room temperature, low gas permeability, good resistance to ozone, ageing and weathering.

For the use of other fluids and temperatures, please contact SAIP

SIZING

For an accumulator sizing, various factors are to be considered, associated with the type of accumulator itself, operating pressure, relevant precharge pressure, necessary volumes and operating temperatures.

Status



- 1) P_0 = (nitrogen precharge pressure) and V_0 = (gas effective volume) correspond to precharge conditions. Hydraulic pressure value is lower than precharge value, i.e. the membrane expansion is maximum and there is no fluid inside the accumulator. A special button closes the hole on the liquid side to prevent membrane extrusion.
- 2) P_1 = (minimum operating pressure) and V_1 = (gas volume at pressure P_1) correspond to minimum pressure conditions, i.e. since the fluid pressure is slightly higher than precharge pressure, it remains inside the accumulator, to prevent that - at each cycle - the membrane and the plate collide against the accumulator internal surface.
- 3) P_2 = (maximum operating pressure) and V_2 = (gas volume at pressure P_2) correspond to maximum pressure conditions, i.e. membrane has reached its maximum shrinkage, resulting in maximum liquid accumulation.

ΔV = rated volume delivered/absorbed =

$$V_{1,gas} - V_{2,gas} = V_{2,fluid} - V_{1,fluid}$$

Precharge pressure

Value of precharge pressure varies depending on accumulator application:

- A) Energy accumulation, emergency function, hydraulic spring, force compensator, leakage compensator, volume compensator: in these applications, precharge pressure is usually $P_0 = 0.9 \div 0.95 \times P_1$ (at maximum operating temperature). Compression ratio $P_2 : P_0$ is also to be met, being lower than specified in paragraph Technical data (4:1. 6:1, max 8:1)
- B) Pulsation damper
 $P_0 = 0.7 \div 0.9 \times P$ (operating pressure)
 Referred to maximum operating pressure.
- C) Absorber of water hammers
 $P_0 = 0.9 \div 0.95 \times P$ (operating pressure)
 Referred to maximum operating pressure.

Temperature changes

Operating temperature change can strongly affect the accumulator precharge pressure. When temperature increases, the precharge pressure increases; on the contrary, when temperature decreases, the precharge pressure decreases. To better use the accumulator, precharge pressure needs to be calculated considering temperature changes during operation.

$$P_0(T_{20}) = P_0(T_x) \times \frac{20 + 273}{T_x + 273}$$

$P_0(T_x)$ = pressure at temperature measured T_x
 $P_0(T_{20})$ = nitrogen pressure P_0 at 20 °C

Sizing with isothermal transfer

Example: leakage compensation, volume compensation. Calculation in isothermal transfer only applies when both accumulation and discharge occur in a long time (more than 10 minutes), so that an efficient heat exchange is allowed and nitrogen temperature is kept almost constant.

Accumulator volume:

$$V_0 = \frac{\Delta V}{\frac{P_0}{P_1} - \frac{P_0}{P_2}}$$

Maintenance free welded membrane accumulators/dampeners

V_0 and ΔV in litres

P_0 and P_1 and P_2 in absolute bars (bar(a) = bar(g) + 1)

Accumulator yield:

$$\Delta V = V_0 \times \left(\frac{P_0}{P_1} - \frac{P_0}{P_2} \right)$$

Dimensionamento con trasformazione adiabatica

Example: energy accumulation, hydraulic spring, suspensions, force compensator.

Calculation in adiabatic transfer only applies when accumulation and discharge both occur in a short time, so that no heat exchange is allowed between gas and environment. (When quickly compressed, nitrogen increases temperature, on the contrary temperature decreases when released).

Accumulator volume:

$$V_0 = \frac{\Delta V}{\left(\frac{P_0}{P_1} \right)^{\frac{1}{1.4}} - \left(\frac{P_0}{P_2} \right)^{\frac{1}{1.4}}}$$

V_0 and ΔV in litres

P_0 and P_1 and P_2 in absolute bars (bar(a) = bar(g) + 1)

Accumulator yield:

$$\Delta V = V_0 \times \left[\left(\frac{P_0}{P_1} \right)^{\frac{1}{1.4}} - \left(\frac{P_0}{P_2} \right)^{\frac{1}{1.4}} \right]$$

Sizing with polytropic transfer

Example: emergency, safety.

Calculation in polytropic transformation only applies when accumulation is slow (isothermal) and discharge is quick (adiabatic).

