Storage application

Data equired

1. Maximum working pressure (bar)
2. Minimum allowable working pressure (bar)
3. Volume of stored fluid required (litres)
4. System flow rate
5. System fluid
6. Temperature

Notes

Notes:

P_3 = Maximum reliable system pressure

P_2 = Minimum permitted system pressure

P_1 = 90% of P_2

Volumes delivered based on

$P_1 V_1 = P_3 V_3$ = Isothermal Compression

$P_3 V_3^n = P_2 V_2^n$ = Adiabatic Expansion where n = 1.4

Storage

The sizing of accumulators applies the law for the expansion and compression of gases which state $PV^n=C$, where 'n' depends on the type, temperature and pressure of the gas being used. When sizing an accumulator using nitrogen gas, n=1.4 is normally taken. The relationship between $P_1 V_1$, $P_2 V_2$ and $P_3 V_3$ is as follows:-

$P_1 V_1 = P_3 V_3$ where an isothermal compression of the gas is assumed.

$P_3 V_3^n = P_2 V_2^n$ where an adiabatic expansion of the gas is assumed.

If you are considering using additional back-up vessels it is essential that -

a) The accumulator to which the back-up bottle(s) is connected is not holding more than four-fifths its own volume of fluid between precharge (P_1) and maximum system pressures (P_3).

b) Flow rate from accumulator does not exceed gas flow capability through back-up pipe work.

How to use the chart (Standard Bladder Accumulator selection)

Problem: What size of accumulator will discharge 1.4 litres of liquid between 140 bar and 120 bar.

1) $P_3/P_2 = \frac{140}{120} = 1.17$

2) Find the value of P_3/P_2 which is equal to or next lowest to 1.17. In this case the value is 1.15.

3) Select the accumulator reference equal to or next greater to 1.4 litres from the values located in the row 1.15 i.e. 1.55. Project upwards and read off the accumulator reference i.e. 20.

How to use the chart (Transfer Barrier selection)

1) Use this chart the same way as above but limiting volume discharged to that shown, so that V1 - V3 does not exceed 0.80 of actual accumulator shell volume. the corresponding pressure ratio is seen under the P3/P2 column.

2) See datasheet for dimension details of Transfer Barrier Accumulators and Back-up Bottles.

Accumulator Discharge Volumes (Litres)

	Standard Bladder Accumulator Sizes										Transfer Barrier with 50 litre Gas Back-up Bottle (BUB) fitted					
P_3 / P_2	OB	OF	O1	O3	O4	10	20	28	37	54	28+ 1 BUB	37+ 1 BUB	37+ 2 BUB	54+ 1 BUB	54+ 2 BUB	P_3/P_2
1.05	0.005	0.018	0.035	0.08	0.12	0.29	0.57	0.78	1.07	1.49	2.20	2.46	3.87	2.87	4.28	1.05
1.10	0.010	0.035	0.066	0.14	0.22	0.34	1.09	1.49	2.03	2.84	4.18	4.69	7.37	5.49	8.16	1.10
1.15	0.015	0.049	0.094	0.21	0.31	0.78	1.55	2.12	2.90	4.04	5.96	6.73	10.56	7.88	11.73	1.15
1.20	0.019	0.063	0.120	0.26	0.39	0.98	1.97	2.69	3.68	5.13	7.58	8.60		10.06	14.97	1.20
1.25	0.022	0.074	0.143	0.31	0.47	1.17	2.35	3.20	4.39	6.12	9.06	10.20		11.94	17.76	1.25
1.30	0.026	0.086	0.149	0.36	0.54	1.35	2.69	3.68	5.03	7.02		11.91		13.94		1.30
1.35	0.029	0.096	0.183	0.40	0.60	1.50	3.01	4.11	5.62	7.84		13.11		15.35		1.35
1.40	0.032	0.104	0.201	0.44	0.66	1.65	3.29	4.51	6.16	8.60				16.77		1.40
1.45	0.034	0.113	0.217	0.47	0.71	1.78	3.56	4.87	6.65	9.28				18.09		
1.50	0.036	0.121	0.231	0.50	0.76	1.90	3.80	5.20	7.11	9.98				19.33		
1.55	0.038	0.128	0.245	0.53	0.81	2.01	4.03	5.51	7.53	10.50						
1.60	0.041	0.135	0.258	0.56	0.85	2.12	4.23	5.79	7.89	11.04						
1.65	0.042	0.141	0.270	0.59	0.89	2.21	4.43	6.05	8.27	11.54						
1.70	0.044	0.146	0.280	0.61	0.92	2.30	4.60	6.30	8.60	12.01						
1.75	0.046	0.152	0.290	0.63	0.95	2.38	4.77	6.52	8.91	12.44						
1.80	0.047	0.157	0.300	0.65	0.98	2.46	4.92	6.73	9.20	12.84						
1.85	0.048	0.161	0.310	0.67	1.00	2.53	5.06	6.93	9.47	13.21						
1.90	0.049	0.165	0.320	0.69	1.04	2.60	5.20	7.11	9.71	13.56						
1.95	0.051	0.169	0.325	0.71	1.06	2.66	5.32	7.28	9.95	13.88						
2.00	0.052	0.173	0.331	0.72	1.09	2.72	5.44	7.44	10.17	14.19						
2.10	0.054	0.179	0.344	0.75	1.13	2.83	5.65	7.73	10.56	14.74						
2.20	0.056	0.186	0.355	0.77	1.17	2.92	5.84	7.98	10.91	15.23						
2.30	0.057	0.191	0.365	0.80	1.20	3.00	6.00	8.21	11.22	15.66						
2.40	0.059	0.195	0.374	0.82	1.23	3.07	6.18	8.41	11.49	16.04						
2.50	0.060	0.200	0.382	0.83	1.26	3.14	6.28	8.58	11.74	16.38						
2.60	0.061	0.203	0.389	0.85	1.28	3.20	6.39	8.74	11.95	16.68						
2.70	0.062	0.207	0.395	0.86	1.30	3.25	6.50	8.88	12.15	16.95						
2.80	0.063	0.210	0.401	0.87	1.32	3.29	6.59	9.01	12.32	17.19						
2.90	0.064	0.212	0.406	0.88	1.34	3.34	6.67	9.12	12.42	17.41						
3.00	0.065	0.215	0.411	0.89	1.35	3.37	6.75	9.22	12.61	17.60						
3.20	0.066	0.219	0.419	0.91	1.38	3.44	6.88	9.40	12.85	17.94						
3.40	0.067	0.222	0.425	0.92	1.40	3.49	6.98	9.54	13.04	18.20						
3.60	0.068	0.224	0.430	0.94	1.41	3.53	7.06	9.65	13.20	18.42						
3.80	0.069	0.227	0.434	0.95	1.43	3.57	7.13	9.75	13.33	18.60						
4.00	0.070	0.228	0.437	0.96	1.44	3.59	7.18	9.82	13.43	18.74						
4.50	0.075	0.231	0.443	0.97	1.46	3.64	7.28	9.45	13.61	18.98						

Above volumes in litres discharged between P_3/P_2

- Above volumes in litres discharged between P_3/P_2
- Pressure Ratio P3/P1>5

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