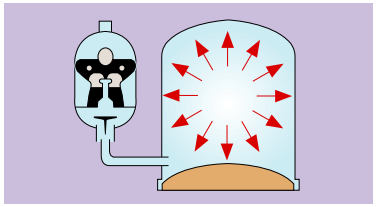
ACCUMULATORS

2010 CD-ROM Brochure

SERVOT **NAKAMURA KOKI CO.,LTD.**

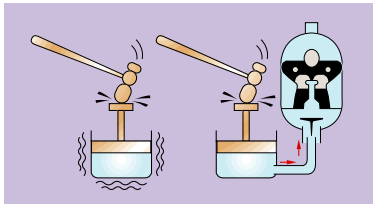
http://www.accumulator.co.jp/

1. Functions & Effects



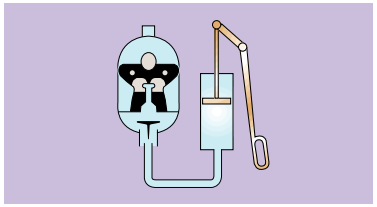
■ Energy Storage (Power Compensator)

This is a typical application of an accumulator where it stores energy from an external pressure source during idle time and discharges it as needed. In other words, it is used for reduction of pump and motor sizes, as an auxiliary power source in case of emergency, and/or to augment the output of the pump during high speed operation of actuator and hydraulic starter of internal combustion engines.



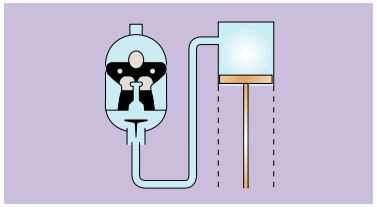
■ Water Hammer and Surge Pressure Absorber (Shock Dampener)

If a high pressure, high flow pipe line was shut suddenly, a huge pressure surge occurs. or, if an external mechanical shock was introduced to an actuator, vibration to fluid occurs, causing damages to machinery and equipment. The accumulator will dampen these fluid and mechanical shocks.



■ Pump Pulsation Dampener (Pulsation dampener)

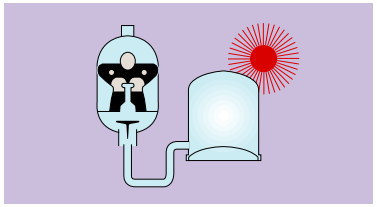
Pulsation pressure of high pressure piston pumps, such as single, double, or triple actings, causes difficulties in various controls of hydraulic pressure systems. These pulsation pressure and knocking phenomenon that will occur, due to small feeding by cylinder, can be eliminated by an accumulator.



■ Leakage Compensator

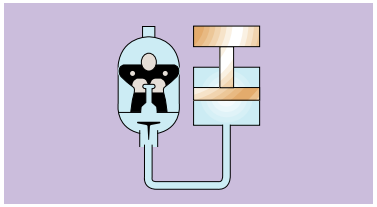
An accumulator will minimize pressure reduction due to leakage when an accumulator was held at a set position for a long period of time or when something is being clamped.

The hydro-pneumatic accumulator is a pressurized fluid storage vessel that utilizes compression of gas and by the expansion power of the compressed gas the pressurized fluid stored in the accumulator is discharged.
The bladder type accumulator uses a soft rubber bag to separate the compressed gas and non-compressed fluid and is charged with gas. It has many functions, in addition to storing pressure.



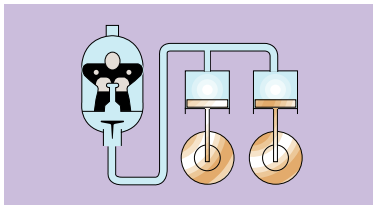
■ Thermal Change Compensator

An accumulator will compensate for rising pressure in a closed line that is exposed to hot weather or lowering pressure due to fluid contraction in a cold area.



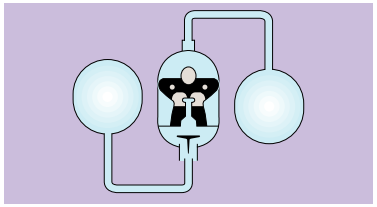
■ Hydraulic Balancer

Because the gas pressure in an accumulator will act as a weight for raising or lowering of machine tool heads or T.V. camera pedestal. they can be operated with minimum cylinder friction.



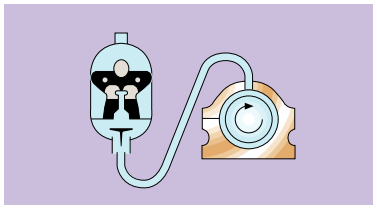
■ Hydro-Pneumatic Shock Absorbers

An accumulator serves as a spring for absorbing shocks between the body and wheels of a vehicle. In addition, it can be used as a pneumatic spring for various kinds of reduction rolls. It has less fatigue and greater shock absorption than a spring.



■ Transfer Barrier

An accumulator transfers or sends pressure occurring at one side of the fluid to the other without mixing heterogeneous fluid. With this method the accumulator acts as a compressor of gas or transport of corrosive fluid. The pressure change in an accumulator. which is caused by storage and discharge of fluid. can be minimized by enlarging the gas chamber and operating at low pressure difference.



■ Fluid Supplier

An accumulator can be used for supply of lubricant or as a portable lubricator.

2. Accumulator Volume Calculation

COMMON SYMBOL

ΔV	:	Available Discharge Volume of Acc. (Liter)	P_A	:	Normal Pressure (MPa・A)
P_1	:	Precharge Pressure (MPa・A)	P_X	:	Mean Operating Pressure (MPa・A)
P_2	:	Min. Operating Pressure (MPa・A)	P_B	:	Max. Permissible Pressure (MPa・A)
P_3	:	Max. Operating Pressure (MPa・A)	P_m	:	
n	:	Polytropic Exponent at Discharging (Per Graph Below)	W	:	Mass of Fluid in Line (kg)
m	:	Polytropic Exponent at Storage. (Value of "n" − 0.2)	υ	:	Flow Velocity (m/sec)
V_1	:	Accumulator Gas Volume (Liter)	q	:	Pump Displacement per Revolution (Liter/rev)
			F_1	:	Pump Coefficient (See Graph Next)

CALCULATION FORMULA

Energy Storage

$$V_1 = \frac{\Delta V \times P_2 \times \left(\frac{P_3}{P_2}\right)^{\frac{1}{m}}}{P_1 \left\{\left(\frac{P_3}{P_2}\right)^{\frac{1}{n}} - 1\right\}}$$

$$\Delta V = \frac{P_1 \times V_1 \left\{\left(\frac{P_3}{P_2}\right)^{\frac{1}{n}} - 1\right\}}{P_2 \left(\frac{P_3}{P_2}\right)^{\frac{1}{m}}}$$

Note: In the case of Isothermal Change, n=1 and m=1

Surge Absorption

$$V_1 = \frac{W \times \upsilon^2 \times (n - 1)}{200 \times g \times P_1 \left\{\left(\frac{P_B}{P_A}\right)^{\frac{n-1}{n}} - 1\right\}}$$

g: Acceleration of Gravity, 9.8m/sec^2

Note: For n, please put in a numerical value of less than 1(sec.) from the graph next.

Pulsation Dampening

$$V_1 = \frac{q \times F_1 \left(\frac{P_X}{P_1}\right)}{1 - \left(\frac{P_X}{P_m}\right)^{\frac{1}{n}}}$$

Note: $P_1 = 0.6\ Px$

F_1 : Pump Coefficient

Pump Type		F_1
Simplex	Single Action	0.60
	Double Action	0.25
Duplex	Single Action	0.25
	Double Action	0.15
Triplex	Single Action	0.13
	Double Action	0.06
Quaduplex	Single Action	0.10
	Double Action	0.06
Quintuple	Single Action	0.06
	Double Action	0.02

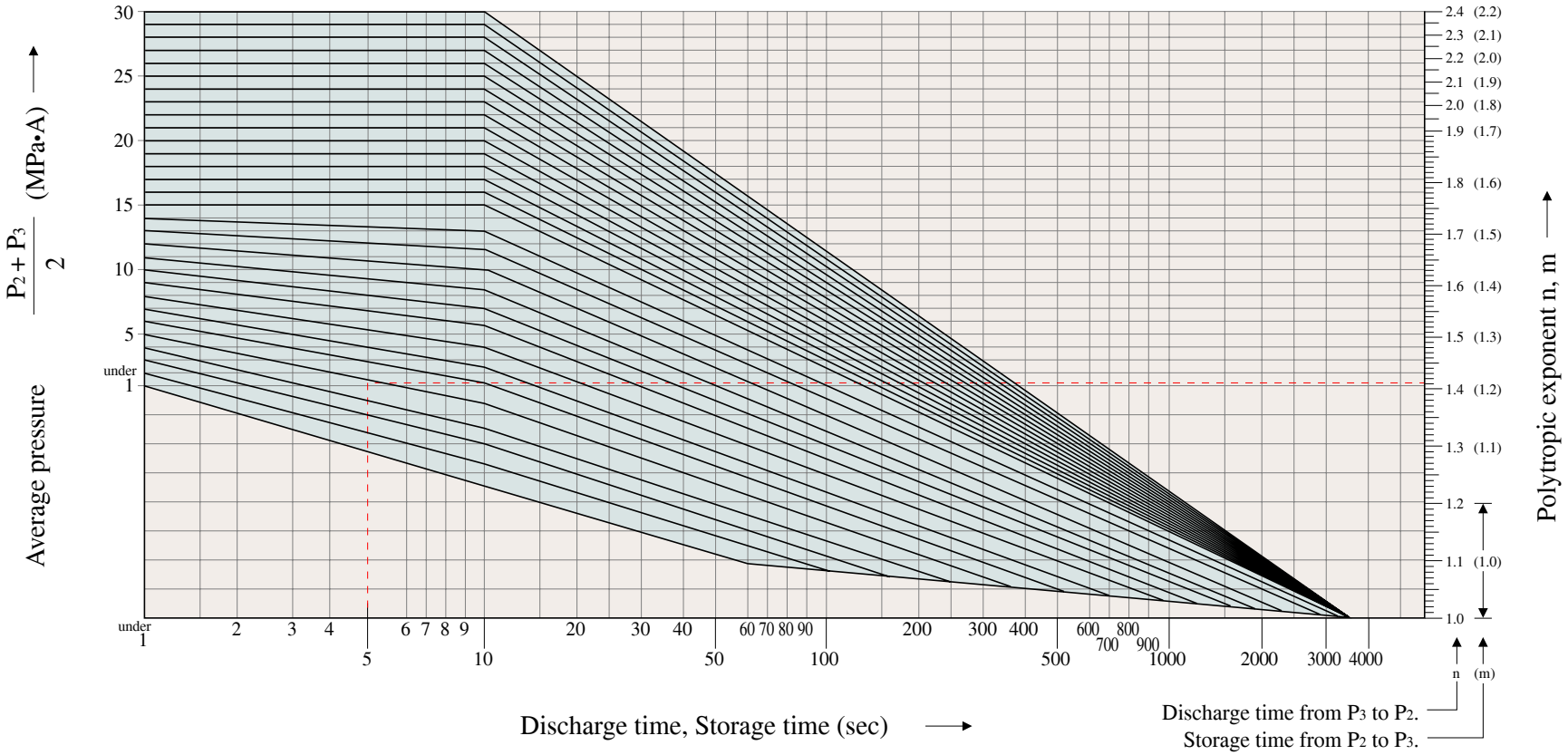
LIMITATION

(1) The relationship between higher or lower pressure is $0.25 \times (P_3 \text{ or } P_B \text{ or } Pm) \leq P_1 \leq 0.9 \times (P_2 \text{ or } P_A \text{ or } P_X)$.
(2) In case of n < m in energy storage, make the value of "n" as "m" (but, it is over 1).

2.1 Accumulator Volume Calculation (Graph)

Polytropic Change and Exponent ··· Graph to obtain a polytropic exponent from time change and average pressure.

(Example) If the time change is 5 sec. and the average pressure if 5MPa·A, polytropic exponent is n=1.41.