Accumulator volume:

$$V_0 = \frac{\Delta V \times \frac{P_2}{P_0}}{\left(\frac{P_2}{P_1} \right)^{\frac{1}{1.4}} - 1}$$

V_0 and ΔV in litres

P_0 and P_1 and P_2 in absolute bars (bar(a) = bar(g) + 1)

Accumulator yield:

$$\Delta V = V_0 \times P_0 \times \frac{\left(\frac{P_2}{P_1} \right)^{\frac{1}{1.4}} - 1}{P_2}$$

Using the formulas above, accumulator volume can be calculated with good degree of approximation and/or the volume obtained depending on accumulator dimension specified.

For other usages and/or for a more accurate calculation, considering temperature changes, real charge and discharge times, real and not ideal gas usage, SAIP SIZAC calculation software can be used as available on site www.saip.it or contacting directly SAIP technical service.

CERTIFICATIONS

All hydraulic accumulators are pressure vessels and are subject to the national legislation and directives applicable in the country of installation.

The accumulators type WA are manufactured in accordance with the European directive PED (97/23); for capacities lower than or equal to 1 litre CE marking is not required, while for higher capacities, in addition to the CE marking, each accumulator must be accompanied by the declaration of conformity and by the operation and maintenance manual.

The Technical data table indicates the category related to the use with not dangerous fluids (group 2), as a function of the product: volume by pressure.

For use with hazardous fluids (group 1), please contact SAIP.

In compliance with the European Directive PED (97/23/CE), documentation includes the declaration of conformity and the use and maintenance manual.

Accumulators can also be supplied according to directive ATEX 94/9/CE (annex VIII) and harmonized standards EN 13463-1 concerning non electrical products to be used in potentially explosive atmosphere environments and not included in classification ATEX CE II2GcT4.

SAIP also provides for other tests and certifications for countries where CE certification is not recognized.

- ASME-"U"- Stamp for USA (National Board), Canada (CRN), South Africa, etc.
- ML (ex SQL) for China.
- Australian Pressure Vessel standard AS1210-1997 for Australia.
- GOST-R for Russia, Ukraine, Kazakhstan, etc.
- Dossier RTN - Rostekhnadzorf for Ukraine, Russia, Kazakhstan, etc.
- DDP passport for Algeria, Tunisia etc.
- DOSH for Malaysia

Anyway, for other countries or applications requiring for a specific test, accumulators are manufactured in compliance with the European Directive, but supplied without CE mark and with factory test or according to the standard applied.

Other certifications, such as for naval sector, can be required upon order.



