776 Cryogenic Safety Valve

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INTRODUCTION

The effects of exceeding safe pressure levels in an unprotected pressure vessel or system, can have catastrophic effects on both plant and personnel.
Safety relief valves should be used to protect any pressurised system from the effects of exceeding its design pressure limit.
A safety relief valve is designed to automatically discharge gas, vapour or liquid from any pressure containing system, preventing a predetermined safe pressure being exceeded, and protecting plant and personnel.

Safety Valve
A valve which automatically discharges gases and vapours so as to prevent a predetermined safe pressure being exceeded. It is characterised by a rapid full opening action and is used for steam, gases or vapour service.
Relief Valve
A valve which automatically discharges fluid, usually liquid, when a predetermined upstream pressure is exceeded. The term is commonly used for pressure relieving valves in which the lift is proportional to the increase in pressure above the set pressure.
Safety Relief Valve
A valve which will automatically discharge gases, vapours or liquids, to prevent a predetermined safe pressure being exceeded. It is characterised by a rapid opening action.

DEFINITIONS

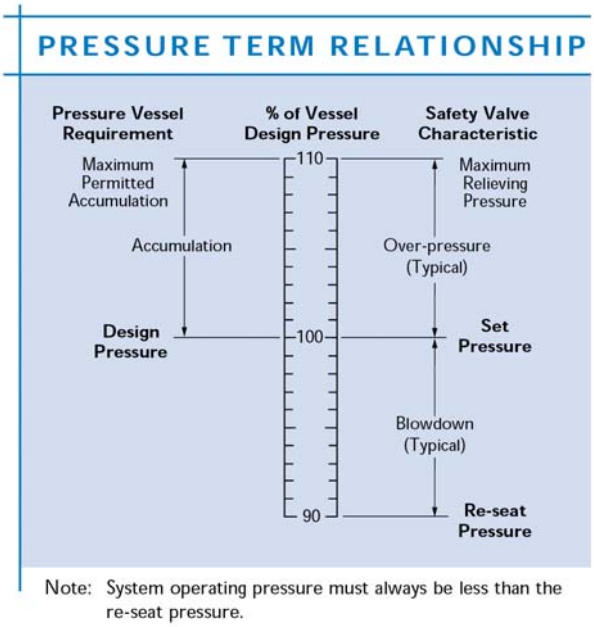
Set Pressure
The pressure measured at the valve inlet at which a safety relief valve should commence to lift under service conditions.
Overpressure
The pressure increase above set pressure at the valve inlet at which the discharge capacity is attained. Usually expressed as a percentage of set pressure.
Accumulation
The pressure increase over a maximum safe working pressure of the vessel or system when the safety relief valve is discharging at its rated capacity is called accumulation. The term refers to the vessel or system to be protected and not to the valve. Accumulation is the same as over-pressure when the valve is set at the design pressure of the vessel.
Re-Seat Pressure
The pressure measured at the valve inlet at which the safety relief valve closes.
Blow-Down
The difference between the set pressure and the re-seating pressure expressed as a percentage of the set pressure or as a pressure difference.
Simmer
The pressure zone between the valve set pressure and the popping pressure. In this pressure zone the valve is only slightly open and therefore discharging a small percentage of its rated capacity.
Popping Pressure
The pressure at which the valve disc rapidly moves from a slightly open (simmer) position to a practically full open position.
Superimposed Back Pressure
Pressure higher than atmosphere in the safety relief valve outlet. This may result from discharge into the common disposal system of other safety relief valves or devices, or as a result of a specific design requirement. Back pressure can be either constant or variable depending on the operating conditions.
Built Up Back Pressure
The pressure existing at the outlet of a safety relief valve caused by flow through the valve into the disposal system.

Differential Set Pressure
This is the difference between the set pressure and the constant superimposed back pressure. It is applicable only when a conventional type safety relief valve is used to discharge against constant superimposed back pressure. (It is the pressure at which the safety valve is set at on the test bench without back pressure.)

Cold Differential Set Pressure
The pressure at which a safety relief valve, intended for high temperature service, is set on a test rig using a test fluid at ambient temperature. The cold differential test pressure will be higher than the set pressure, in order to compensate for the effect of elevated temperature on the valve.

Valve Lift
The actual travel of the valve disc away from the seat when the valve is relieving.

Discharge Capacity
Actual rate of discharge of service media, which can be expressed in mass flow or volumetric terms.



Equivalent Capacity
Calculated mass or volumetric flow rate of the valve of a given test fluid. The fluids commonly used for test purposes are steam, air and water.