(Example) ··· Refer to broken lines

1. If the discharge time from P_3 to P_2 is 5 seconds and the average pressure is 5 MPa·A ····· n = 1.41
2. If the storage time from P_2 to P_3 is 5 seconds and the average pressure is 5 MPa·A ····· m = 1.21

Exercise 1, Energy Storage :

Operate a 500 kN press of which ram diameter is 200mm. Stroke 115 mm at 1.5 sec. There is a 2 min. idle time for removing the work. If this is done with a pump and motor only, what will their sizes be? If an accumulator is used, what will their sizes be? The comparison of two cases are shown in Table 1 below.

$$\text{Ram dia. 200mm, Required pressure} = \frac{500\ \text{kN} \times 10^3}{314\ \text{cm}^2 \times 10^2} = 15.92 \cong 16\text{MPa}$$

(Ram area = $20^2 \times 0.785 = 314\ \text{cm}^2$)

$$\text{Fluid Required for 1 stroke} = 314\text{cm}^2 \times 11.5\text{cm} = 3{,}611\text{cc} \cong 3.7\ \text{Liter}$$

$$\text{Fluid volume required in second} = \frac{3.7\ \text{Liter}}{1.5\ \text{sec}} = 2.47\ \text{Liter/sec}$$

Flow volume required in a minute = 2.47 × 60 = 148.2 Liter/min
Pump shall be 16 MPaG or more at 149 Liter/min

$$\text{Motor} = \frac{149\ \text{Liter/min} \times 16\ \text{MPaG}}{61.2 \times \eta\rho(\text{Pump Efficiency})} = \frac{39.0}{0.82} = 47.6\ \text{kw} \cong 55\ \text{kw}$$

Table 1: Comparison with and without accumulator

	Without acc.	With acc.
Pressure required	16 MPaG	21.5 MPaG
Pump	149 Liter/min	1.9 Liter/min
Motor	55 kw	1.1 kw
Accumulator	None	33 Liter

If an accumulator was used ··· There are two approaches. One is that since the pressure drops as the bladder type accumulator discharges fluid, select a larger bore of cylinder, another is increase the pressure and put the minimum required pressure at the end of discharge. Let us work on the latter example. If an accumulator that withstands 21.5 MPaG and a pump that is capable of producing the pressure of 21.5 MPaG were used at the same time,

$$V_1 = \frac{\Delta V \times P_2 \, (P_3/P_2)^{1/m}}{P_1 \, \{(P_3/P_2)^{1/n} - 1\}}$$

Note: ❑ On the pressure, convert (MPaG + 0.1) into MPaA.
❑ Refer to following item f at P_1.

$$V_1 = \frac{3.7 \times 16.1 \, (21.6/16.1)^{1/1.28}}{13.4 \, \{(21.6/16.1)^{1/1.85} - 1\}} = 32.5\ \text{Liter}$$

$$\text{Flow rate to accumulator} = \frac{3.7\ \text{Liter}}{2\ \text{min}} = 1.9\ \text{Liter/min}$$

$$\text{Motor} = \frac{1.9\ \text{Liter/min} \times 21.5\ \text{MPaG}}{61.2 \times 0.82} = 0.82\ \text{kw} \cong 1.1\ \text{kw}$$

If an accumulator was used, the pressure will increase 1.35 times, however, the sizes of a pump and a motor becomes smaller, 1/79 and 1/50 respectively.

Accumulator Model Selection Examples :

a. The model shall be G230 or T230 (Ref. to INDEX 5 and 6) as the pressure is 21.5 MPaG.

b. At gas volume of 32.5 Liter , the accumulator model is 30 Liter (Ref. to "Gas Volume" in INDEX 5 and 6).

c. As the flow rate required per minute is 149 Liter/min, it is acceptable as refer to the maximum allowable discharge flow of non-stamped standard type (Ref. to INDEX 5 and 6) .

d. If the fluid is the standard mineral oil (or water glycol) and the temperature is 80 ℃ or less, refer to INDEX 3 for bladder material 20. (Ref. to INDEX 3)

e. If piping is done with flange connections, it will be OPF-B32 (requires a mating flange) . (Ref. to INDEX 12) .

Therefore, Model: G or T230-30-20-OPF-B32 (requires a mating flange.)

f. With respect to the filling pressure P_1, if it is 90% or less than the minimum operating pressure P_2, the higher it is the greater discharge amount ΔV becomes. However, if the temperature of gas charging time rises and the pressure goes over 90%, it will lead to shortening of the bladder life, therefore, a caution is required. If gas was charged at the ambient temperature of 26 ℃ and the oil temperature during operation of it is 50 ℃ .

$$P_1 = \frac{\text{Absolute temperature at precharging}}{\text{Max. absolute temperature}} \times 0.9 \times P_2 = \frac{273 + 26}{273 + 50} \times 0.9 \times 16.1 = 13.4 \text{ MPaA}$$

ΔV = 3.7 Liter can be archived at P_1 = 13.3 MPaG

Exercise 2, Pulsation Dampening :

Assume that the average working pressure is 5 MPaG, maximum allowable pressure is raised 3% of the average working pressure (5.15 MPaG), pump is one stage, 62rpm, and its displacement is 32 liter/min. and $P_1 = 3$ MPaG ,

$$F_1 = 0.6,\ n = 1.51$$

$$V_1 = \frac{q \cdot F_1 \cdot \left(\frac{P_X}{P_1}\right)}{1 - \left(\frac{P_X}{P_m}\right)^{\frac{1}{n}}} = \frac{\frac{32}{62} \times 0.6 \times \left(\frac{5.1}{3.1}\right)}{1 - \left(\frac{5.1}{5.25}\right)^{1/1.51}} = 26.8 \text{ Liter}$$

Therefore, by using an accumulator, of which gas volume is 26.8 liter it is possible to dampen the pulsation by plus/minus 3% of average working pressure.

Further, you can determine the displacement per revolution from the pump plunger size and stroke.

a. Refer to Exercise 1 for accumulator model selection.

b. Refer to INDEX 4 for the effect of pulsation dampening.

Exercise 3, Surge Absorption :

Assume that we are going to reduce caused by sudden closure of a valve installed at the end of a pipe which overall length (L) is 700m, 8B X Sch40 (216.3 mm X 8.2 mm) JIS Standard, and is operated at normal line pressure of 0.53 MPaG, and fluid volume Q = 4,500 liter /min.

$$V_1 = \frac{W \times \upsilon^2 \times (n-1)}{200 \times g \times P_1 \left\{ \left(\frac{P_B}{P_A} \right)^{\frac{n-1}{n}} - 1 \right\}}$$

V_1 : Accumulator gas volume, Liter
W : Fluid mass within the line, kg

$$W = \frac{\pi}{4} \cdot d^2 \cdot L \cdot \gamma = \frac{\pi}{4} \times 200^2 \times 700 \times 0.9 \times 10^{-3} = 19792 \text{ kg}$$

d : I.D. of the pipe, (mm)
γ : Fluid specific gravity, (kg/cm^2)

υ : Velocity of fluid, (m/sec)
$\upsilon = 21.23\ Q/d^2 = 21.23 \times 4{,}500/200^2 = 2.4$ m/sec.
g : Acceleration of gravity, 9.8 m/sec^2
P_A : Normal pressure, 0.53 MPaG = 0.63 MPaA
P_B : Maximum allowable pressure = 1.23 MPaA
P_1 : Precharge pressure, MPaA
From $P_1 \leq 0.9P_A$, it becomes 0.53 MPaA
n : Politropic coefficient 1.405

$$V_1 = \frac{19792 \times 2.4^2 \times (1.405 - 1)}{200 \times 9.8 \times 0.53 \left\{ \left(\frac{1.23}{0.63} \right)^{0.2883} - 1 \right\}} = 209 \text{ Liter}$$

Therefore, install an accumulator which size is 209 liters near the valve installed at the end of the pipe. Refer to Exercise 1 for a selection of accumulator models.

3. Explanation of Model Symbols

G □ 350 – 20 H – 20 – OPF – J – 32 – CG 60M – MT – PV – S7

S7 ··· Cleanliness class of NAS.
Class 7, 8, or 9 for use of servo circuitry, etc. If not specified, a standard will apply.

PV ··· Accumulator Preventor.
G.T Series for a standard accumulator of 20 liters and over. (Ref. INDEX 13) .

MT ··· Safety device for gas port.

60M ··· Glycerol filled pressure gauge for gas port.

CG ··· Coreless type gas port (Ref. INDEX 11-1) .

If not specified, a standard gas valve will be provided.

Nominal dia. of flange.

Flange connection. (Ref. INDEX 12) .

If not specified, a standard gas valve will be provided.

Rubber materials

10	Nitrile rubber (NBR)	Low Temperature	– 25 to +80 ℃
20	Nitrile rubber (NBR)	Mineral oil, water glycol	– 10 to +80 ℃
30	Epicholorhydrine (CHC)	Gasoline, etc., Aromatic material	– 10 to +90 ℃
40	Butyl rubber (IIR)	Phosphate ester	– 10 to +90 ℃
28	Fluorine rubber (FKM)	Chemical material	– 5 to +120 ℃

Types

No stamp	Standard	Ref. INDEX 4, 5, and 6
H	High flow type	High flow discharge, Refer INDEX 5, 6.
P	Screen type	Poppetless, Ref. to INDEX 8.
B	Transfer barrier type	Transfer of heterogeneous Ref. to INDEX 9

Nominal capacity of accumulator (Liter)

Maximum working pressure (kgf/cm^2)

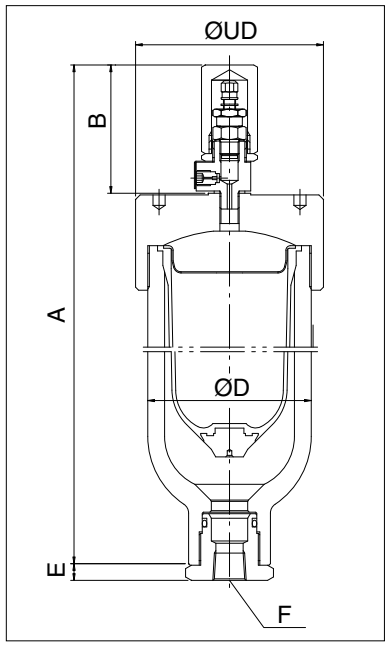
Surface treatment (or material)

No stamp	Parkerizing	Water glycol, mineral oil.	
W	Nickel plating	Water hyd.	Shell/Nickel plating, Connection / Stainless steel
S	Stainless steel	Others	Both shell & connection / Stainless steel, Ref. to INDEX 10

Series of accumulator

D	Damper series	In-line type	Ref. to INDEX 7
G	General series	Standard type	Ref. to INDEX 5
M	Miniorator Series	Small capacity type	Ref. to INDEX 4
T	Twin Open Series	Open top type	Ref. to INDEX 6

4. MINIORATOR M-Series

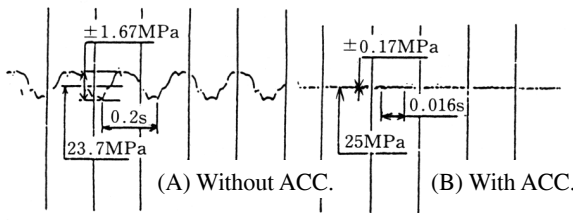


Spec. \ Model	M210
Max. W.P	20.6 MPa
Precharge	N_2 gas
Precharge pressure limits	max. 9/10 of min. operating pressure min. 1/4 of max. operating pressure
Installation	Vertically (oil port downward)
Surface treatment	Oil service : parkerizing Water service, etc. : nickel plating
Model symbols	**M 210 – 1 – 20** 20. (NBR) Mineral Oil 40. (IIR) Phosphate Esters 28. (FKM) Chemical Material Rubber Materials nominal capacity of accumulator (Liter) max. working pressure Series

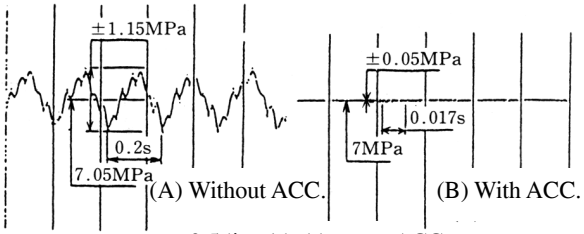
Model \ Dimension	Max. W.P MPa	Gas volume Liter	Mass kg	A	UD	D	B	E	F	Max. Allowable Discharge Flow Liter / min.
M210 – 0.1	20.6	0.115	2	232	74	60.5	85	–	Rc1/4	62
0.3		0.29	5	286	94	76.3	85	35	Rc3/4	92
0.5		0.5	6.3	376	94	76.3	85	35	Rc3/4	92
1		1	12.5	398	124	107.9	85	10	Rc3/4	260

✻ Maximum allowable discharge flow is the limit where the stopper will start chattering due to discharge of pressurized fluid.
✻ Maximum allowable discharge flow is for the case of mineral oil VG46.

■ Examples of pulsation dampening effect

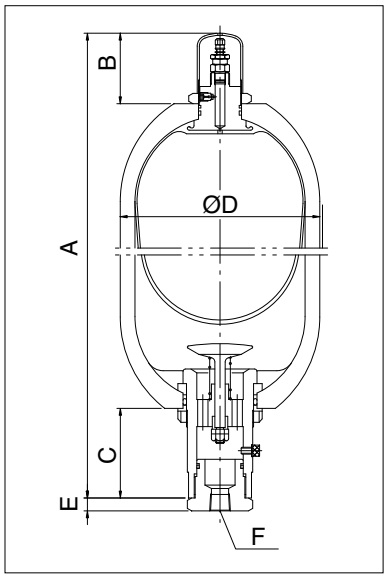


0.5 liter bladder type ACC.



0.5 liter bladder type ACC.

✻ Data on the effects of pulsation dampening by different structure of accumulators is available upon request.