Construction: carbon steel body

Capacity: 0,05 ÷ 4 litres

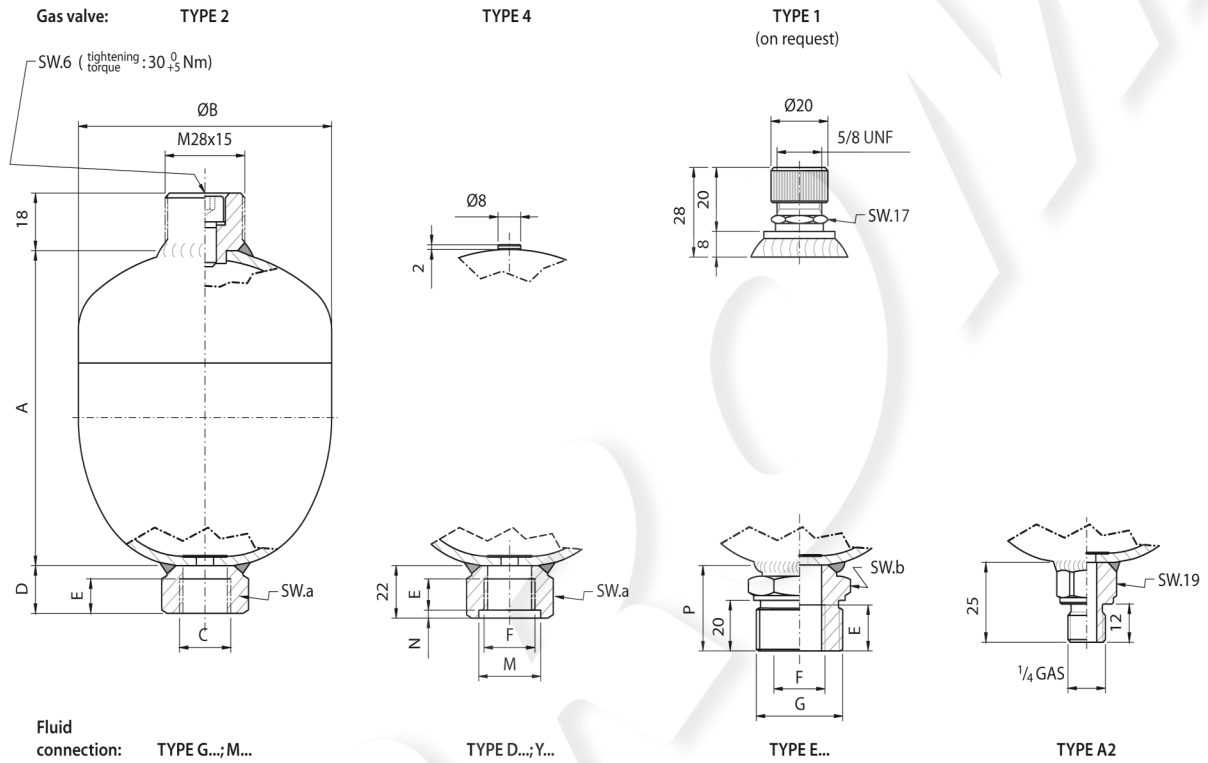
Pressure: up to 350 bar

ORDERING CODE

WA	2	1,4	8	0	G5	A	250			
Accumulator type	Gas valve	Nominal capacity		Membrane material	Fluid side connection		Calculation code and testing/certification	Maximum pressure		
WA	membrane, welded with electron beam	litres		1	capacity	threading	A	According to the relative capacity and with calculation code EN14359		
		0,05	0,05					litres	bar	
	2	M28x1.5 gas valve	0,16	0,16	0,05	1/4" gas (ISO228) male	A	210	0,05	210
	4	Plug in welded carbon steel	0,35	0,35		M8		M18x1.5 female	210	0,16
	1	5/8 UNF galvanized valve (on request)	0,5	0,5	1C	G4	K	100	0,35	100
			1	1				210		210
			1,4	1,4	8	M8	L	210	0,5	210
			2	2				G4		M18x1.5 female
			3	3	Other compounds on request. Membrane with stainless steel button on request	D4	J	100	0,75	100
			3,5	3,5				E1		1/2" gas (ISO228) female + outer threading M33x1.5
			4	4	Other connections on request	E1	Other calculation codes and certifications on request	250	1	250
								G4		1/2" gas (ISO228) female
					1 ÷ 2	Y9	D4	100	1,4	100
								E1		1/2" gas (ISO228) female + outer threading M33x1.5
					3 ÷ 4	E7	Y9	250	2	250
								E1		1/2" gas (ISO228) female + outer threading M33x1.5
					3 ÷ 4	E7	Y9	140	2	140
								E1		1/2" gas (ISO228) female + outer threading M33x1.5
					3 ÷ 4	E7	Y9	210	3,5	210
								E1		1/2" gas (ISO228) female + outer threading M33x1.5
					3 ÷ 4	E7	Y9	210	4	210
								E1		1/2" gas (ISO228) female + outer threading M33x1.5
					3 ÷ 4	E7	Y9	250	4	250
								E1		1/2" gas (ISO228) female + outer threading M33x1.5
					3 ÷ 4	E7	Y9	250	4	250
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Maintenance free welded membrane accumulators/dampeners

