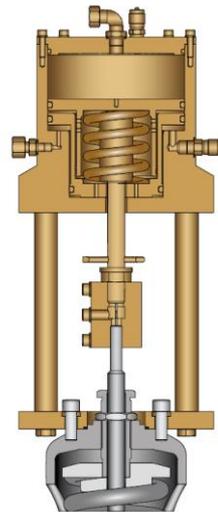




PNEUMATIC ACTUATOR ASSISTED PRESSURE RELIEF DEVICES EXPLAINED

R. BUYCK



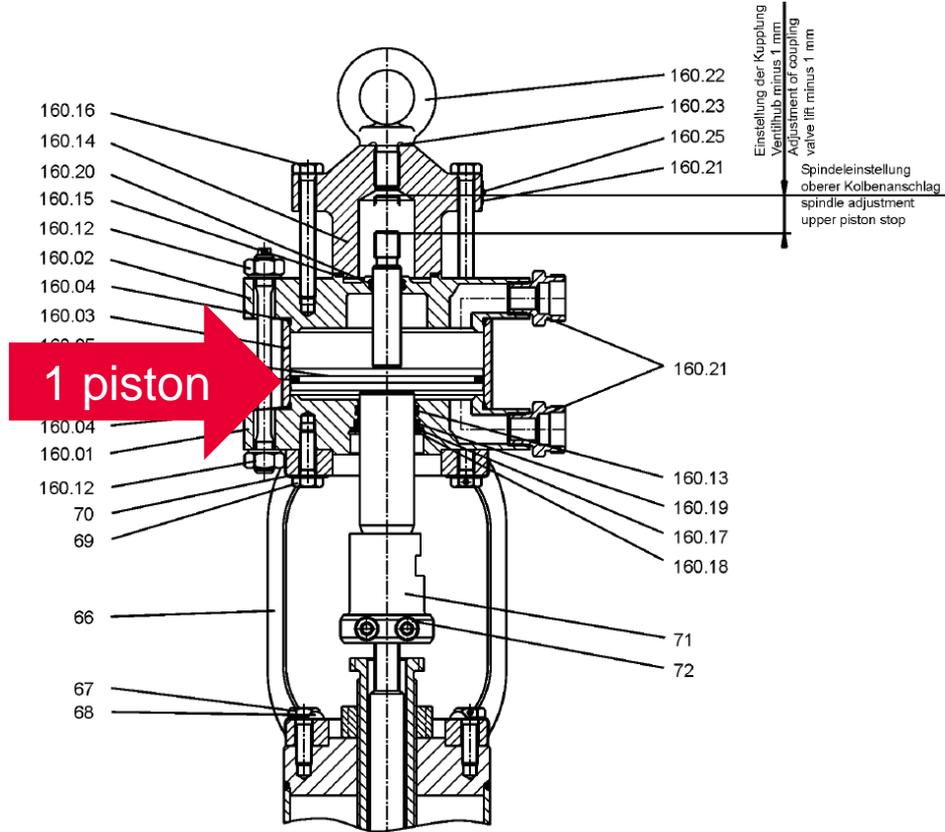
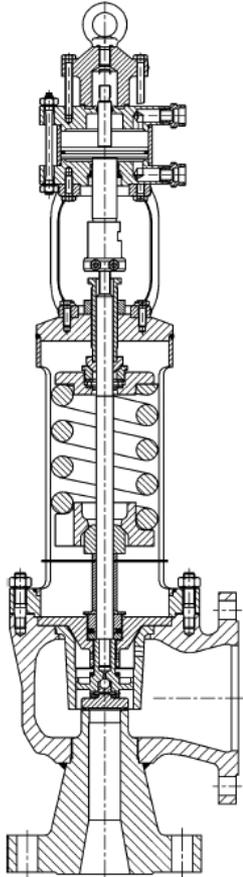
INCIDENT

A PSV with pneumatic air assistance did not start relieving at the required 102 barg set pressure because the assisting lifting air was **not** activated in the control panel resulting in additional friction in the actuator increasing the relieving pressure to ~108 barg

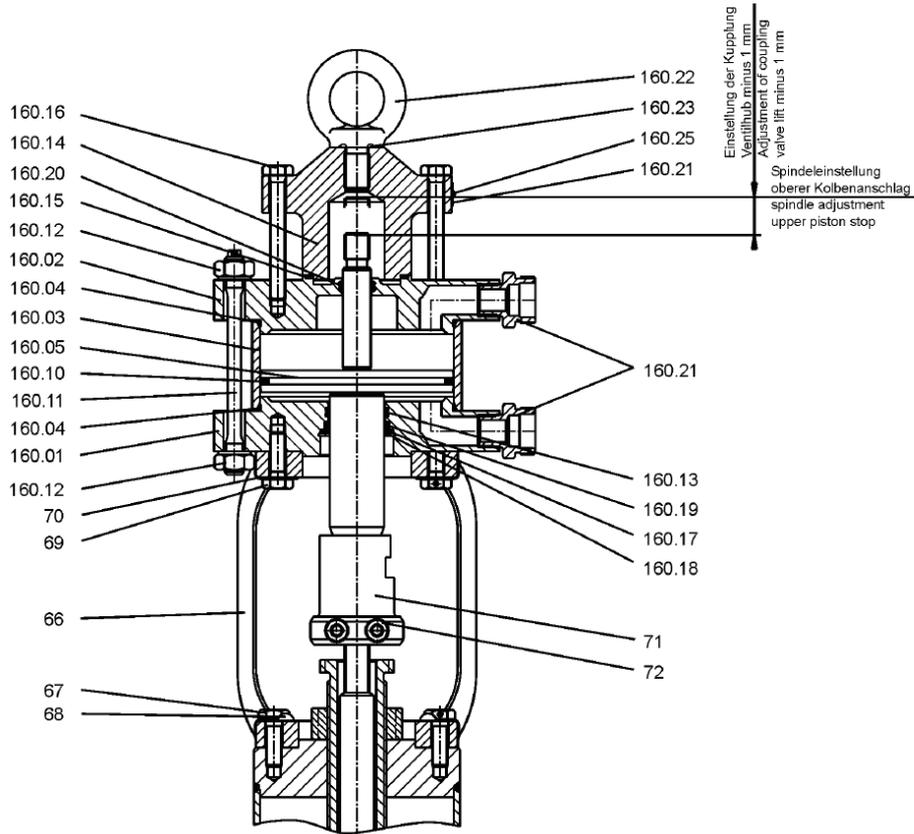
But Why...????