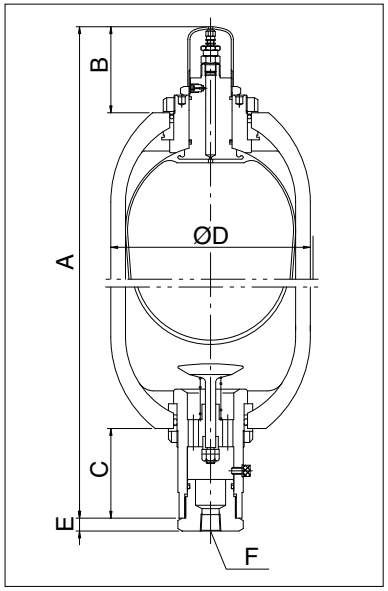


Spec. \ Model	G175	G230	G300	G350
Max. W.P.	17.2 MPa	22.6 MPa	29.5 MPa	34.4 MPa
Precharge	N_2 gas			
Precharge pressure limits	max. 9/10 of min. operating pressure min. 1/4 of max. operating pressure			
Installation	Vertically (oil port downward)			
Surface treatment	Oil service : parkerizing Water service, etc. : nickel plating			
Model symbols	G 230 – 10 H – 20 Rubber Materials { 10. (NBR) Low Temperature; 20. (NBR) Mineral Oil; 30. (CHC) Aromatic Material; 40. (IIR) Phosphate Esters; 28. (FKM) Chemical Material } Hi-Flow TYPE Nominal capacity of accumulator (lit.) Max. working pressure Series			

Model \ Dimension	Max. W.P. MPa	Gas volume Liter	Mass kg	A	B	C	D	E	F	Max. Allowable Discharge Flow Liter / min.
G175 -1	17.2	1.2	9	391	107	64	118	10	Standard unit comes with an Rc3/4 OR flange connection (Ref. to INDEX12)	342
-2.5		2.4	11	577			120			
-4		3.7	18	474			168.3			
-5		4.7	20	536						
-10		12.0	44	660	89	106	232	15		1400
-20		20.8	61	933						
-30		37.2	96	1444						
-50		53.1	128	1952						
-60		64.7	152	2318						
G175 -10H		11.3	59	649		108		Connection is flange OPF-S (Ref. to INDEX 12)		3600
-20H		20.1	76	922						
-30H		36.5	111	1433						
-50H		52.4	143	1941						
-60H		64.0	167	2307						
G230 -10	22.6	10.6	55	662	89	101	232	15	Standard unit comes with an Rc3/4 OR flange connection (Ref. to INDEX 12)	1400
-20		19.0	79	935						
-30		34.0	127	1446						
-50		48.5	172	1954						
-60		59.4	206	2320						
-10H		9.9	70	653		103		Connection is flange OPF-S or OPF-J (Ref. to INDEX 12)		3600
-20H		18.5	94	926						
-30H		33.6	142	1437						
-50H		48.1	187	1945						
-60H		58.7	221	2311						
G300 -1	29.5	1.2	10	391	107	64	120	10	Standard unit comes with an Rc3/4 OR flange connection (Ref. to INDEX 12)	342
-2.5		2.4	20	577			127			
-4	29.4	3.6	19	458			177.8			
-5		4.6	22	514						
G350 -1	34.4	1.2	10	391	107	64	120	15		1400
-10		10.1	65	647	89	101	241.8			
-20		19.0	102	945						
-30		34.2	163	1456						
-50		49.3	219	1964						
-60		60.0	262	2322						
-10H		9.4	80	633		103		Connection is flange OPF-S or OPF-J (Ref. to INDEX 12)		3600
-20H		18.3	117	931						
-30H		33.5	178	1442						
-50H		48.7	234	1950						
-60H		59.3	277	2308						

✻
✻ Refer to INDEX 13 for flange connection.
✻ Maximum allowable discharge flow is for the case of mineral oil VG46.

6. TWIN OPEN SERIES T-Series



■ Features :

- A large opening is provided on the top for ease of maintenance.
- Because the bladder is a fully enclosed type, it is easy for the degree of deformation and offers a longer life.
- Because the bladder is not configured with a seal, no special maintenance skill is required.
- Maintenance can be easily done either from the top or bottom.
- Because the shell has no threaded, there is no problem such as impossibility of disassembly and no probability of damaging the bladder at the time of maintenance.

■ Model symbols :

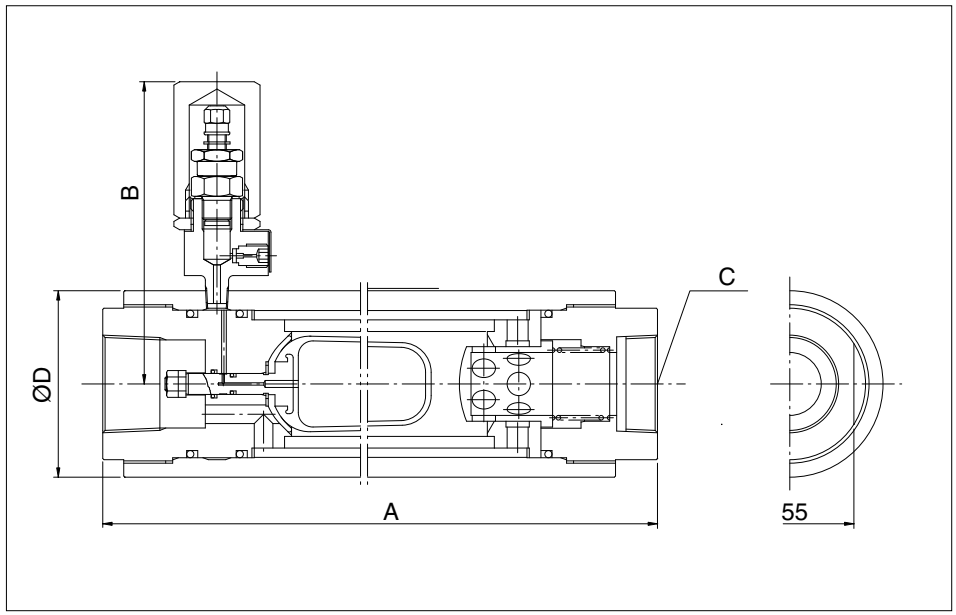
T 175 – 10 H – 20

- Rubber Materials
  - 10. (NBR) Low Temperature
  - 20. (NBR) Mineral oil
  - 30. (CHC) Aromatic Material
  - 40. (IIR) Phosphate Esters
  - 28. (FKM) Chemical Material
- Hi-Flow TYPE
- Nominal capacity of accumulator (Liter)
- Max. working pressure
- Series

Model \ Dimension	Max. W.P. MPa	Gas volume Liter	Mass kg	A	B	C	D	E	F	Max Allowable discharge flow Liter / min
T175 -10	17.2	11.6	45	673	110	106	232	15	Standard unit comes with an Rc3/4 OR flange connection (Ref. to INDEX12)	1400
-20		20.4	62	946						
-30		36.8	97	1457						
-50		52.7	129	1965						
-60		64.3	153	2331						
-10H		10.9	60	662		108		Connection is flange OPF-S (Ref. to INDEX 12)		3600
-20H		19.7	77	935						
-30H		36.1	112	1446						
-50H		52.1	144	1954						
-60H		62.6	168	2320						
T230 -10	22.6	10.3	56	673	107	101		15	Standard unit comes with an Rc3/4 OR flange connection (Ref. to INDEX 12)	1400
-20		18.8	80	946						
-30		33.8	128	1457						
-50		48.3	173	1965						
-60		59.0	207	2331						
-10H		9.6	71	664		103		Connection is flange OPF-S or OPF-J (Ref. to INDEX 12)		3600
-20H		18.2	95	937						
-30H		33.2	143	1448						
-50H		47.7	188	1956						
-60H		58.3	222	2322						
T350 -10	34.4	9.7	67	657		101	241.8	15	Standard unit comes with an Rc3/4 OR flange connection (Ref. to INDEX 12)	1400
-20		18.6	104	955						
-30		33.8	165	1466						
-50		48.9	221	1974						
-60		59.6	264	2332						
-10H		9.6	84	663		103		Connection is flange OPF-S (Ref. to INDEX 12)		3600
-20H		17.9	119	941						
-30H		33.1	180	1452						
-50H		48.3	236	1960						
-60H		58.9	279	2318						
T120 -40	11.8	43	110	918	110	108	355.6			
-58		61	136	1144						
-80		79	162	1364						
-120		127	234	1968						
-180		183	316	2666						
T175 -40	17.2	41	155	918	105	103				
-58		58	192	1144						
-80		75	227	1364						
-120		120	323	1956						
-170		170	439	2670						
TL175 -170		167	423	2046	102	100	406.4			
-230		222	549	2652						
T230 -40	22.6	37	177	918	105	103	355.6	Connection is flange OPF-S or OPF-J (Ref. to INDEX 12)		
-58		54	222	1144						
-75		70	270	1364						
-120		112	391	1956						
-170		164	535	2670						
TL230 -160		157	531	2056	102	100	406.4			
-220		213	689	2662						
T350 -40	34.4	35	214	918	105	103	355.6			
-58		51	267	1144						
-70		66	321	1364						
-100		103	459	1950						
-160		155	636	2700						
TL350 -160		152	609	2056	102	100	406.4			
-220		205	792	2662						

※
※ Refer to INDEX 12 for flange connection.

7. In-Line Type Accumulator D-Series



■ Features :

- Because the fluid flows on the surface of the bladder, the bladder absorbs high frequency pulsations.
- Very effective for reduction of water hammer, surge pressure and noise.
- Fluid does not sojourn within the accumulator.
- Because the bladder is configured with no seal, no special maintenance skill is required.

Model \ Dimension	Max. W.P. MPa	Gas volume Liter	Mass kg	A	B	C	D	Max Allowable discharge flow Liter / min
D215-02	21.0	0.19	8.0	328	131	Rc11/4	80	140
D215-1.5		1.2	33.0	400	167	40 A flange connection	154	420

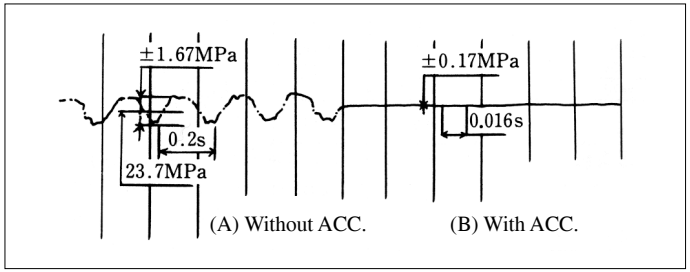
✻Model D215-1.5 has a flange connection, however the flanges at each end have an unmatched rotation direction.
The mating flanges and O-ring will be provided.

■ Model symbols :

D 215 – 02 – 20

- 20 → Rubber Materials { 20. (NBR) Mineral oil / 40. (IIR) Phosphate Esters / 28. (FKM) Chemical Material
- 02 → Nominal capacity of accumulator (Liter)
- 215 → Max. working pressure
- D → Series

■ Examples of pulsation dampening effect :



8. Screen Type Accumulator P-Type

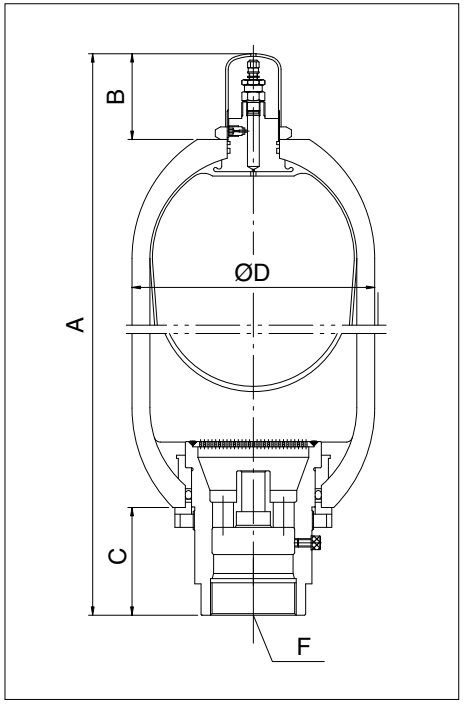
Screen type accumulator has a plate with many small orifices to allow fluid to pass through that is used in lieu of a poppet valve placed at the fluid port of G.T. Series accumulator.
This accumulator can be used at the maximum precharged gas pressure of 0.75 MPa and particularly it is used when the fluid pressure is less than the precharged gas pressure or when the fluid pressure drops to the atmospheric pressure. In the case of a G.T. Series accumulator, if it was used under the same conditions, the bottom part of the bladder sometimes will be damaged by the poppet valve, however, the Screen Type Accumulator will prevent such occurrence and is widely used for surge absorption in low pressure water lines, pipe lines of petrochemical industry, etc.