DIMENSIONS for pressures up to 300 bar



Type	Pressure [bar]	Gas valve			A [mm] (± 2)	$\varnothing B$ [mm] (+0/-1)	C	D	E	F	G	M	N	P	SW a	SW b	
		Type 1	Type 2	Type 4													M8
WA 0,05	210	5/8"UNF	M28X1,5	Welded plug	67	55,5	-	1/2"Gas	20	15	-	-	-	-	30	-	
	210	5/8"UNF	M28X1,5	Welded plug	86	70	M18X1,5	1/2"Gas	20	15	1/2"Gas	M33x1,5	27	2,5	38	30	41
WA 0,16	250	5/8"UNF	M28X1,5	Welded plug	97	90	-	-	-	-	-	-	-	-	-	-	
	100	5/8"UNF	M28X1,5	Welded plug	112	96	M18X1,5	1/2"Gas	20	15	1/2"Gas	M33x1,5	27	2,5	38	30	41
WA 0,35	210	5/8"UNF	M28X1,5	Welded plug	112	96	-	-	-	-	-	-	-	-	-	-	
	250	5/8"UNF	M28X1,5	Welded plug	122	101	M18X1,5	1/2"Gas	20	15	1/2"Gas	M33x1,5	27	2,5	38	30	41
WA 0,5	140	5/8"UNF	M28X1,5	Welded plug	122	101	M18X1,5	1/2"Gas	20	15	1/2"Gas	M33x1,5	27	2,5	38	30	41
	210	5/8"UNF	M28X1,5	Welded plug	126	105	-	-	-	-	-	-	-	-	-	-	
	300	5/8"UNF	M28X1,5	Welded plug	130	109	-	-	-	-	-	-	-	-	-	-	
	100	5/8"UNF	M28X1,5	Welded plug	139	109	-	-	-	-	-	-	-	-	-	-	
WA 0,75	140	5/8"UNF	M28X1,5	Welded plug	139	109	M18X1,5	1/2"Gas	20	15	1/2"Gas	M33x1,5	27	2,5	38	30	41
	210	5/8"UNF	M28X1,5	Welded plug	135	117	-	-	-	-	-	-	-	-	-	-	
	250	5/8"UNF	M28X1,5	Welded plug	133	122	-	-	-	-	-	-	-	-	-	-	
	280	5/8"UNF	M28X1,5	Welded plug	135	117	-	-	-	-	-	-	-	-	-	-	
WA 1	210	5/8"UNF	M28X1,5	Welded plug	171	117	-	1/2"Gas	20	15	1/2"Gas	M33x1,5	27	2,5	38	30	41
	250	5/8"UNF	M28X1,5	Welded plug	146	136	-	3/4"Gas	24	16	-	-	34	1	-	41	-
	280	5/8"UNF	M28X1,5	Welded plug	171	117	-	-	-	-	-	-	-	-	-	-	
WA 1,4	100	5/8"UNF	M28X1,5	Welded plug	153	142	-	1/2"Gas	20	15	1/2"Gas	M33x1,5	27	2,5	38	30	41
	140	5/8"UNF	M28X1,5	Welded plug	153	142	-	3/4"Gas	24	16	-	-	34	1	-	41	-
	250	5/8"UNF	M28X1,5	Welded plug	154	153	-	-	-	-	-	-	-	-	-	-	
WA 2	140	5/8"UNF	M28X1,5	Welded plug	200	142	-	1/2"Gas	20	15	1/2"Gas	M33x1,5	27	2,5	38	30	41
	250	5/8"UNF	M28X1,5	Welded plug	193	153	-	3/4"Gas	24	16	-	-	34	1	-	41	-
WA 3	210	5/8"UNF	M28X1,5	Welded plug	235	170	-	3/4"Gas	24	16	3/4"Gas	M45x1,5	34	1	42	41	46
	250	5/8"UNF	M28X1,5	Welded plug	239	174	-	-	-	-	-	-	-	-	-	-	
WA 3,5	210	5/8"UNF	M28X1,5	Welded plug	262	170	-	3/4"Gas	24	16	3/4"Gas	M45x1,5	34	1	42	41	46
	250	5/8"UNF	M28X1,5	Welded plug	266	174	-	-	-	-	-	-	-	-	-	-	
WA 4	210	5/8"UNF	M28X1,5	Welded plug	288	170	-	3/4"Gas	24	16	3/4"Gas	M45x1,5	34	1	42	41	46
	250	5/8"UNF	M28X1,5	Welded plug	292	174	-	-	-	-	-	-	-	-	-	-	