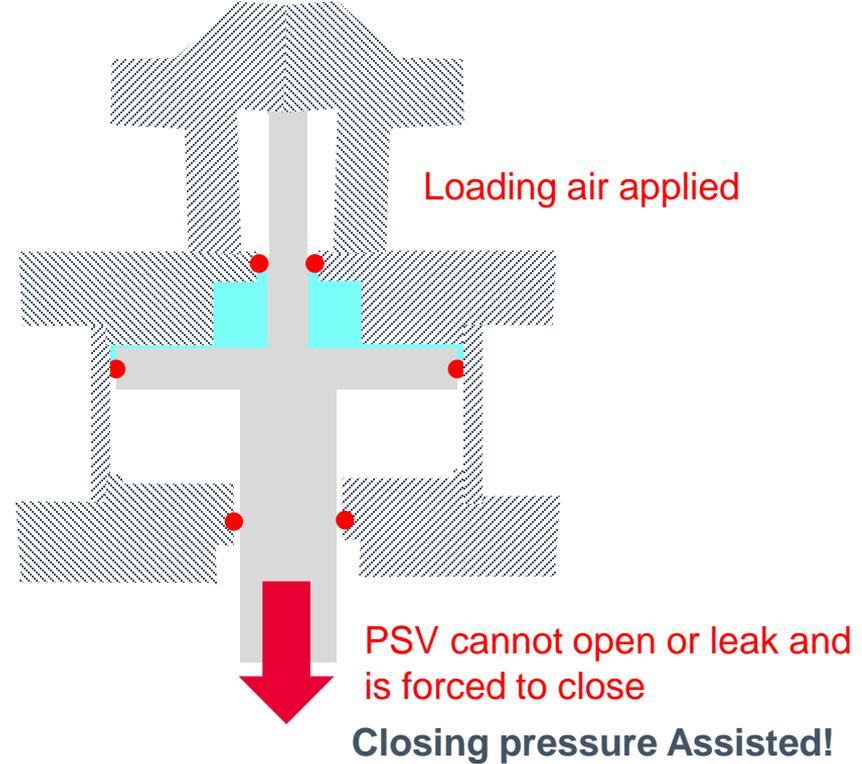
INSTALLED PSV IS AN EMERSON SEMPELL A160 (SINGLE PISTON)



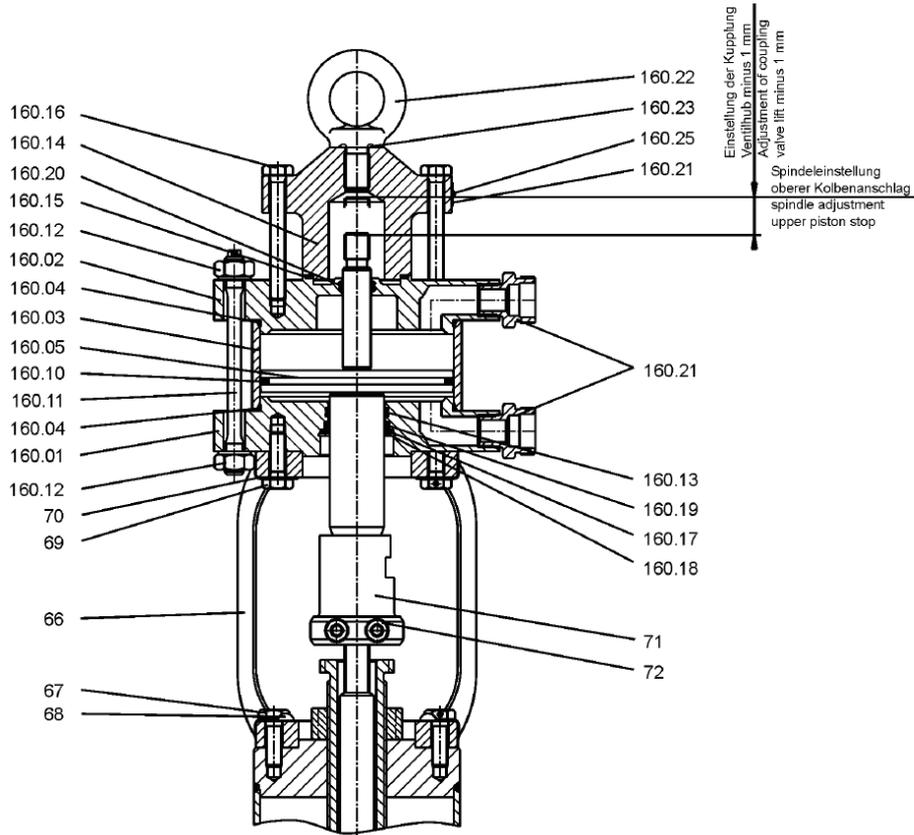
SEMPELL (SINGLE PISTON)