■ Model symbols :

G 30 – 10 P – 20

- G: Series
  If the Twin Open Series is required, indicate "T".
- 30: 30-Max. working pressure, 3.0 MPa
- 10: Nominal capacity of accumulator (Liter)
- P: P-Screen type
- Rubber Materials:
  - 10. (NBR) Low Temperature
  - 20. (NBR) Mineral oil
  - 30. (CHC) Aromatic Material
  - 40. (IIR) Phosphate Esters
  - 28. (FKM) Chemical Material
- 20: ❏ For a bushing connection, specify Rc diameter.
  ❏ For a flange connection, specify the standard and nominal

G series Screen Type



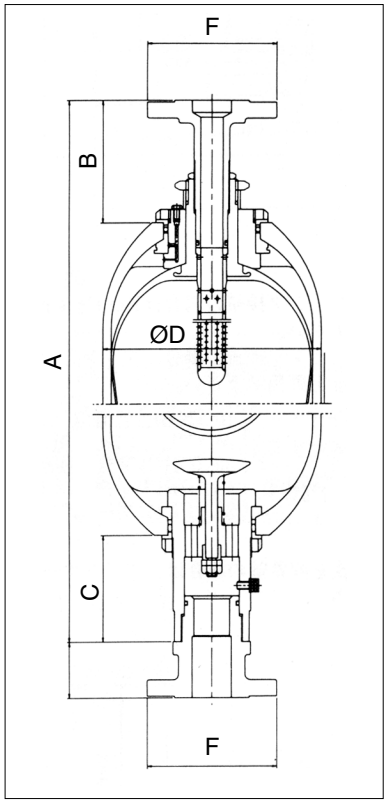
Model \ Dimension	Max. W.P. MPa	Gas volume Liter	Mass kg	A	B	C	D	E	F	Max Allowable discharge flow Liter / min
G30 -1P	3.0	1.2	9	391	107	64	118	Bushing height 10 (Ref. to INDEX 5)	Standard unit comes with a bushing Rc 3/4 connection	75
-2.5P		2.4	11	577			120			
-4P		3.7	18	474			168.3			
-5P		4.7	20	536			168.3	Ref. to INDEX 12 for flanges.		
G30 -10P		11.3	59	649	89	108	232	Connection is OPF -S (Ref. to INDEX 12)		700
-20P		20.1	76	922						
-30P		36.5	111	1433						
-50P		52.4	143	1941						
-60P		64.0	167	2307						
T30 -10P		10.9	60	662	110					
-20P		19.7	77	935						
-30P		36.1	112	1446						
-50P		52.1	144	1954						
-60P		62.6	168	2320						
T30 -80P		79	162	1364			355.6			
-120P		127	234	1968						
-180P		183	316	2666						

✻Maximum allowable flow rate is the value at the pressure difference of 1.18 MPa.
✻Maximum allowable flow rate is for the case of mineral oil VG46 (28 ℃).

9. Transfer Barrier Accumulator B-Type

Transfer Barrier Accumulators are used for transfer of pressure between different types of fluids, for example, oil and water, clean oil and contaminated oil, liquid and gas. etc. There is a perforated tube inside of the bladder and it prevents the bladder from being damaged due to the fluid's direct contact with the interior of the bladder. Applications are, for example, attaining water pressure by oil pressure, supply oil to compressor bearings, etc.

T Series Transfer Barrier



■ Model symbols :

T 175 – 20 B – 20

- ❑ For a bushing connection, Rc3/4 is provide as standard for both gas and oil port sides..
- ❑ For a flange connection, specify the standard and nominal diameter of it.

Rubber Materials
- 10. (NBR) Low Temperature
- 20. (NBR) Mineral oil
- 30. (CHC) Aromatic Material
- 40. (IIR) Phosphate Esters
- 28. (FKM) Chemical Material

B-Transfer Barrier Type

Nominal capacity of accumulator (Liter)

Max. working pressure

Series
If the General Series is required, indicate "G".

Model \ Dimension	Max. W.P. MPa	Gas volume Liter	Mass kg	A	B	C	D	E	F
G175 -20B	17.2	20.8	61	954	110	106	232	55	Reference dimension ASME 150lb 1-1/2BRF
-30B		37.2	96	1465					
-50B		53.1	128	1973					
-60B		64.7	152	2339					
T175 -20B		20.4	62	951	115				
-30B		36.8	97	1462					
-50B		52.7	129	1970					
-60B		64.3	153	2336					
T175 -80B		75	227	1374		103	355.6	90	
-120B		120	323	1966					
-170B		170	439	2680					

✻If the mineral oil VG46 flows at 200 L/min. through the perforated tube, there will be a pressure loss of approximately 0.08 MPa.
✻Use within the bladder compression ratio of maximum ($0.2P_3 \leq P_1 \leq 0.9P_2$) or ($V_3 \geq 0.2V_1$, $V_2 \leq 0.9V_1$).

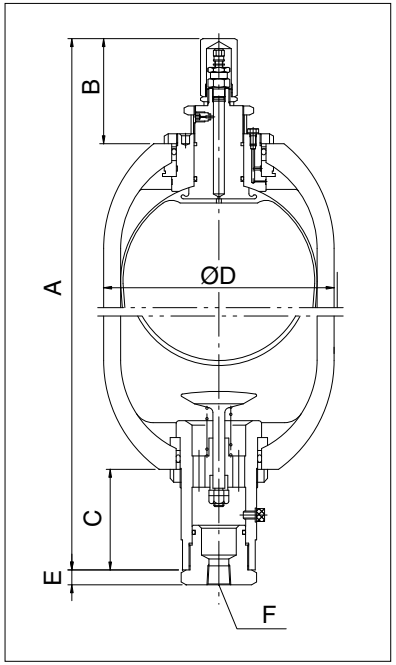
10. Stainless Steel Accumulator M.G.T. Series

Recently accumulators are being used in systems, other than oil hydraulic systems, such as water and special fluid (for example, high purity washing water, oil hydraulic fluid that requires high cleanliness, drinking water, chemical fluid) . For such applications, a stainless steel accumulator is most appropriate.

■ Features :

- Use stainless steel that has high anti-corrosiveness such as SUS304, SUS316L, etc.
- Excellent for maintaining a high level of cleanliness in lubricating and hydraulic systems.
- The shell is made in accordance with JISB8358 and is seamless.
- Titanium (TB480H) bladder type accumulators are also available.

TWIN OPEN SERIES "T"



■ Model symbols :

G S 70 – 50 – 20

- 20 — For flange connection, specify the standard and nominal diameter of flange.
- Rubber Materials:
  - 10. (NBR) Low Temperature
  - 20. (NBR) Mineral oil
  - 30. (CHC) Aromatic Material
  - 40. (IIR) Phosphate Esters
  - 28. (FKM) Chemical Material
- 50 — Nominal capacity of accumulator (Liter)
- 70 — Max. working pressure
- S — S-Stainless Steel Accumulator
- G — Series
  - M – Miniorator Series
  - G – General Series
  - T – Twin Open Series

Model \ Dimension	Max. W.P. MPa	Gas volume Liter	Mass kg	A	B	C		D	E	F
MS210-0.1	20.6	0.115	2	232	85	UD *1	74	60.5	–	Rc1/4
-0.3		0.29	5	286			94	76.3	35	Standard unit comes with an Rc 3/4 or flange connection. (Ref. to INDEX 12)
-0.5		0.5	6.3	376						
-1		1.0	10.5	398			115	100	10	
GS140 -1	13.8	1.0	9	391	107		64	114.3		
-2.5		2.4	12.5	577						
-4		3.4	21	500			104	177	15	
-5		4.4	24	558						
GS70 -10	7.0	12.0	35	656	89		106	232		
-20		21.3	48	929						
-30		38.7	76	1440						
-50		56.1	101	1948						
TS60 -100	6.0	106.0	164	1968	110		108	318.5	Connection is OPF -S (Ref. to INDEX 12)	
-160		154.0	219	2666						
TS140 -10	13.8	10.3	56	672	106		101	232	15	Standard unit comes with an Rc 3/4 or flange connection. (Ref. to INDEX 12)
-20		18.3	80	945						
-30		33.8	128	1456						
-50		48.3	173	1964						
-60		59.0	207	2330						
TS210 -10	20.6	9.1	71	672				241.8		
-20		17.6	110	945						
-30		32.6	175	1456						
-50		47.1	233	1964						
-60		57.8	278	2330						
-100		105	471	2001			98	355.6	Connection is OPF -S (Ref. to INDEX 12)	
-160		157	664	2771						

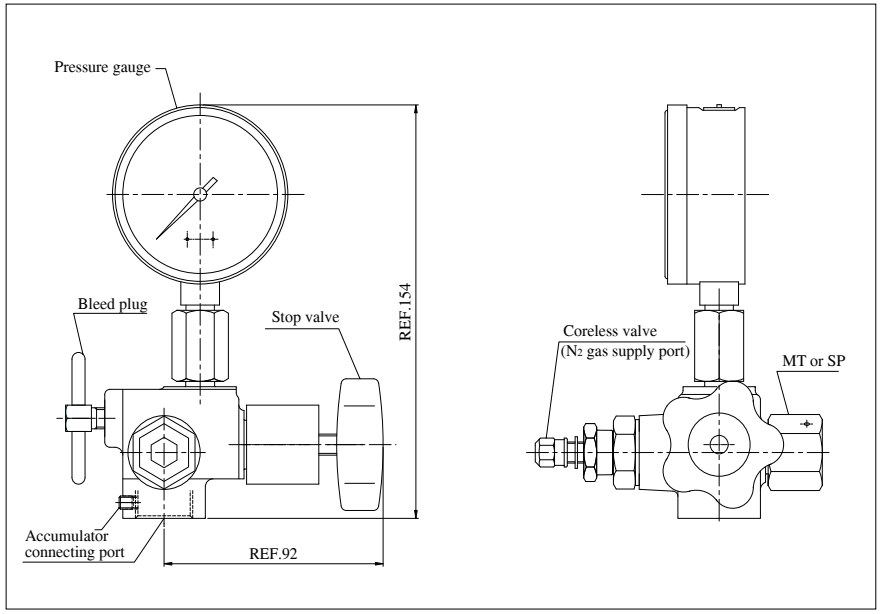
*1 : Reference to INDEX 4.

✻"E" and "F" shown in the above are standard units. Should you require ones of other standards, such as ANSI, API, JPI, DIN, or of specific material, please specify.

✻Please discuss with us your desired allowable flow rate.

11. Accessories on gas side

1. Coreless type gas port (safety device with pressure gauge)



■ Model symbols :

G 230 – 50 – 20 – CG – Safety unit

- Series
- Max. working pressure
- Nominal capacity of accumulator (Liter)
- Rubber Materials
- Max. scale of pressure gauge

❑Coreless type gas port (Approved by the Japanese High Pressure Gas Control Law of METI)

Type	Rated Pressure	Proof Test Pressure
CG	34.4 MPa	52 MPa

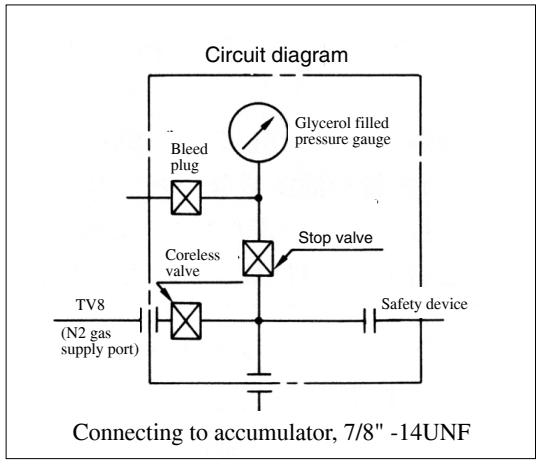
❑ Glycerol filled pressure gauge

Maximum scale	Working pressure range
25 MPa	0 ~ 18 MPa
40 MPa	0 ~ 25 MPa
60 MPa	0 ~ 35 MPa

❑Melting type safety unit (Not required for 10 liters or more as it comes as a standard.)

Type	Melting Temperature
MT	105 ± 5 ℃
SP	Stop plug

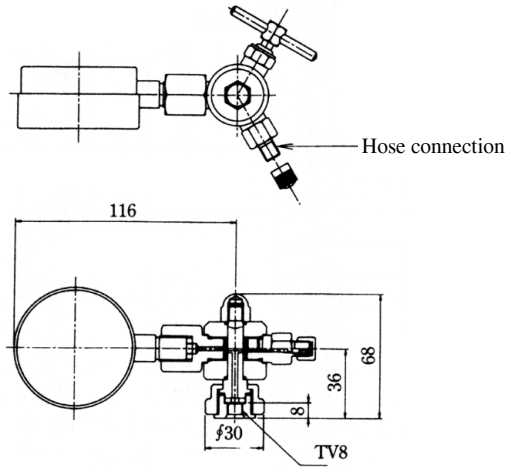
Note : If our coreless type gas port was used, a charging valve is not required. Only a hose assembly is required.