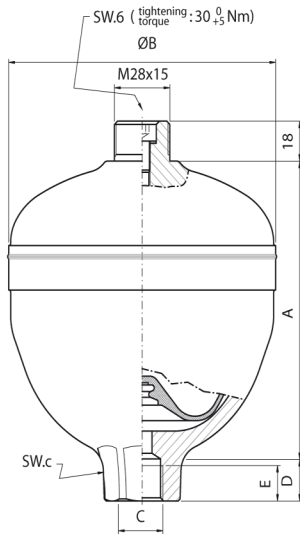


Construction: carbon steel body

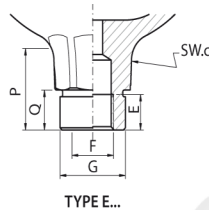
Capacity: 0,05 ÷ 4 litres

Pressure: up to 350 bar

DIMENSIONS for pressure at 350 bar



Type	Pressure [bar]	Gas valve Type 2	A [mm] (±2)	ØB [mm] (+0/-1)	C G....	D [mm]		E [mm]	F E.....		G M33x1,5	P [mm]	Q [mm]	SW b [mm]
WA 0,75	350	M28X1,5	133	134	½"Gas	20	15	15	½"Gas	M33x1,5	38	18	41	
WA 1,4	350	M28X1,5	161	164	½"Gas ¾"Gas	20 24	15 16	15	½"Gas	M33x1,5	38	18	41	
WA 3	350	M28X1,5	224	182	¾"Gas	24	16	16	¾"Gas	M45x1,5	42	20	55	
WA 3,5	350	M28X1,5	264	182	¾"Gas	24	16	16	¾"Gas	M45x1,5	42	20	55	



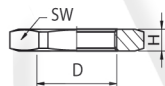
Fluid connection: TYPE G...

ACCESSORIES

Fastening nut

They are used to simply and safely fasten accumulators by outer threading type E1 (M33x1.5) or E7 (M45x1.5) on fluid side attachment.

Accumulators equipped with gas valve type 2 can be fastened by M28x1.5 threading, by using the relevant ring nut in the table. Nuts shown below are made of zinc plated white carbon steel in compliance with directive 2002/95/CE (RoHS) with excellent corrosion resistance.



Type	D	SW		H
		[mm]	[mm]	
DADORM2-OZ28	M28 x 1,5	41	7	
DADORE1-OZ33	M33 x 1,5	50	7	
DADORE7-OZ45	M45 x 1,5	70	7	

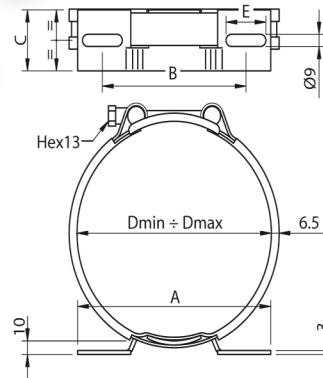
Mounting collars

SAIP mounting collars type CFOZ_LF_ can be used to safely fasten various types of WA accumulators and ensure an independent and non-rigid mounting on plants.

The rubber insert is used to reduce vibration transmission, compensate manufacturing tolerances and release external stresses from connection.

This type of collar consists of a two-piece frame to make installation easier, increase modularity and stability depending on needs and spaces available. Base plate is made of zinc plated white carbon steel in compliance with directive 2002/95/CE (RoHS) with excellent corrosion resistance.

The belt fastening the accumulator at the base also consists of carbon steel with the same characteristics as its base and keeps the accumulator body as it is isolated from by a nitrile rubber NBR belt a 80 Shore A.



Type	Description						Weight [kg]	To be used on WA
	D _{min}	D _{max}	A	B	C	E		
	[mm]	[mm]	[mm] +/ -1	[mm] +/ -0,5	[mm]	[mm]		
CFOZ72LF120	67	72	124	94	45	22	0,3	WA0,16
CFOZ96LF120	90	96	124	94	45	22	0,3	WA0,35
CFOZ96LF160			164	123	45	33	0,4	
CFOZ102LF160	97	102	164	123	45	33	0,4	WA0,5 100/140
CFOZ111LF160	103	111	164	123	45	33	0,4	WA0,5 210/300 WA0,75 100/140
CFOZ120LF160	112	120	164	123	45	33	0,4	WA0,75 210/280 WA1 210/280
CFOZ128LF160	121	128	164	123	45	33	0,4	WA0,75 250
CFOZ137LF160	129	137	164	123	45	33	0,4	WA1 250 WA0,75 350
CFOZ146LF160	138	146	164	123	45	33	0,4	WA1,4 100/140
CFOZ146LF210			214	173	50	33	0,5	WA2 140
CFOZ159LF160	147	159	164	123	45	33	0,4	WA1,4 250
CFOZ159LF210			214	173	50	33	0,5	WA2 250
CFOZ172LF160	160	174	164	123	45	33	0,5	WA1,4 350
CFOZ172LF210			214	173	50	33	0,5	WA3,3,5/4 210/250
CFOZ185LF160	173	185	164	123	45	33	0,6	WA3,3,5 350
CFOZ185LF210			214	173	50	33	0,6	