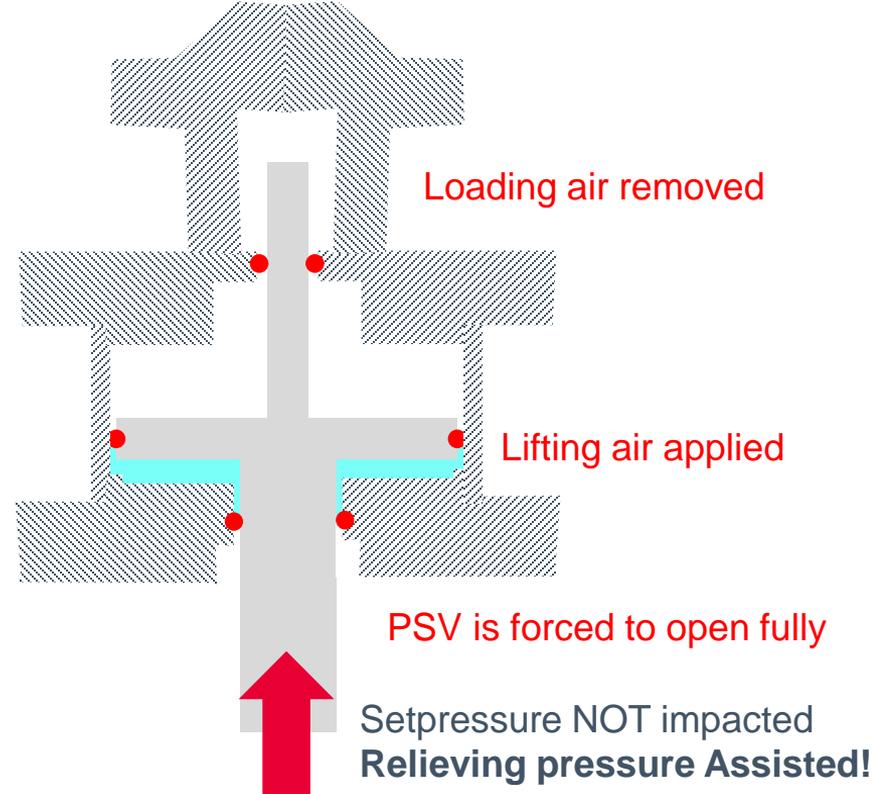
Operation with loading air



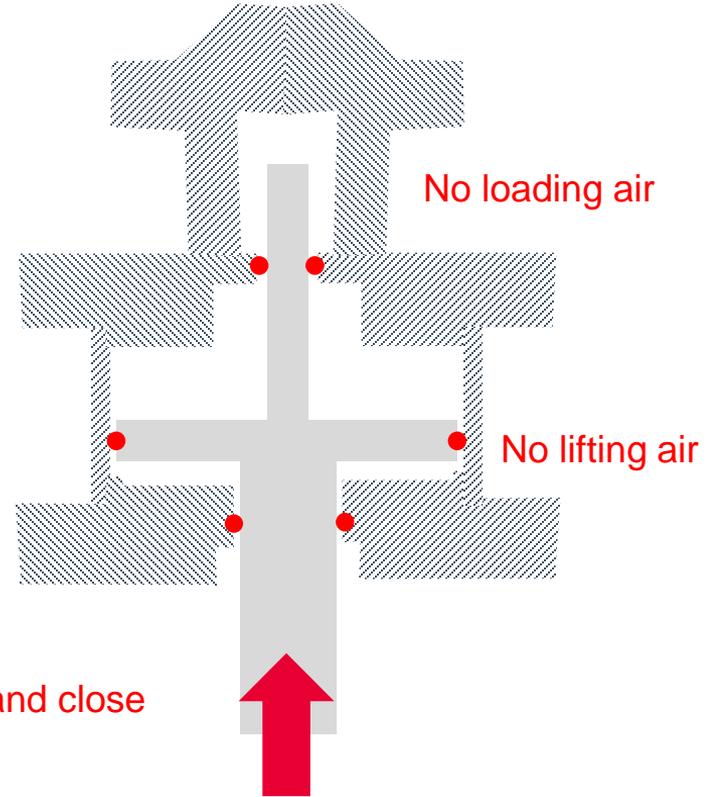
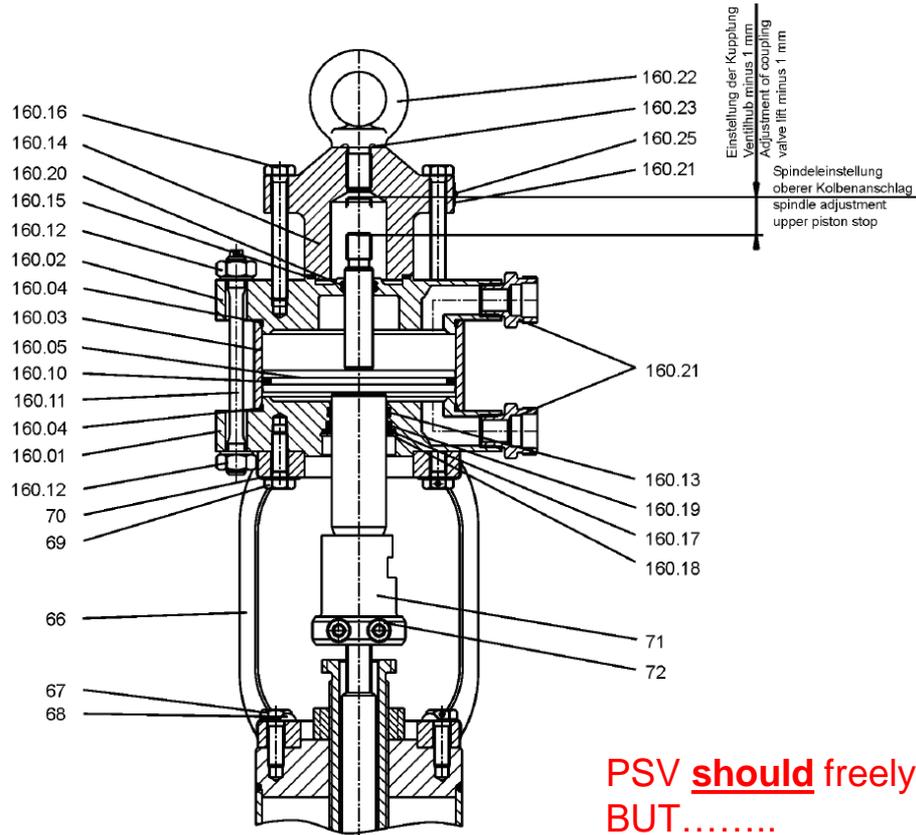
SEMPELL (SINGLE PISTON)



Operation with lifting air

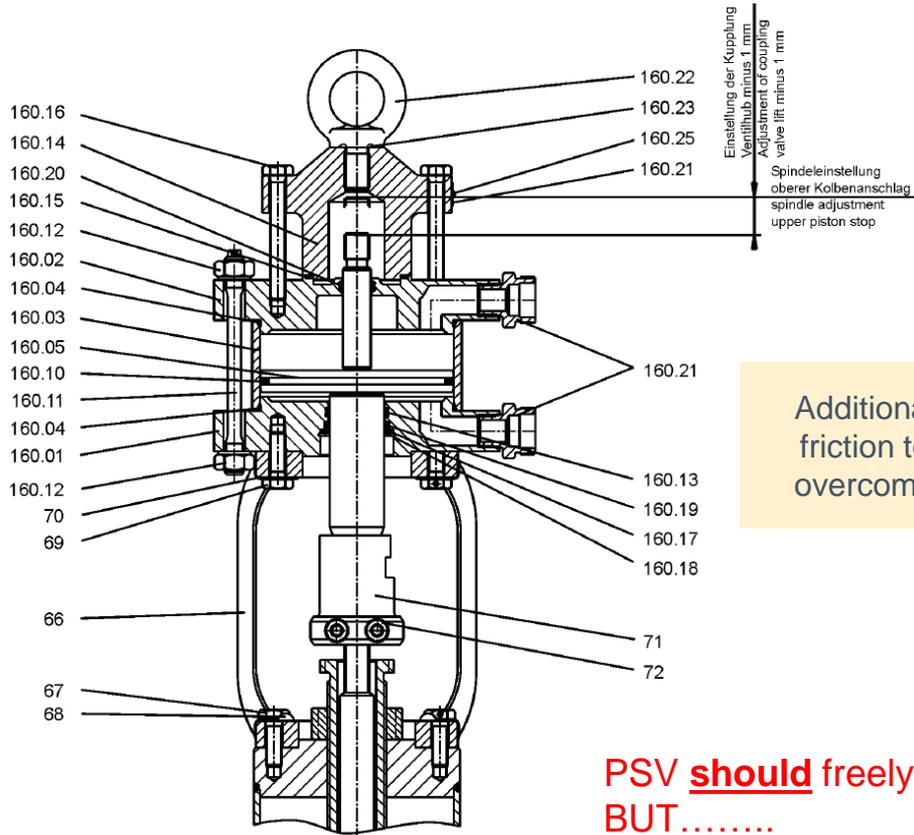


SEMPELL (SINGLE PISTON)

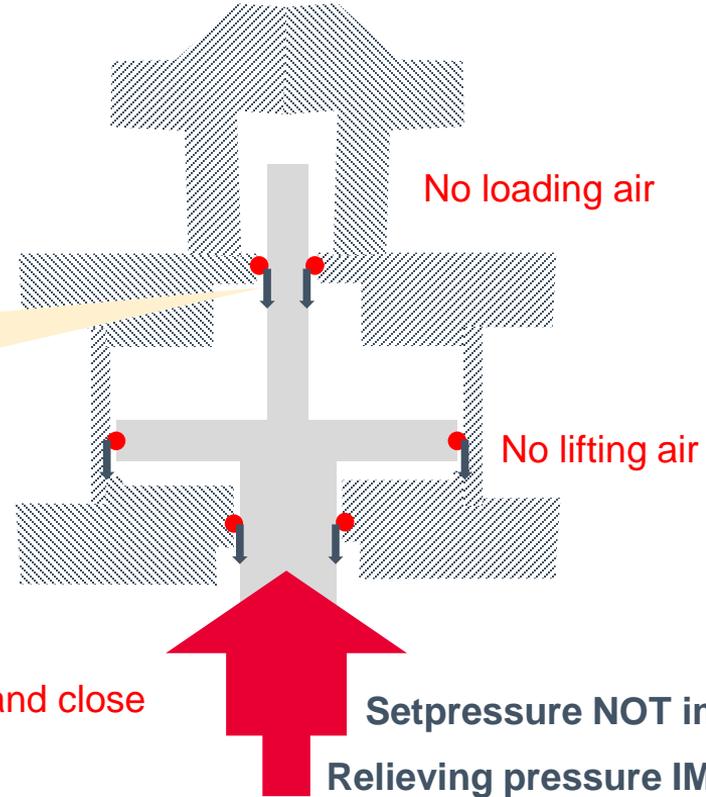


PSV should freely open and close
BUT.....