Connecting to accumulator, 7/8" -14UNF

2. Charging Hose Assembly :

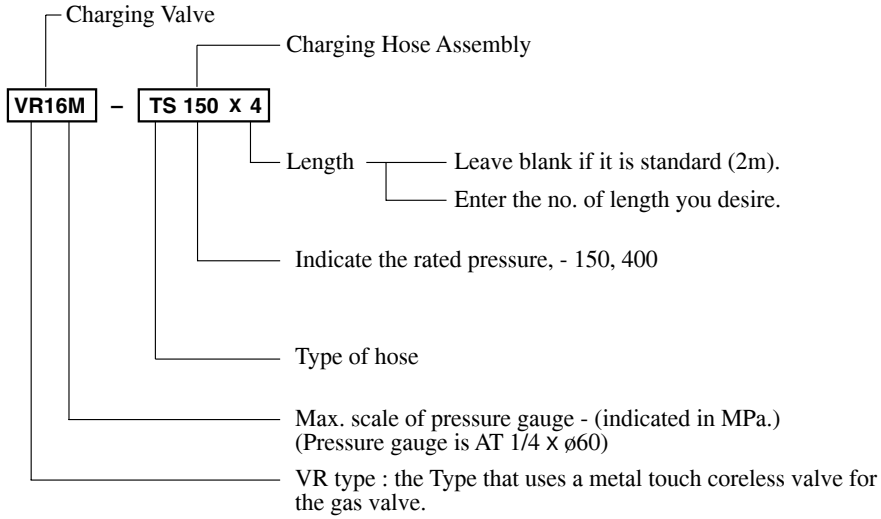
❑ Charging Valve (VR type)



Connection to accumulator

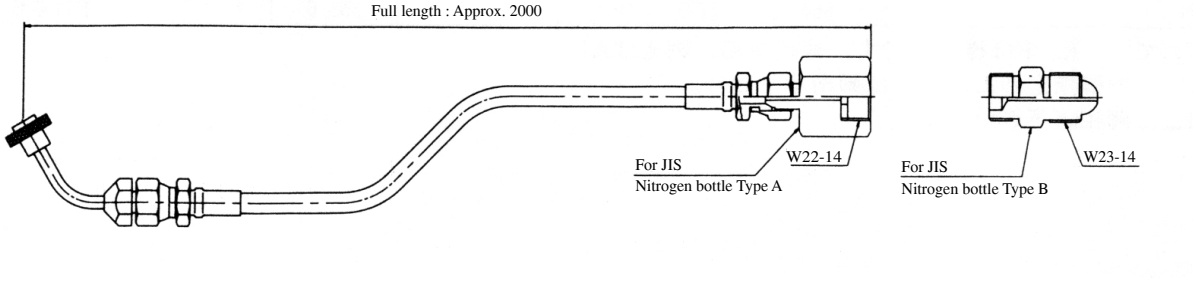
Type	Rated Pressure
TS150	14.7 MPa
TS400	39.2 MPa

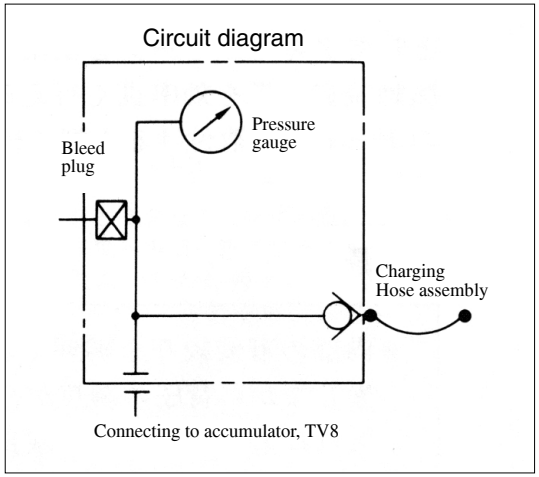
■ Model symbols :



Note : If charging gas is less than 1 MPaG, please indicate.

❑ Charging Hose Assembly (TS type)



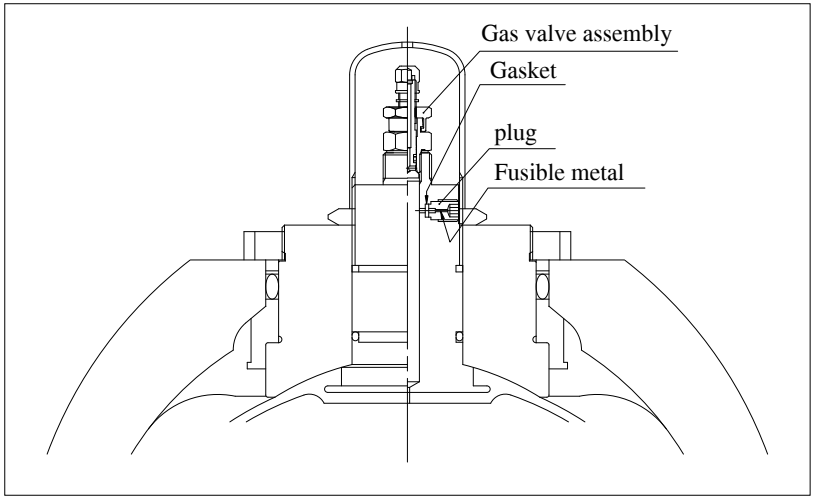


3. Melting plug :

Melting plug is a safety device that will protect the accumulator.

■ Features :

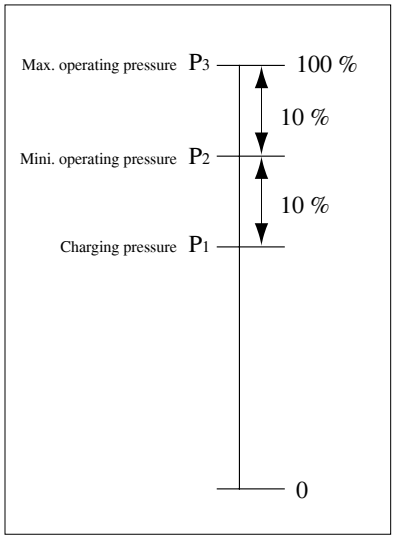
- Sure safety device as there are no moving parts.
- No damage due to mal-gas charging, etc., because gas supply valve seat and the safety device are independently provided.
- Even if the fuse is melted due to fire, no melted piece will be thrown out because of the protection of a valve guard.
- A new safety device is provided when a bladder is changed.
- Safe against external shocks, etc.
- Because the safety device is incorporated in the valve stem (standard part) , no extra space is required.



In order to find a temperature (T) to melt within 1.1 X P_3 at the time of fire, assuming that the max. operating pressure is P_3 and probable maximum precharge pressure P_1 is $P_1 = 0.8P_3$ as shown in the Fig. on the right, and the temperature is expected to be 0 degrees ℃, it becomes

$$T = 273\ ^\circ K\ (\ 0\ ^\circ C\ ) \times \frac{1.1P_3}{0.8P_3} = 375.4\ ^\circ K = 102.4\ ^\circ C$$

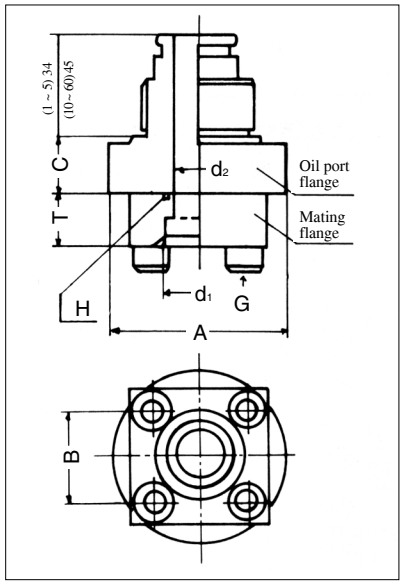
Based on this, we set the melting temperature of our fusible metal at 105 plus/minus 5 degrees ℃ as a standard.
In the event the temperature is much higher, under certain operating conditions, it may lose the significance of the safety unit. Further, if the temperature is much lower, the fusible metal may melt as a result of temporary temperature rise that is still less than abnormal.



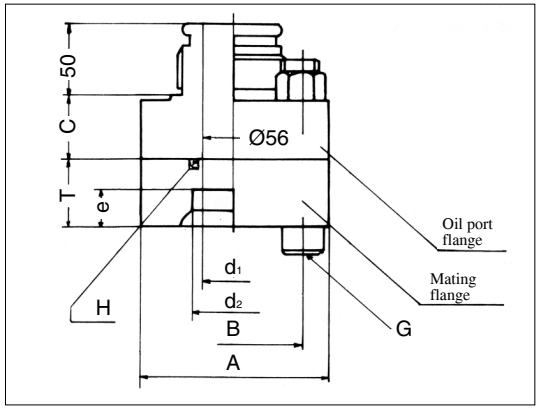
12. OIL PORT FLANGE OPF Series

If you choose a flange connection for the accumulator, we recommend that you will choose the flange from the following.

For 1 to 60 liter accumulators



For high flow (H type) and 40 to 220 liter accumulators



■ Model symbols :

G 230 – 10 – 20 – OPF – B20 (Require a mating flange.)

When you place an order combined with the accumulator, please indicate the accumulator model followed by the model of oil port flange, nominal diameter (with or without a mating flange) . If there is no indication the accumulator is supplied with the Rc 3/4 bushing.

- Rubber material
- Nominal capacity of accumulator (Liter)
- Maximum working pressure.
- Accumulator series.

❑ For 1 to 60 liter accumulators

Press	Nominal capacity	Model	Nominal dia.	A	B	C	d_1	d_2	T	G	H	Mating flange	Standard
20.6 MPa	1 ~ 5	OPF-A	15(1/2B)	88	45	28	16	22.2	25	M12	G25	NHA15	Nakamura in-house standard
			20(3/4B)	88	45	28	20	27.7	22	M10	G30	SHA20	JIS
			25(1B)	88	48	28	24	34.5	28	M12	G35	SSA25	B2291
	10 ~ 60	OPF-B	15(1/2B)	88	45	28	16	22.2	25	M12	G25	NHA15	Nakamura in-house standard
			20(3/4B)	88	45	28	20	27.7	22	M10	G30	SHA20	
			25(1B)	88	48	28	25	34.5	28	M12	G35	SSA25	JIS
			32(1 1/4B)	118	56	32	31.5	43.2	28	M12	G40	SSA32	B2291
			40(1 1/2B)	118	65	32	35	49.1	36	M16	G50	SSA40	
			50(2B)	144	75	40	35	61.1	36	M16	G50	NHA50	
34.4 MPa	1 ~ 5	OPF-C	15(1/2B)	88	45	28	16	22.2	25	M12	G25	NFA15	Nakamura in-house standard
			20(3/4B)	88	48	28	20	27.7	25	M12	G30	NFA20	
			25(1B)	118	56	32	24	34.5	31	M16	G35	NFA25	
	10 ~ 60	OPF-D	15(1/2B)	88	45	28	16	22.2	25	M12	G25	NFA15	
			20(3/4B)	88	48	28	20	27.7	25	M12	G30	NFA20	
			25(1B)	118	56	32	25	34.5	31	M16	G35	NFA25	
			32(1 1/4B)	118	65	32	31.5	43.2	31	M16	G40	NFA32	
			40(1 1/2B)	144	75	40	35	49.4	39	M20	G50	NFA40	
			50(2B)	156	84	48	35	61.1	47	M20	G60	NFA50	

✻Please indicate if you will require a mating flange or not.

❑ For high flow (H type) and 40 to 220 liter accumulators

Press	Nominal volume	Model	Nominal dia.	A	B	C	d_1	d_2	T	e	G	H	Mating flange	Standard
20.6 MPa	10H ~ 60H and 40 ~ 230	OPF-S	32(1 1/4B)	Ø118	56	44	31.5	43.2	28	16	G40	M12	SSA32	JIS B2291
			40(1 1/2B)	Ø135	65	44	37.5	49.1	36	18	G50	M16	SSA40	
			50(2B)	Ø144	73	44	47.5	61.1	36	20	G60	M16	SSA50	
			65(2 1/2B)	Ø185	92	45	60.0	77.1	45	22	G75	M20	SSA65	
			80(3B)	Ø200	103	45	71.0	90.0	45	25	G85	M22	SSA80	
34.4 MPa		OPF-J	32(1 1/4B)	⌀176	116	45	32	43.2	44	18	G65	M27	NHFA32J	Nakamura in-house standard
			40(1 1/2B)	⌀176	116	45	40	49.1	44	20	G65	M27	NHFA40J	
			50(2B)	⌀176	116	45	50	61.1	44	23	G65	M27	NHFA50J	
			65(2 1/2B)	⌀176	116	45	56	77.1	44	28	G65	M27	NHFA65J	
			80(3B)	⌀176	116	45	56	90.0	44	31	G65	M27	NHFA80J	

13. Accumulator with a sensor PV Series

The 12th Invention Award!

A bladder type accumulator discharges the fluid by the expansion force of gas that is charged within the bladder. If it repeats compression and expansion for a long period of time, the charged gas penetrates the bladder's rubber member and goes into the fluid. As a result, the gas volume decreases, causing the bladder to become overly compressed, deformed and damaged.