SEMPELL (SINGLE PISTON)



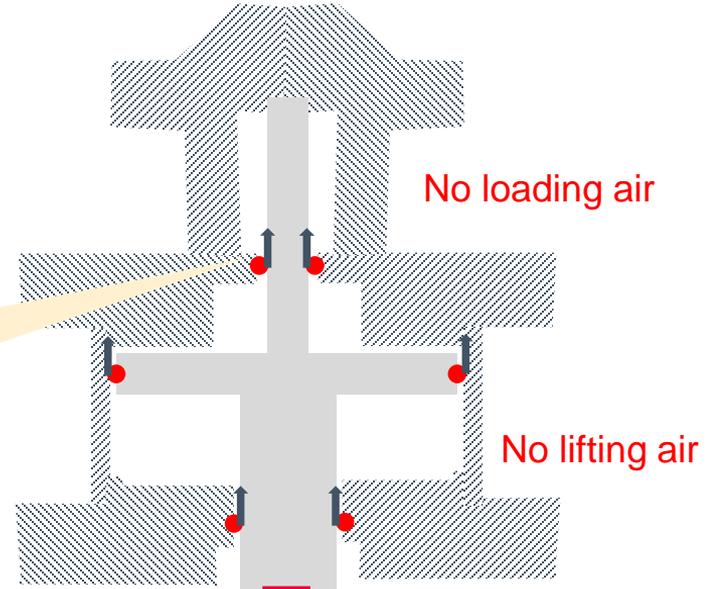
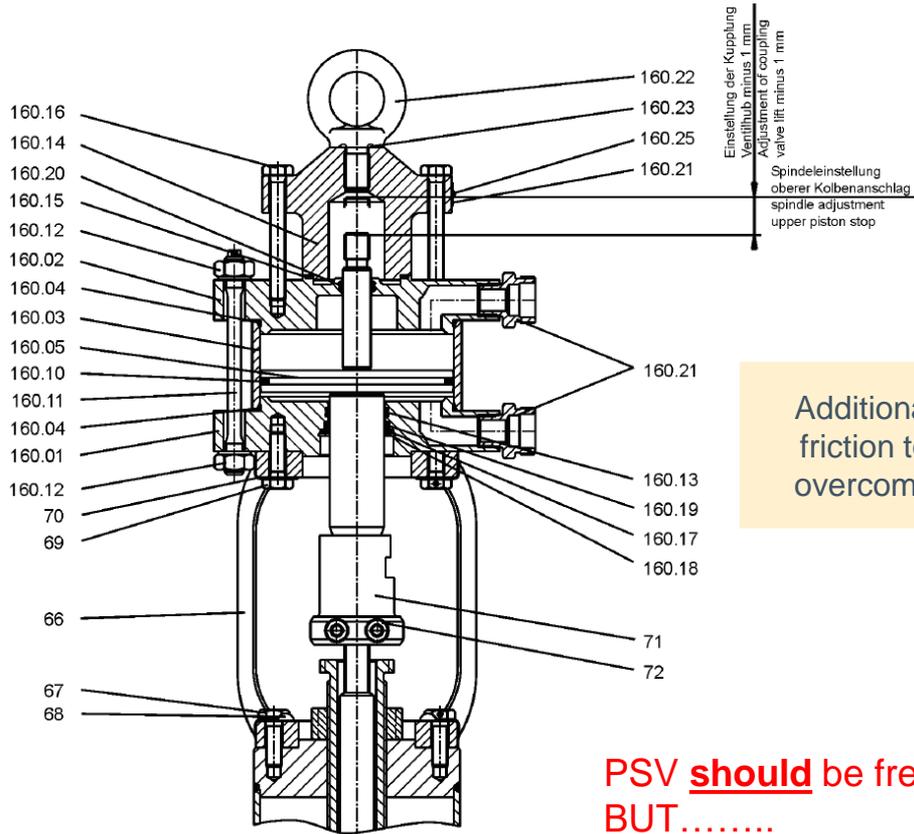
Additional friction to overcome ↓



PSV should freely open and close BUT.....



SEMPELL (SINGLE PISTON)



Additional friction to overcome ↑

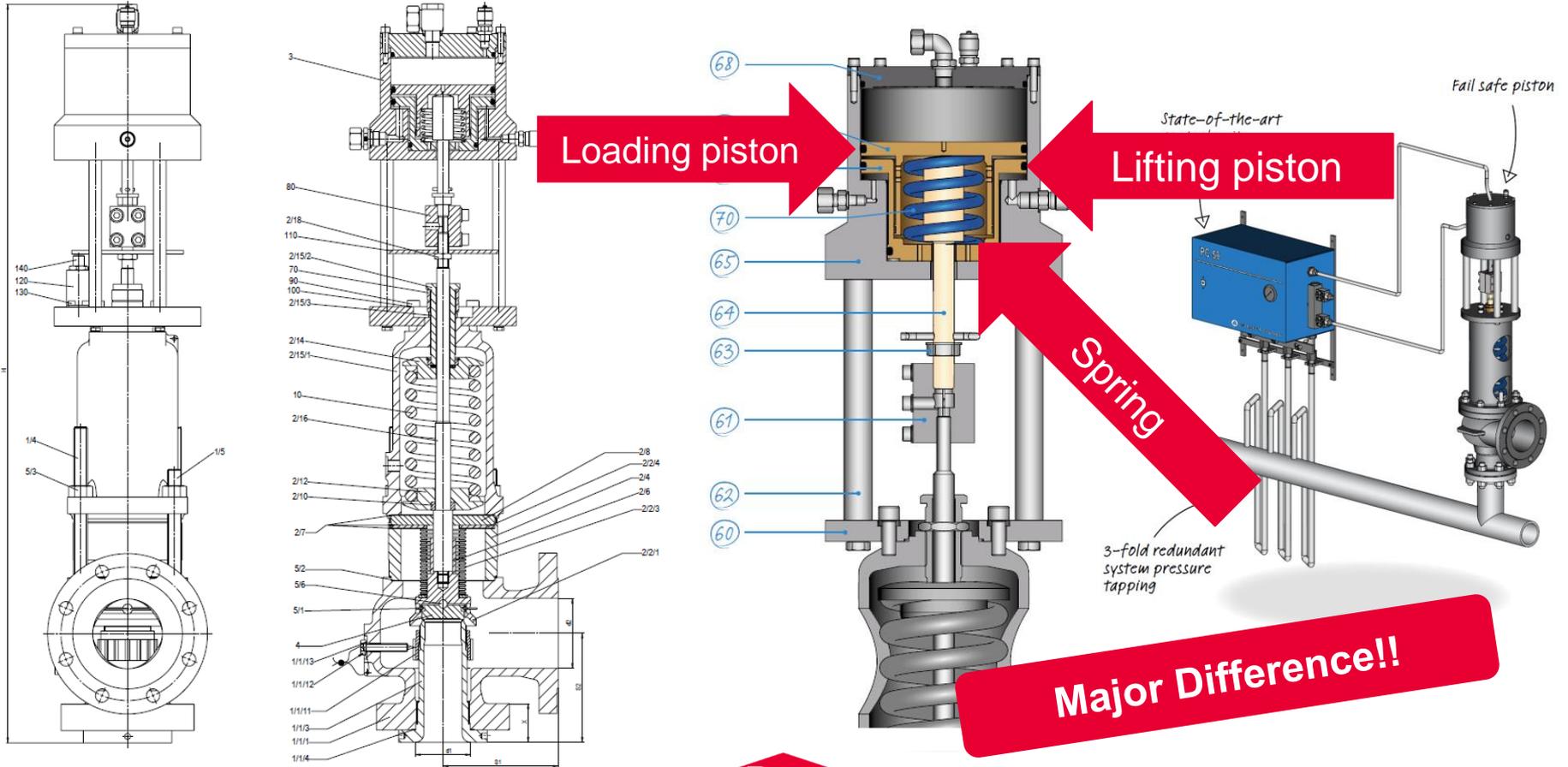
PSV should be freely open and close BUT.....



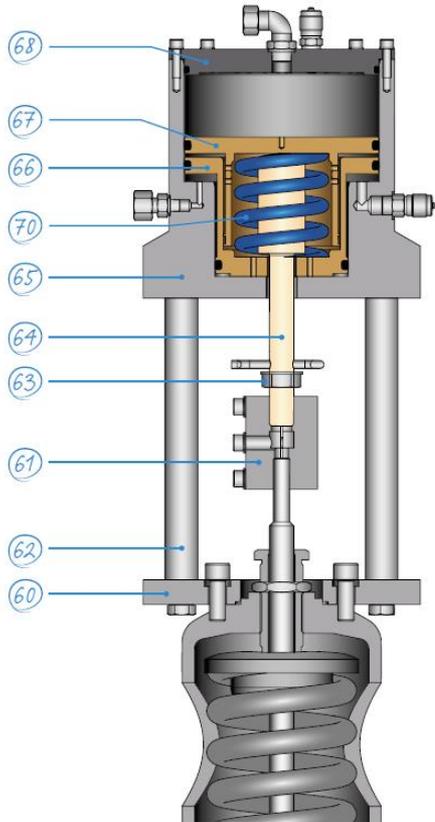
Closing pressure IMPACTED!



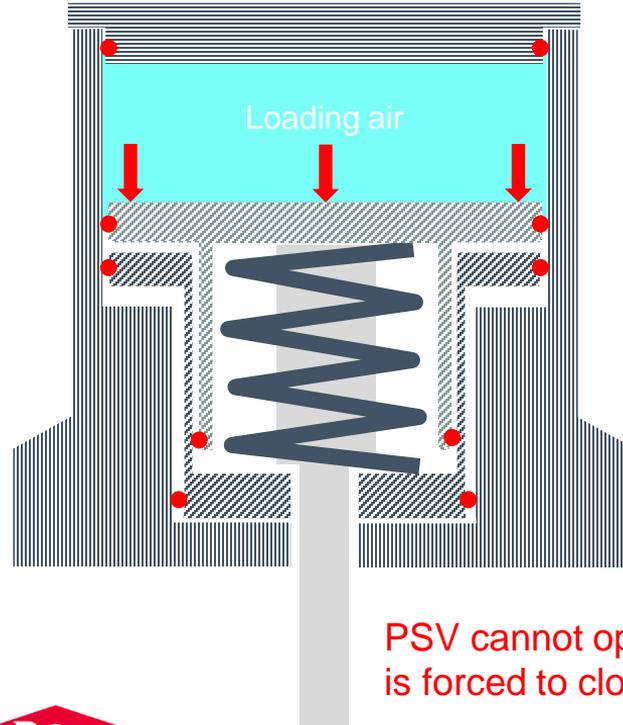
IMI BOPP & REUTHER (DOUBLE PISTON)



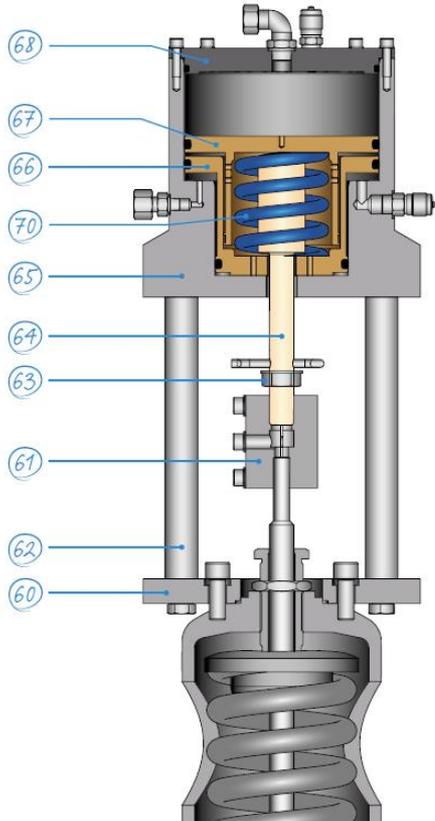
IMI BOPP & REUTHER (DOUBLE PISTON)