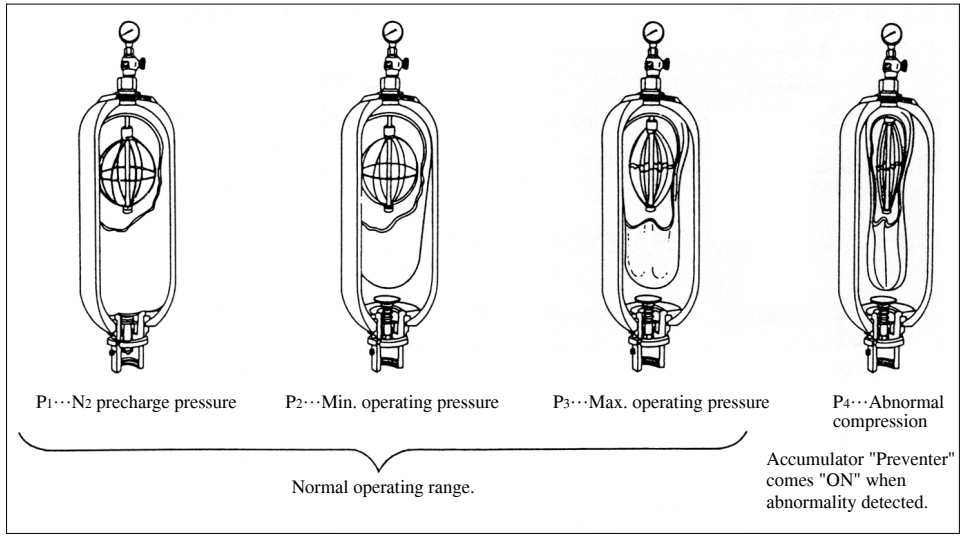
The accumulator with a sensor was developed in order to avoid such phenomenon.

N_2 gas precharge pressure normal range $0.25P_3 \leq P_1 \leq 0.9P_2$.

N_2 gas precharge pressure abnormal detection $0.25P_3 > P_1$.

(P_1 : N_2 gas precharge pressure, P_2 : Minimum operating pressure, P_3 : Maximum operating pressure)

■ Principle of operation



■ Features :

- This is to detect a change in the volume of bladder in an accumulator electrically and is aimed at preventive maintenance to detect abnormality during the operation of a hydraulic unit.
- This is to detect and prevent bladder damages from occurring due to reduction of gas pressure.
- This can be used as a fluid pressure system alarm for malfunction of the hydraulic circuit, abnormal high pressure, etc.
- This can be used as a warning lamp or buzzer on the shop floor or in a control room, or for switching or stopping a fluid pressure circuit at any time because this detects abnormality by electrical signals. .

■ The following can be supplied with the standard accumulators of 20 liters or more.

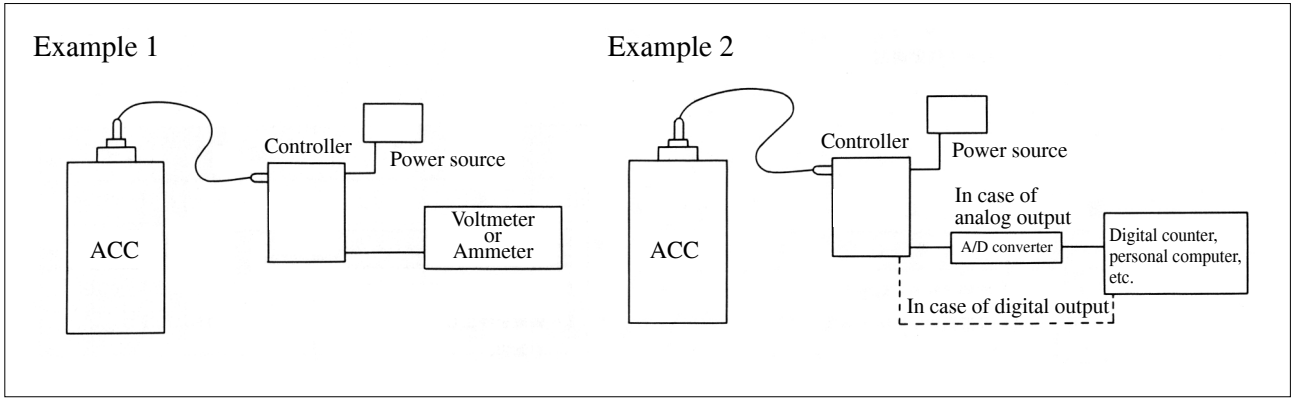
	Accumulator with a preventer	Accumulator without a preventer
Maintenance	1) Can be relieved from regular inspection. 2) Can conclude N_2 pressure and condition of bladder compression during operation of a subsystem. 3) Can make central control possible as it will send signals to a control room. Simple warning control. 4) Replenish N_2 by the motion of Preventer.	1) A regular inspection of once a month is necessary. 2) Measure N_2 pressure after stopping a unit and making the pressure of fluid pressure line zero. 3) Inspect one unit at a time with a pressure gauge. 4) Fill up N_2 at each inspection.
Preventive maintenance	1) Bladder damage due to lack of N_2 gas pressure will be eliminated. 2) Arrangement for spare parts can be done beforehand. 3) Unexpected sudden unit seizure due to bladder damages will be eliminated.	1) Over 90% of bladder damages are caused by lack of N_2 gas pressure. Because the hydraulic pressure is constant, if N_2 gas pressure drops, the compression ratio of gas and fluid pressures becomes 1/4 or more causing a severe bend on a bladder and ultimately pushing the upper part of bladder against the gas supply port causing puncture damage. 2) Spare parts arrangement will be after finding the bladder is damaged. 3) Unexpected sudden system stoppage will occur.

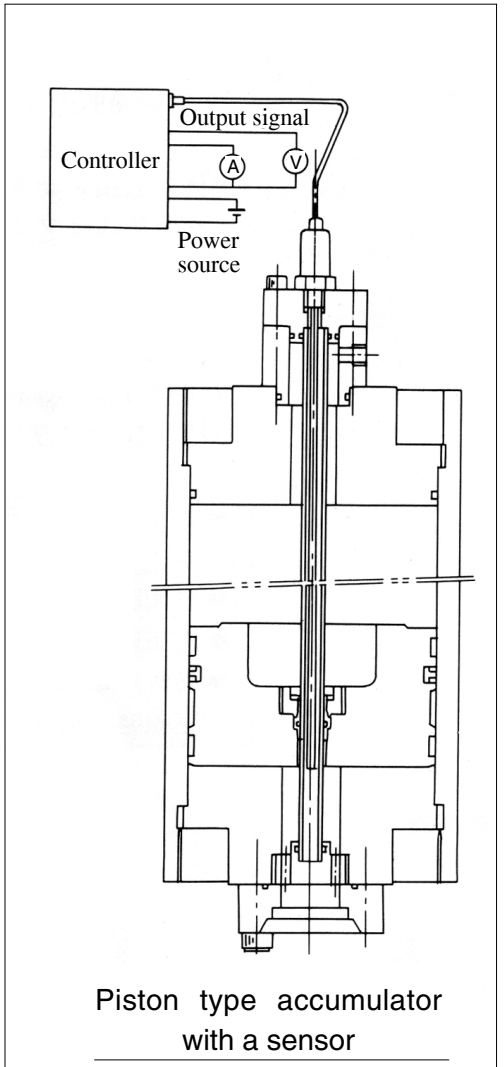
14. Piston type accumulator with a sensor LS Series

The piston type accumulator with a sensor has a position sensor within an accumulator so that it will permit sensing the position of a piston within an accumulator continuously by an electric signal in order to correspond to hydraulic systems that are more and more electronically controlled.

■ Features :

- It allows detecting the position of the piston of the accumulator continuously.
- By detecting the position of a piston it is possible to find easily the available displacement and forecast the time of maintenance inspection. Also, the sensor has a long life because it is placed at a non-pressurized area, having no abnormal force.
- The output signal is analog (voltage, current) , the position of piston can easily be found by a tester, etc. (Example 1.)
- The output signal can be displayed on a digital counter or used for a high level of control system by programming it in a computer. (Example 2.)
- A higher level of control is possible by using it with a pressure transducer. Piston type accumulator with a sensor.
- It can be incorporated in all piston type accumulators manufactured by Nakamura Koki Co., Ltd. (Refer to INDEX 15.)





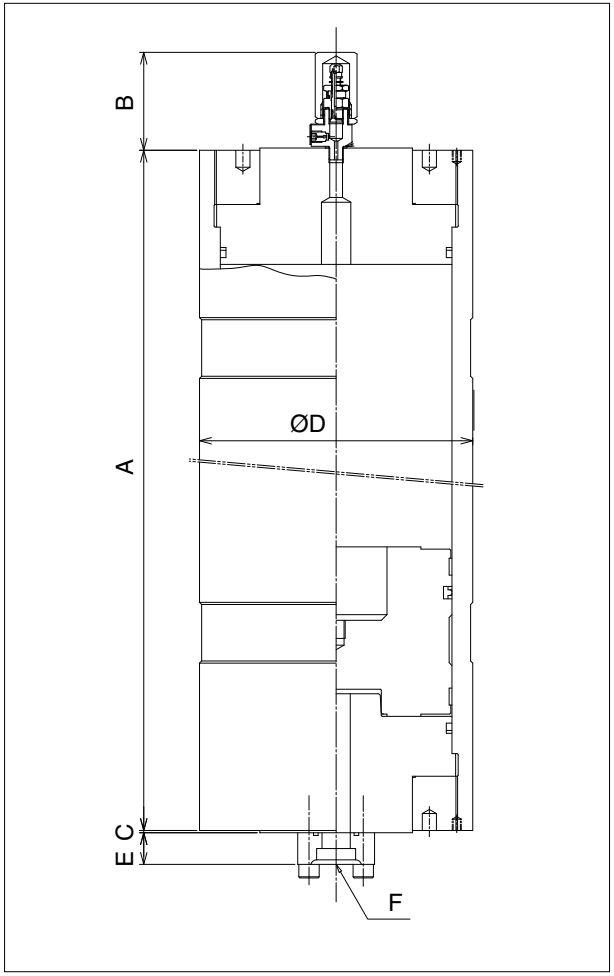
Piston type accumulator with a sensor

15. Piston type accumulator PA Series

Our piston type accumulators have been in manufacture since 1967 with our own technology. In 1970 we supplied ones of 150 liters to Nippon Steel Corporation, Ohita factory, for their slab continuous casting machines and since then they have been widely used by many customers and applications such as the Japanese Defense, power plants, hydraulic controls, etc.

■ Features :

- Because low friction packings are used, there is very little movement frictions.
- There is no limitation in the ratio between precharged N2 gas pressure and hydraulic pressure.
- Large gas volume sizes and / or more hi-pressure types can be supplied.



■ Model symbols :

PA 230 – 20 – 20 – LS

- LS — With a sensor
- 20 — Seal Materials: 20. (NBR) Mineral oil / 28. (FKM) Chemical Material
- 20 — Nominal capacity of accumulator (Liter)
- 230 — Max. working pressure
- PA — Piston type accumulator

Model \ Dimension	Max. W.P. MPa	Gas volume Liter	Mass kg	A	B	C	D	E	F	Max Allowable Flow Rate Liter / min
PA230 - 20	22.6 MPa	20	160	957	87	2	241.8	36	Please specify the diameter of piping. Standard unit comes with ø27.7 (3/4 inch)	990
- 40		40	220	1562						
- 60		60	490	1310		16	355.6			2200
- 100		100	605	1860						

✻ Please advise the fluid you will use beforehand.
✻ One with an ASME stamp can also be supplied.

■ Features :

- Pollution control of the hydraulic fluid
- Prevention from vaporization of the water glycol type hydraulic fluid .

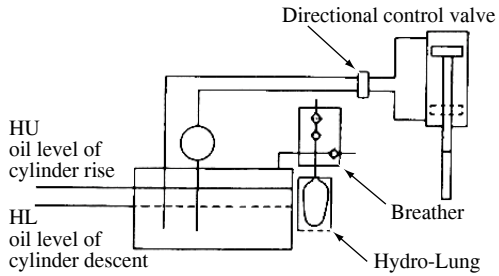


Fig. 1 Example of Hydro-Lung use

Selection of the type

(1) Calculate the max. displacement of the hydraulic fluid in the oil reservoir

$$V_k = \frac{\pi}{4} d^2 s \cdot 10^{-6}$$

Vk : max. displacement of the hydraulic fluid(L)
d : piston rod diameter (mm)
s : cylinder stroke (mm)

(2) Calculate the max. flow rate when the max. displacement is done.

$$Q_0 = \frac{V_k}{T_c} \cdot 60$$

Q_0 : max. flow rate (L/min)
Tc : operating time of cylinder (sec)

(3) Confirmate the max. flow rate

$Q_0 \leq Q$
Q : max. allowable flow rate (L/min)

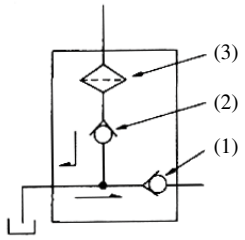


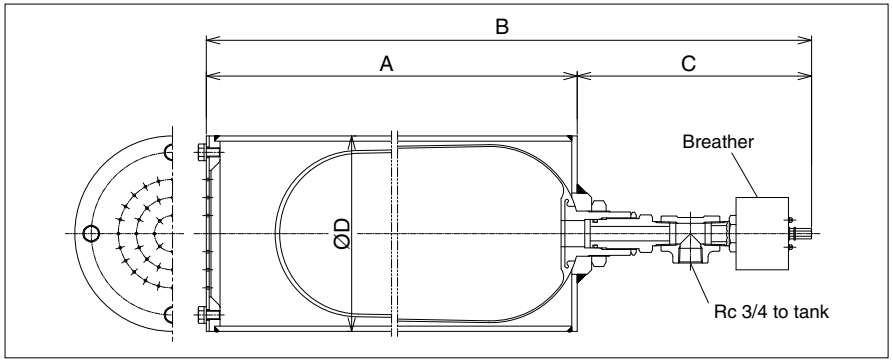
Fig. 2 Breather

As a result, when Qo is less than Q, it is needed to select a hydro-lung which maximum displacement is adequate to Vk (see the dimension table at the right side). But if Qo is more than Q it is better to increase the number of hydro-lungs.

As the example of hydro-lung use (fig.1), due to working a hydraulic cylinder, the piston-rod-volume starts to change the oil-level. Then a hydro-lung acts as a buffer between the increase and decrease of an air chamber space in an oil-reservoir. In other words, when the oil-level rises the rubber bag of a hydro-lung expands and as the oil-level falls it contracts.

Equipped with the breather, a hydro-lung is useful for the furious fluctuation of the oil content due to hydraulic fluid supply or an equipment exchange, etc. As the oil-level falls, the vacuum valve (2) absorbs air through the filter (3) after the rubber bag of a hydro-lung contracts. On the contrary, when the oil-level rises or the pressure in an air chamber rises, air is exhausted from relief valve (1) to outside after the rubber bag expands.

In addition, hydro-lung can prevent the oil-reservoir from pollution since inside of the oil-reservoir is isolated from outside.



Model	Max. Volume of Breath (Liter)	Max. allowable flow rate Q (L/min)	A mm	B mm	C mm	D mm	Mass kg	Max. W.P. MPa
BAB 1	0.8	47.1	167	384	217	114.3	6	
BAB 2.5	1.6	47.1	355	572	217	114.3	9	
BAB 4	2.4	47.1	225	442	217	165.2	10	
BAB 10	6.0	152.6	376	635	259	216.3	16	0.03 MPa
BAB 20	11.7	152.6	666	925	259	216.3	24	
BAB 30	21.0	152.6	1187	1446	259	216.3	38	
BAB 50	32.0	152.6	1673	1932	259	216.3	52	

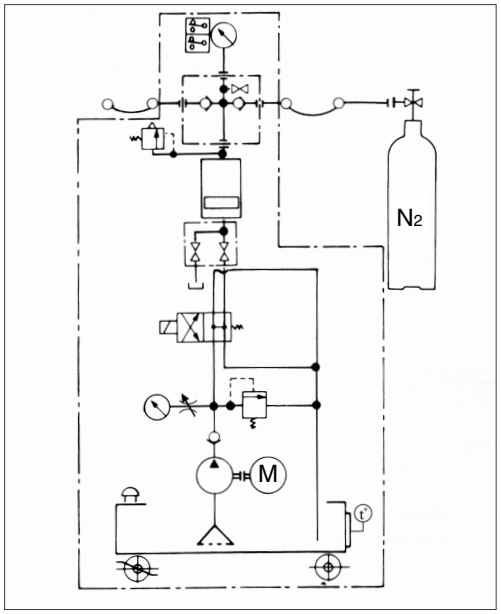
17. N_2 gas booster HYB Series

We have developed a hydraulic high pressure booster that offers more energy savings than traditional ones by utilizing our piston type accumulators that have a long application history and high reliability that we are proud of.

■ Features :

- It is compact compared to the traditional compressors and easy to transport.
- Low noise.
- Electrical consumption is small.
- Cooling water is not required.
- Simple maintenance as the structure is simple.
- The cost is very low compared with the traditional high pressure compressor.

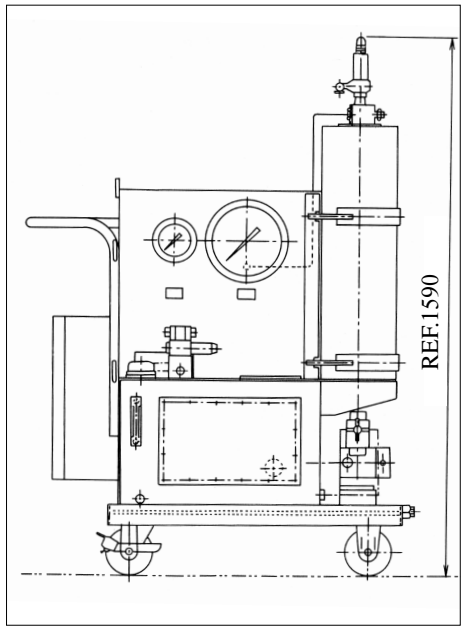
Circuit diagram



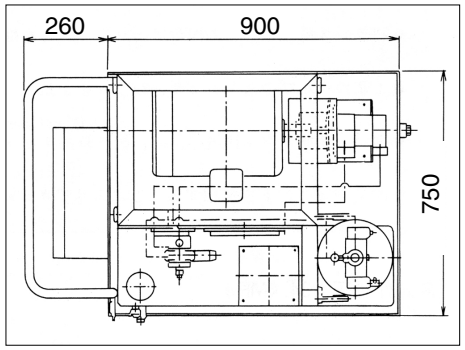
■ Model symbols :

HYB 10 – ES 2 – 24 – 7.5 X 220V

- Power source voltage
- Electric motor output (kw)
- Maximum N_2 gas generating pressure (MPa) (Max. W.P. of Hyd. pump Minus 1.5)
- Design number
- Type
  - ES: Electrical control type
  - EX: Anti-explosion electrical control type
- Booster (Compressor) volume (Liter)
- Hydraulically driven booster unit



ES Type



Specification examples of applications

Specification		Type	ES
Unit	Motor output/cycle	kw/Hz	7.5/60
	Maximum N2 gas pressure	MPa	24
	Outer dimensions(W*L*H)	Mm	750×1160×1590
	Mass	Kg	600
Hydraulic Pump	Maximum working pressure	MPa	25.5
	Output Capacity	liter/min.	10.6
	Revolution	rev./min.	1800
Compressor	Type	–	Reciprocal Type
	Volume	liter	10

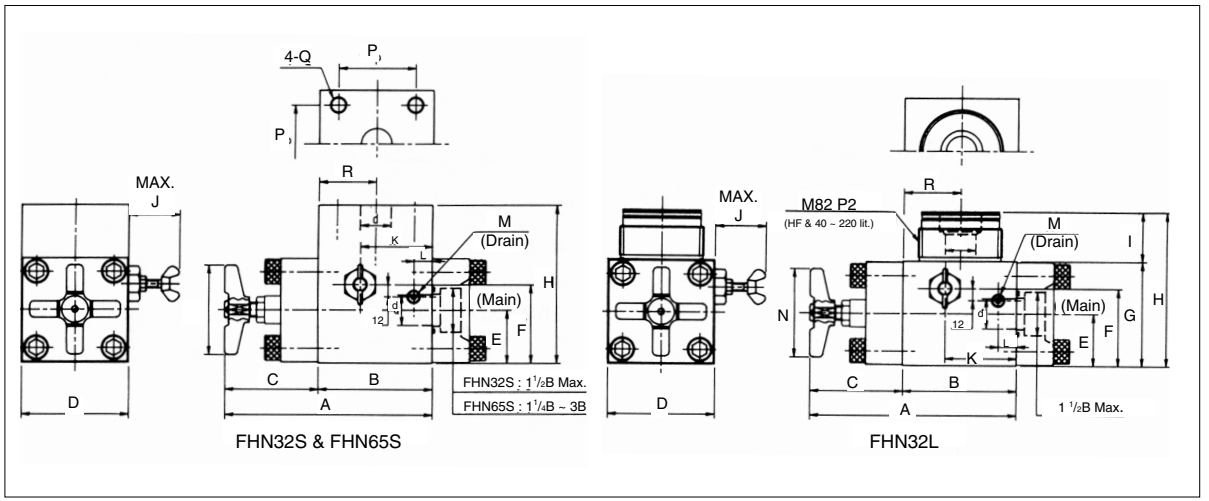
18. Accumulator Stop Valve FHN Series

1. We have been supplying FHN series to many customers as accumulator stop valves since 1985 and are proud of supplying them in large quantities and their high reliabilities.

■ Features :

- Designed compact with few parts.
- Can be directly connected to an accumulator.
- With its balancing structure and a bearing, it is possible to open/close even at high pressure.
- It can be used as both stop and throttle valves.
- No chattering at throttling because the valve stem is a thread connection to the main valve.
- It is possible to change a bladder without removing an accumulator from a unit by using an ACC joint. (Ref. to INDEX 18-2)

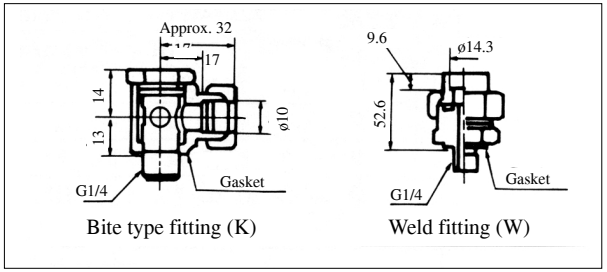
Maximum working pressure 34.4 MPa :



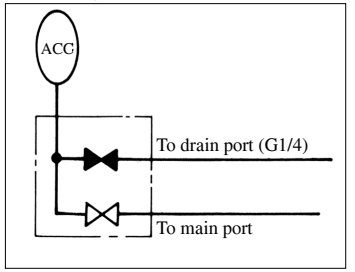
■ Model symbols :

FHN 32 S – 20 – N – F1 1/4B – K – S7

- Cleanliness class of NAS. If no marking, a standard specification will apply.
- Parts for connection to drain
  - N : None (Connection is to be done by the customer)
  - K : Bite type fitting for steel pipe
  - W : Weld type fitting
- Parts for connection to a main line
  - N : None (In case of connection to inline block.)
  - F1-1/4B : With a weld type mating flange (Please indicate a connecting pipe size after F.)
- Parts for connection to an accumulator
  - N : None | In case of FHN32L. In case of connecting to the accumulator flange or join that will be provided by the users.
- Seal Materials | 20. (NBR) Mineral oil | 28. (FKM) Chemical Material
- S : Flange connection
- L : Direct connection (only FHN-32L)
- Valve size
- Accumulator stop valve