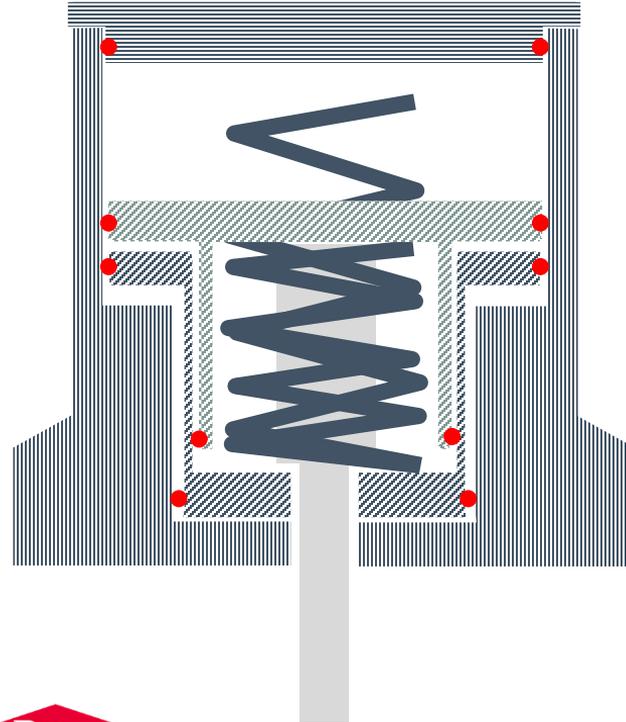
Operation with loading air



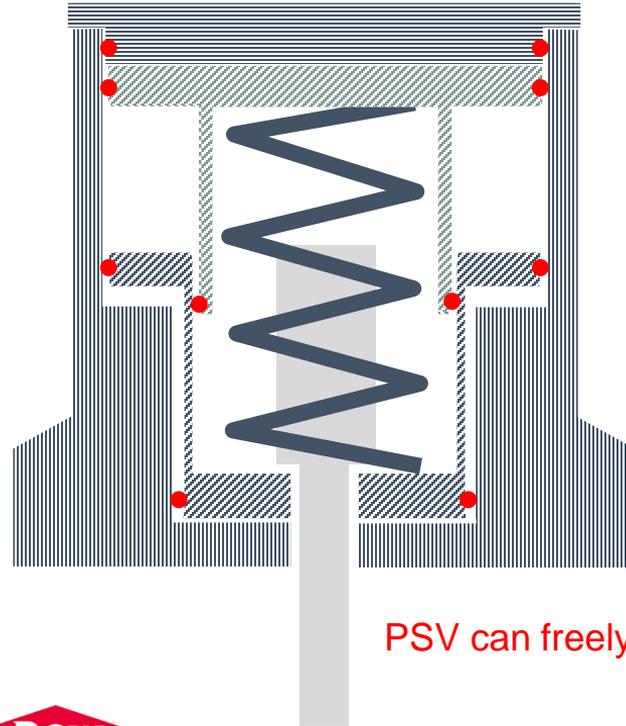
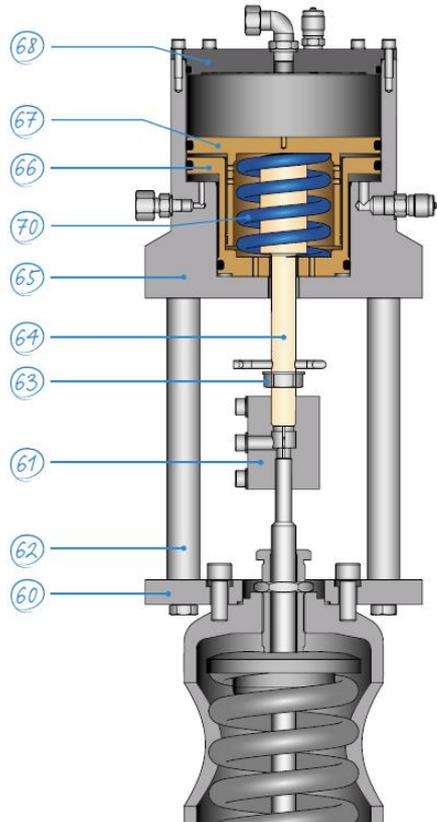
IMI BOPP & REUTHER (DOUBLE PISTON)



Loading air removed

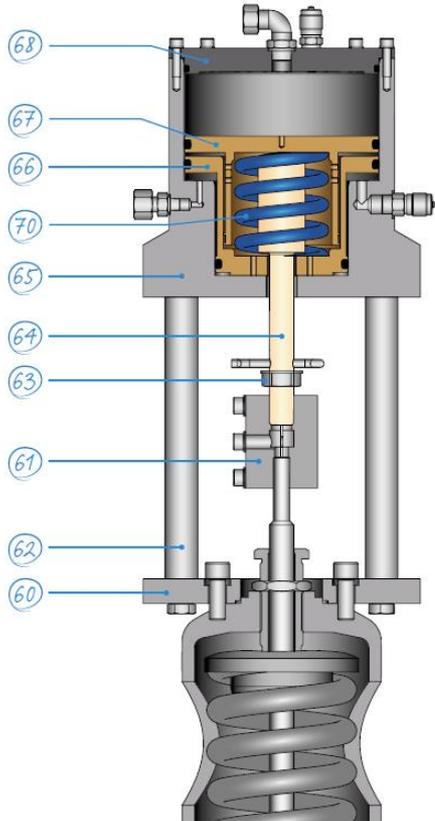


IMI BOPP & REUTHER (DOUBLE PISTON)

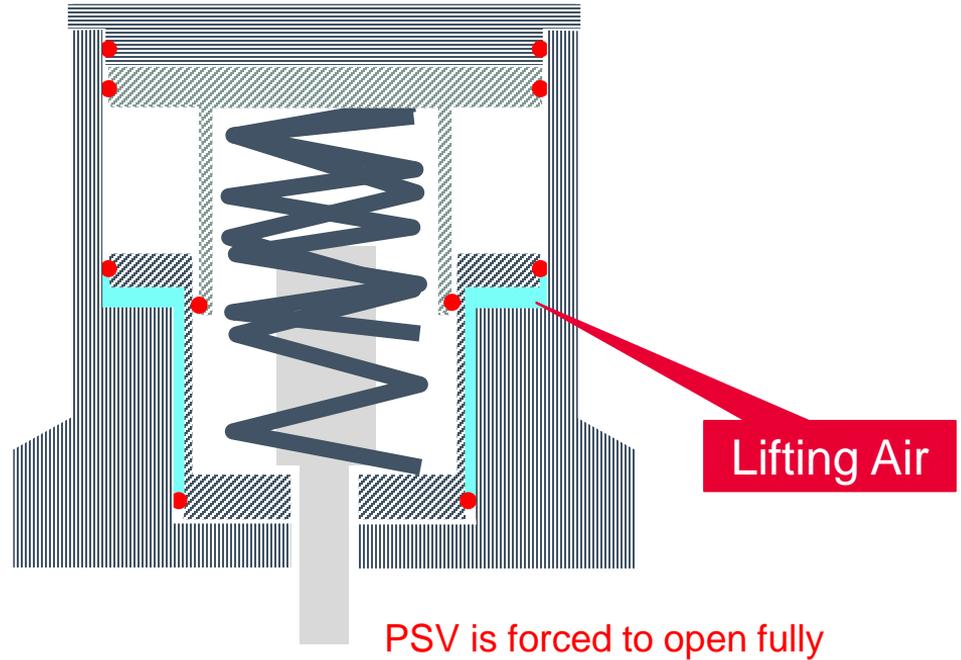


PSV can freely open and close

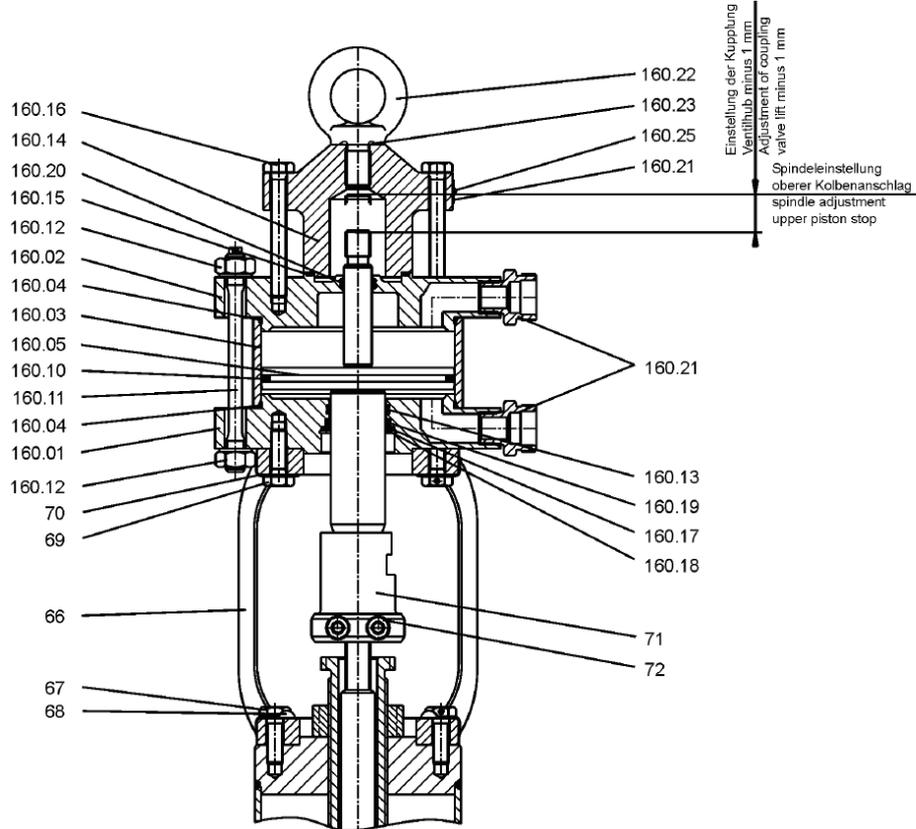
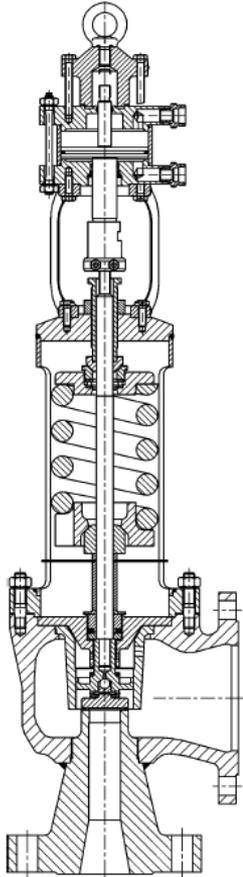
IMI BOPP & REUTHER (DOUBLE PISTON)



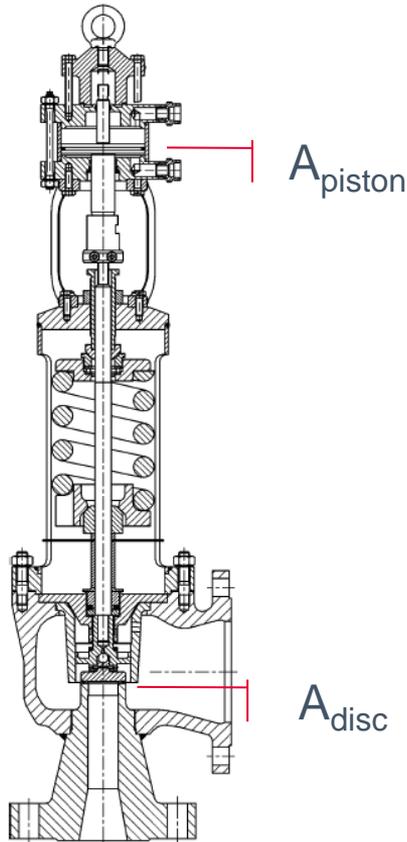
Operation with lifting air



SEPELL (SINGLE PISTON)



SEPELL (SINGLE PISTON)



$$F_{piston} = F_{disc}$$
$$A_{piston} * P_{piston} = A_{disc} * P_{disc}$$

$$P_{piston} = 0.3 \text{ bar} \rightarrow P_{disc} = 5.4 \text{ bar}$$

On top
of Spring
force

Opening

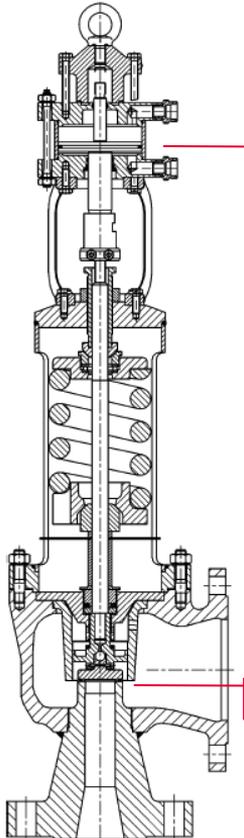
- Set Pressure required: 102bar, as Left: 103.1 bar (<3% tolerance)
- 5.4 bar extra on top 103.1 bar = 108.5 bar relieving pressure!

Reseat

- As left Reseat Pressure: 92.3 bar
- Resulting closing pressure $\rightarrow 92.3 - 5.4 = 86.9$ bar!

SEPELL (SINGLE PISTON)