Circuit diagram

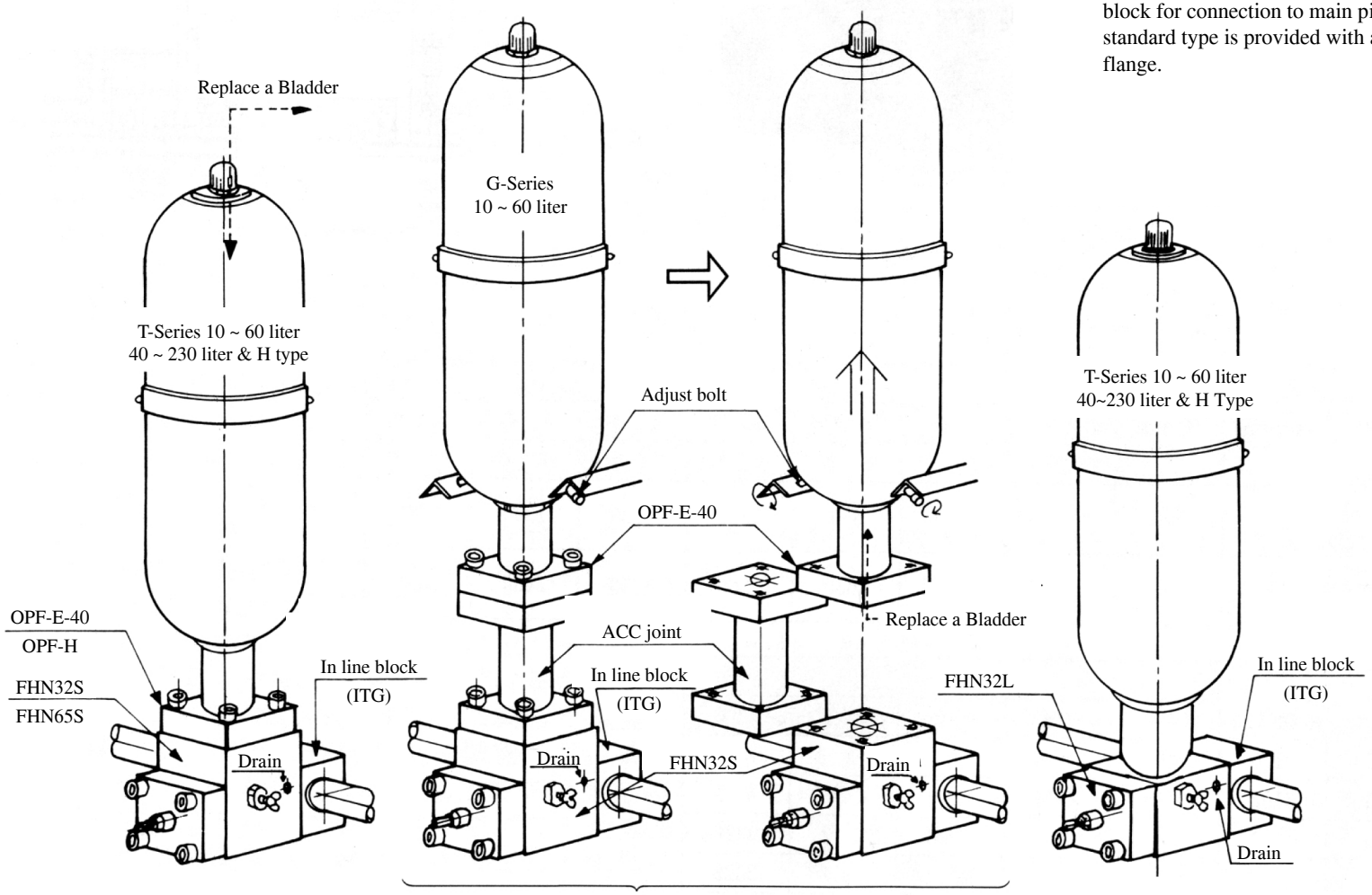


Model \ Dimension	d	A	B	C	D	E	F	G	H	I	J	K	L	M	N	P	Q	R	Applicable accumulator	Remarks
FHN32S	Ø30	217	111	106	104	52	77	–	155	–	55	70	18	G1/4	88	75	M16	55.5	10 ~ 60 lit.	Connection by OPF-E40
FHN65S	Ø56	320	200	120	153	80	114	–	210	–	55	98	38	G1/4	88	110	M24	122	HF & 40 ~ 230 lit.	Connection by OPF-H
FHN32L	Ø30	217	111	106	104	52	77	50	154	50	55	70	18	G1/4	88	–	–	55.5		Direct Connection to accumulator

※ OPF-E and OPF-H are special type flanges.
※ Piping connection to a drain port is as shown at the right. Either a bite type fitting or a welded fitting can be offered. Please specify.

2. Example of application :

Note: This figure shows application of In Line block for connection to main piping but standard type is provided with attached flange.

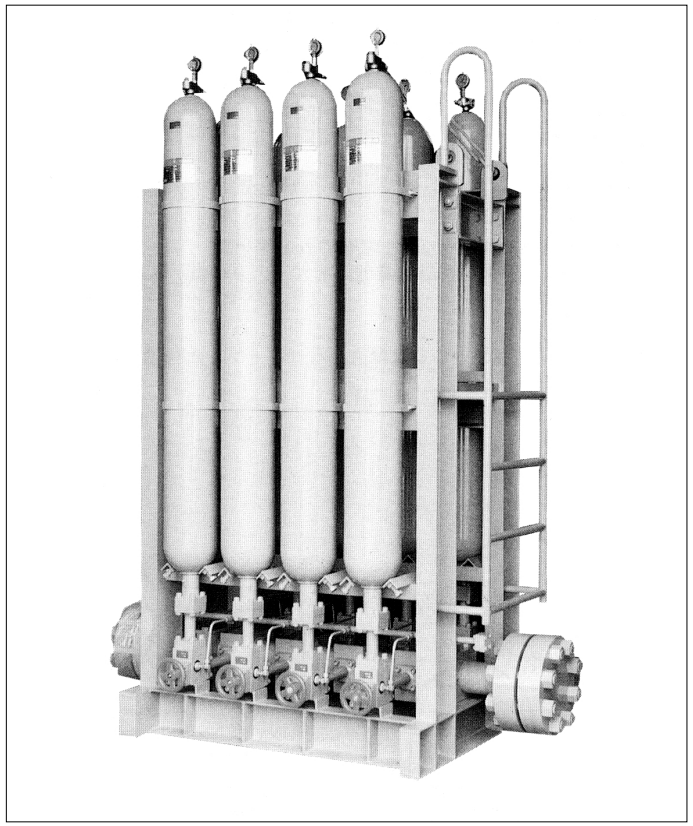


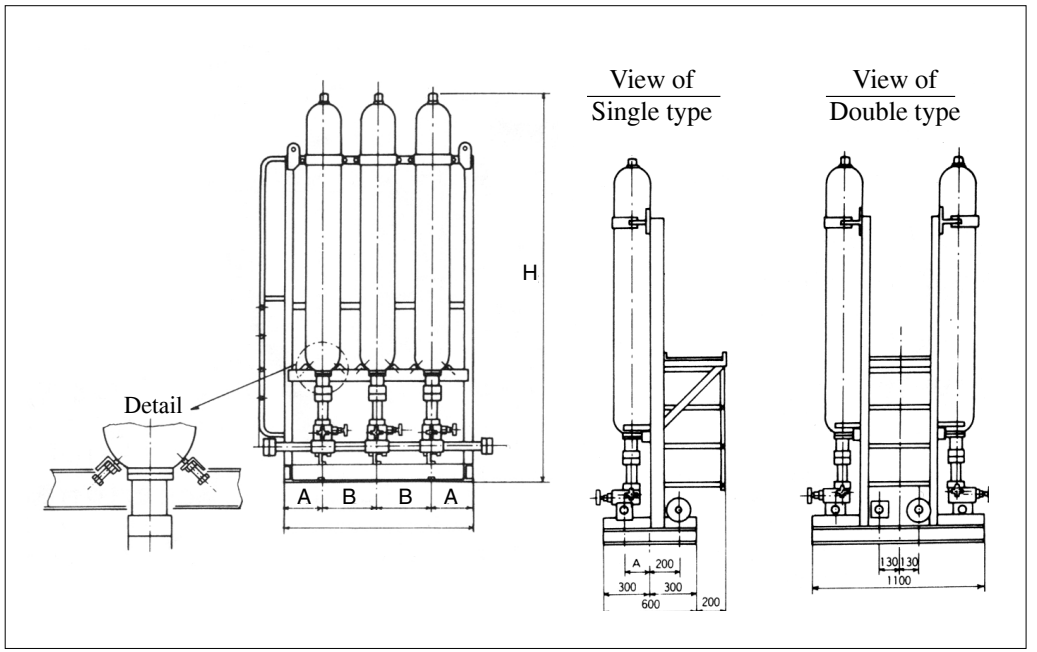
Connection by OPF　　Connection by ACC joint　　Direct Connection

19. Accumulator stand

We supply accumulator stands where several accumulators are put together on a stand, in addition to supplying accumulators by themselves. We also design and manufacture accumulator stands that are equipped with accumulator stop valves, pressure gauges, pressure switches, boosters for gas charging, and other hydraulic components.

The accumulator stand comes with adjusting bolts, therefore, it is possible to change the bladders without removing shells from the stand by using a crane or lifter or inspecting accumulators. The H dimension shown the case of main line being 1-1/2 inches and the throttle valve is 32 mm.





Accumulator shell diameter (mm)	A mm	B mm	Arrangement	No. of Accumulator / L mm					
			Single	1	2	3	4	5	6
			Double	2	4	6	8	10	12
ø232 ø241.8	250	350	500		850	1200	1550	1900	2250
ø318.5 ø355.6	300	450	600		1050	1500	1950	2400	2850

	H					
	30 lit.	50 lit.	60 lit.	80 lit.	120 lit.	170 lit.
G175	2100	2608	2974			
G230	2102	2610	2976			
T175	1887	2395	2761	2020	2612	3326
T230	1891	2399	2965	2020	2612	3326

20. Safety Precautions for Accumulators

The accumulator is a pressure vessel containing pressurized fluid in it. Read the operation manual and well understand its content before using the vessel.
To prevent injury to persons or damage to the accumulator. observe the safety precautions below.

1 . Selecting an accumulator

CAUTION — Accumulators are pressure vessels which are controlled under laws and regulations according to their place of use, pressure. and capacity. When selecting an accumulator, be aware of such regulations.

CAUTION — Select an accumulator which is compatible with its usage conditions, such as operating pressure, amount of work oil to be pressurized, operating temperature, type of fluid to be charged in the accumulator, environmental considerations, and applicable regulations. If a wrong accumulator were selected, it could not only fail to perform to expectations but also adversely affect interconnected machines.

2. Installing an accumulator

WARNING* — Do not attempt to weld any thing to or drill a hole in an accumulator. Such an act would jeopardize its safety and could cause it to explode.

CAUTION — Secure an accumulator to the frame or wall with a band or other suitable means. If such a support were neglected, vibration (due to normal operation or earthquake) would excessively stress the accumulator, and could eventually loosen its fasteners.

CAUTION — Do not subject an accumulator to external heat. Put up a heat shield around the accumulator if it is near a heat source or exposed to direct sunlight. If an accumulator were heated from outside, the fluid inside could build up a dangerously high pressure.

CAUTION — As a safety measure, provide a pressure control valve in the piping system at a location near and directly connected to the accumulator so that its maximum allowable pressure will never be exceeded.

3. Charging an accumulator with nitrogen gas (precharging)

WARNING* — Only use nitrogen gas as the fluid precharged in an accumulator. Never use oxygen or flammable gas because it could cause a fire or explosion.

CAUTION — While no regulatory qualification is required (in Japan) for a person to charge an accumulator with nitrogen gas. it is important for personal safety that the person be trained for handling high-pressure gases. When charging an accumulator with nitrogen gas, use a charging assembly which is compatible with the accumulator.

4. Using a charging assembly

CAUTION — A charging assembly is used for precharging, replenishing, or pressure calibration. Attach a charging assembly to an accumulator only before use, and always remove it from the accumulator after use. A charging assembly as permanently attached to an accumulator could increase the possibility of gas leak or damage to its instruments.

5. Using an accumulator

WARNING* — Ensure that an accumulator is used at pressures not exceeding its maximum working pressure (design pressure). Excessive pressure could cause the accumulator to explode.

CAUTION — Do not leave an accumulator charged only with pressurized fluid but not with work oil for more than two weeks. Otherwise, the bladder rubber could permanently stick to the inside surface of the shell.

6. Maintaining an accumulator

CAUTION — To ensure maximum performance of an accumulator and the integrity of its bladder. check and adjust an accumulator right after precharging, one week after the precharging, and every three months thereafter. When measuring the pressure of the fluid in an accumulator. the pressure inside the work oil circuit must be equal to the pressure of the outside atmosphere.

7. Disassembling, reassembling, or discarding an accumulator

WARNING* — Reduce the pressure inside the work oil circuit to the pressure of the atmosphere and completely discharge the fluid from the accumulator before attempting to disassemble it. If you attempted to disassemble it with some pressure inside. you could be injured by the pressure.

WARNING* — Before discharging the fluid from an accumulator, ensure that the area is well ventilated. Otherwise, there could be a danger of oxygen deficiency. Also ensure that there is no person or objects that could be easily flown away in the direction in which the fluid is to be discharged. Otherwise, the high-pressure jet of the discharged fluid could injure a person or damage objects.

WARNING — After disassembling an accumulator, check and ensure that there is no significantly corroded, scratched, or deformed part in it before reassembling it. Any degraded part used undetected could endanger the safety of the accumulator.

CAUTION* — If a T-series accumulator is disassembled and its bladder is removed off through the top portion, discharge away any fluid remaining at the bottom before replacing a new bladder. Otherwise, the new bladder could be deformed and damaged by the buoyancy from the remaining fluid.

CAUTION* — When discarding an accumulator, first release both work oil and fluid pressures to the atmosphere, and then disassemble it and take necessary measures to make it unusable.

Note : The WARNING or CAUTION statements with the word WARNING. or CAUTION indicated by the asterisk (*) above are also marked on an accumulator in the form of a label.

We have been supplying many products with nurtured technology and quality since 1962 when we first introduced bladder type accumulators in Japan.

For any questions pertaining to selection of economical volume, applicable laws, etc., please do not hesitate to contact us.

Products we offer

- Bladder type accumulators
- Diaphram type accumulators
- Hydro Lung
- Accumulators with sensors
- O-rings and other packings
- Piston type accumulators
- Accumulator stop valve
- N_2 gas boosters for charging gas
- In-line type accumulators

We reserve the right to change the contents of this brochure without any prior notice.

NAKAMURA KOKI CO.,LTD.

NAKAMURA ENGINEERING CO., LTD.

The factory is approved by CE, AQSIQ (China), METI (Japan), and certified by ASME (USA), ISO 9001.

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