Opening pressure when lifting air is not working



A_{piston}

A_{disc}

D _{sv}	Pset																					
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110
10	50,675	55,675	60,675	65,675	70,675	75,675	80,675	85,675	90,675	95,675	100,68	105,68	110,68	115,68	120,68	125,68	130,68	135,68	140,68	145,68	150,68	155,68
15	25,3	30,3	35,3	40,3	45,3	50,3	55,3	60,3	65,3	70,3	75,3	80,3	85,3	90,3	95,3	100,3	105,3	110,3	115,3	120,3	125,3	130,3
20	16,419	21,419	26,419	31,419	36,419	41,419	46,419	51,419	56,419	61,419	66,419	71,419	76,419	81,419	86,419	91,419	96,419	101,42	106,42	111,42	116,42	121,42
25	12,308	17,308	22,308	27,308	32,308	37,308	42,308	47,308	52,308	57,308	62,308	67,308	72,308	77,308	82,308	87,308	92,308	97,308	102,3	107,31	112,31	117,31
30	10,075	15,075	20,075	25,075	30,075	35,075	40,075	45,075	50,075	55,075	60,075	65,075	70,075	75,075	80,075	85,075	90,075	95,075	100,0	105,08	110,08	115,08
35	8,7286	13,729	18,729	23,729	28,729	33,729	38,729	43,729	48,729	53,729	58,729	63,729	68,729	73,729	78,729	83,729	88,729	93,729	98,729	103,73	108,73	113,73
40	7,8547	12,855	17,855	22,855	27,855	32,855	37,855	42,855	47,855	52,855	57,855	62,855	67,855	72,855	77,855	82,855	87,855	92,855	97,855	102,85	107,85	112,85
45	7,2556	12,256	17,256	22,256	27,256	32,256	37,256	42,256	47,256	52,256	57,256	62,256	67,256	72,256	77,256	82,256	87,256	92,256	97,256	102,26	107,26	112,26
50	6,827	11,827	16,827	21,827	26,827	31,827	36,827	41,827	46,827	51,827	56,827	61,827	66,827	71,827	76,827	81,827	86,827	91,827	96,827	101,83	106,83	111,83
55	6,5099	11,51	16,51	21,51	26,51	31,51	36,51	41,51	46,51	51,51	56,51	61,51	66,51	71,51	76,51	81,51	86,51	91,51	96,51	101,51	106,51	111,51
60	6,2688	11,269	16,269	21,269	26,269	31,269	36,269	41,269	46,269	51,269	56,269	61,269	66,269	71,269	76,269	81,269	86,269	91,269	96,269	101,27	106,27	111,27
65	6,0811	11,081	16,081	21,081	26,081	31,081	36,081	41,081	46,081	51,081	56,081	61,081	66,081	71,081	76,081	81,081	86,081	91,081	96,081	101,08	106,08	111,08
70	5,9321	10,932	15,932	20,932	25,932	30,932	35,932	40,932	45,932	50,932	55,932	60,932	65,932	70,932	75,932	80,932	85,932	90,932	95,932	100,93	105,93	110,93
75	5,812	10,812	15,812	20,812	25,812	30,812	35,812	40,812	45,812	50,812	55,812	60,812	65,812	70,812	75,812	80,812	85,812	90,812	95,812	100,81	105,81	110,81
80	5,7137	10,714	15,714	20,714	25,714	30,714	35,714	40,714	45,714	50,714	55,714	60,714	65,714	70,714	75,714	80,714	85,714	90,714	95,714	100,71	105,71	110,71
85	5,6322	10,632	15,632	20,632	25,632	30,632	35,632	40,632	45,632	50,632	55,632	60,632	65,632	70,632	75,632	80,632	85,632	90,632	95,632	100,63	105,63	110,63
90	5,5639	10,564	15,564	20,564	25,564	30,564	35,564	40,564	45,564	50,564	55,564	60,564	65,564	70,564	75,564	80,564	85,564	90,564	95,564	100,56	105,56	110,56
95	5,5061	10,506	15,506	20,506	25,506	30,506	35,506	40,506	45,506	50,506	55,506	60,506	65,506	70,506	75,506	80,506	85,506	90,506	95,506	100,51	105,51	110,51
100	5,4568	10,457	15,457	20,457	25,457	30,457	35,457	40,457	45,457	50,457	55,457	60,457	65,457	70,457	75,457	80,457	85,457	90,457	95,457	100,46	105,46	110,46
105	5,4143	10,414	15,414	20,414	25,414	30,414	35,414	40,414	45,414	50,414	55,414	60,414	65,414	70,414	75,414	80,414	85,414	90,414	95,414	100,41	105,41	110,41
110	5,3775	10,377	15,377	20,377	25,377	30,377	35,377	40,377	45,377	50,377	55,377	60,377	65,377	70,377	75,377	80,377	85,377	90,377	95,377	100,38	105,38	110,38
115	5,3454	10,345	15,345	20,345	25,345	30,345	35,345	40,345	45,345	50,345	55,345	60,345	65,345	70,345	75,345	80,345	85,345	90,345	95,345	100,35	105,35	110,35
120	5,3172	10,317	15,317	20,317	25,317	30,317	35,317	40,317	45,317	50,317	55,317	60,317	65,317	70,317	75,317	80,317	85,317	90,317	95,317	100,32	105,32	110,32
125	5,2923	10,292	15,292	20,292	25,292	30,292	35,292	40,292	45,292	50,292	55,292	60,292	65,292	70,292	75,292	80,292	85,292	90,292	95,292	100,29	105,29	110,29
130	5,2703	10,27	15,27	20,27	25,27	30,27	35,27	40,27	45,27	50,27	55,27	60,27	65,27	70,27	75,27	80,27	85,27	90,27	95,27	100,27	105,27	110,27
135	5,2506	10,251	15,251	20,251	25,251	30,251	35,251	40,251	45,251	50,251	55,251	60,251	65,251	70,251	75,251	80,251	85,251	90,251	95,251	100,25	105,25	110,25
140	5,233	10,233	15,233	20,233	25,233	30,233	35,233	40,233	45,233	50,233	55,233	60,233	65,233	70,233	75,233	80,233	85,233	90,233	95,233	100,23	105,23	110,23
145	5,2172	10,217	15,217	20,217	25,217	30,217	35,217	40,217	45,217	50,217	55,217	60,217	65,217	70,217	75,217	80,217	85,217	90,217	95,217	100,22	105,22	110,22
150	5,203	10,203	15,203	20,203	25,203	30,203	35,203	40,203	45,203	50,203	55,203	60,203	65,203	70,203	75,203	80,203	85,203	90,203	95,203	100,2	105,2	110,2
155	5,1901	10,19	15,19	20,19	25,19	30,19	35,19	40,19	45,19	50,19	55,19	60,19	65,19	70,19	75,19	80,19	85,19	90,19	95,19	100,19	105,19	110,19
160	5,1784	10,178	15,178	20,178	25,178	30,178	35,178	40,178	45,178	50,178	55,178	60,178	65,178	70,178	75,178	80,178	85,178	90,178	95,178	100,18	105,18	110,18
165	5,1678	10,168	15,168	20,168	25,168	30,168	35,168	40,168	45,168	50,168	55,168	60,168	65,168	70,168	75,168	80,168	85,168	90,168	95,168	100,17	105,17	110,17
170	5,158	10,158	15,158	20,158	25,158	30,158	35,158	40,158	45,158	50,158	55,158	60,158	65,158	70,158	75,158	80,158	85,158	90,158	95,158	100,16	105,16	110,16
175	5,1491	10,149	15,149	20,149	25,149	30,149	35,149	40,149	45,149	50,149	55,149	60,149	65,149	70,149	75,149	80,149	85,149	90,149	95,149	100,15	105,15	110,15
180	5,141	10,141	15,141	20,141	25,141	30,141	35,141	40,141	45,141	50,141	55,141	60,141	65,141	70,141	75,141	80,141	85,141	90,141	95,141	100,14	105,14	110,14
185	5,1335	10,133	15,133	20,133	25,133	30,133	35,133	40,133	45,133	50,133	55,133	60,133	65,133	70,133	75,133	80,133	85,133	90,133	95,133	100,13	105,13	110,13
190	5,1265	10,127	15,127	20,127	25,127	30,127	35,127	40,127	45,127	50,127	55,127	60,127	65,127	70,127	75,127	80,127	85,127	90,127	95,127	100,13	105,13	110,13
195	5,1201	10,12	15,12	20,12	25,12	30,12	35,12	40,12	45,12	50,12	55,12	60,12	65,12	70,12	75,12	80,12	85,12	90,12	95,12	100,12	105,12	110,12
200	5,1142	10,114	15,114	20,114	25,114	30,114	35,114	40,114	45,114	50,114	55,114	60,114	65,114	70,114	75,114	80,114	85,114	90,114	95,114	100,11	105,11	110,11

>=3% afwijking

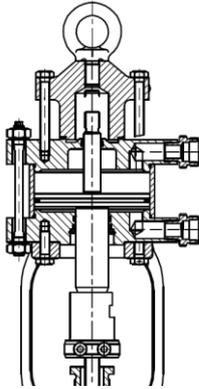


CONCLUSION

Single piston

Like:

- Emerson Sempell A160
- Emerson Sempell A16

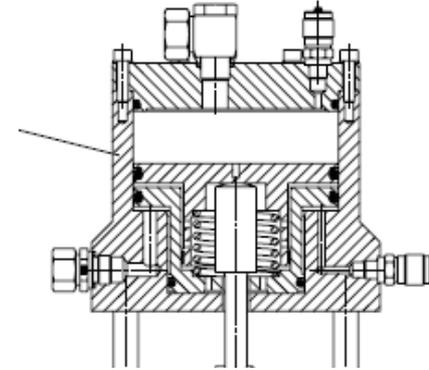


- Loading air **required** to close correctly
- Lifting air **required** to open correctly
- Friction of gaskets has (big) impact

Double piston with spring

Like:

- IMI Bopp & Reuther type AK



- Loading air **advised** for leak free operation
- Lifting air **optional**
- NO impact by Friction of gaskets



Seek

Together™