SAFETY RELIEF VALV E – APPLICATIONS

Application	Medium	Safety Relief Valve Type
Vented boilers Un-vented boilers	Hot Water	706 716 746/766 Pop 716T
Boiler, pipeline and vessel protection	Steam	706/716 746 756/766 Pop 1640B 300
Compressor pipeline and receiver protection	Air	706 716 746 POP 1640B 300
Pipeline and vessel protection	Cold Water	706 716 746 1640B 300
Pump Protection	Liquids	480/485
Process pipeline, pump and vessel protection	Process/Corrosive Liquids	716 Stainless steel 746 Stainless steel 490 Stainless steel
Clean steam and hygienic environments	Steam and Gases	716 Stainless steel 746 Stainless steel
Pipework, tank and equipment protection	Cryogenic Gases	776
Pipework, tank and equipment protection	Cold & Fine Gases	716 776
Blowers, bulk transfer, tank duty, road/rail transfers	Air	616D

The selection of figure number for each application depends on:
Pressure - capacity - material - temperature - fluid - connection required.

776
Cryogenic Safety Valve

TECHNICAL SPECIFICATION

Approvals

AD Merkblatt A2
ASME VIII
BS 6759 Pt. 2 & 3
PED certified Category IV

Materials

Body - Bronze (-196 to 60°C)
- Stainless steel (-268 to 60°C)
Trim - Kel F PCTFE

Size Range

Size (Orifice code)	Orifice mm^2	Min (Barg) Pressure	Max (Barg) Pressure
DN15 (1 & 2M)	109	1	41.3
DN20 (2R)	109	1	41.3
DN20 (2 & 2M1)	109	1	41.3
DN20 (3)	314	1	38.6
DN25 (4)	314	1	38.6
DN32 (5)	415	1	34.5
DN40 (6)	660	1	34.5
DN50 (7)	1075	1	31

Performance

Over Pressure 10% Blowdown 10%

Maximum Back Pressure

Barg	5.5
Constant	80%
Built-up	10%
Variable	0%

(Total % must not exceed Barg shown)

Connections

Screwed In x Screwed Out

Construction

Top Guided / Full Lift

Cap Options

Pressure tight dome fitted as standard

Sizing

Refer to Capacity Charts

Coefficient of Discharge

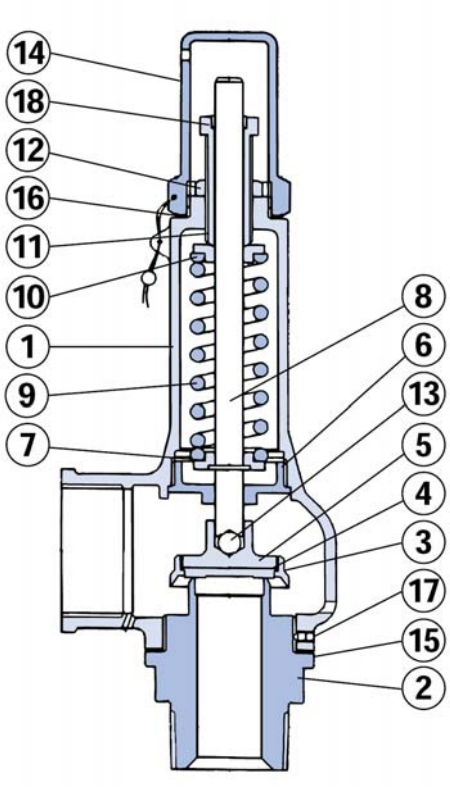
Air (TUV alpha W) Orifice codes	Above 3 Barg	Above 2.5 Barg	Above 2 Barg	Above 1.5 Barg	Above 1 Barg
1, 2, 4, 5, 6, 7	0.69	0.69	0.69	0.67	0.63
3	0.67	0.65	0.63	0.62	0.58
2R	0.40	0.40	0.40	0.39	0.36
Air (ASME Kdr)	0.737				

DESIGN

The 776 Safety Relief Valve is designed for cryogenic duty down to -196°C. The valve combines a full lift design and top guided construction with an unobstructed seat bore to provide maximum discharge capacity. Positive sealing is achieved through a freely pivoted disc with Kel F (PCTFE) soft seat technology.
The valve is designed to conform with ISO4126, AD Merkblatt A2, ASME VIII and BS6759 Parts 2 & 3. Production assembly and tests are carried out in accordance with both BOC and Air Products specifications.

BOC specification: 1819660 and 399856.
Air Products specification: 4WPI-EW80010, and 4WPI-SW70003.

PARTS



ITEM	PART	MATERIAL
1	Body	Bronze
2	Seat	Bronze
3	Valve Skirt	Brass
4*	Valve Disc	Kel F PCTFE
5*	Valve Disc Holder	Brass
6	Guide	Bronze
7	Lower Spring Plate	Brass
8	Spindle	Brass
9*	Spring	St.St
10	Upper Spring Plate	Brass
11	Adjusting Screw	Brass
12	Locknut	Brass
13*	Ball	St.St
14	Cap	Brass
15*	Body Gasket	Gylon PTFE
16*	Cap Gasket	Gylon PTFE
17	Grubscrew	St.St
18	Bush	PTFE

Note:
** Recommended spares.*
Refer to factory for Stainless Steel version

DIMENSIONS

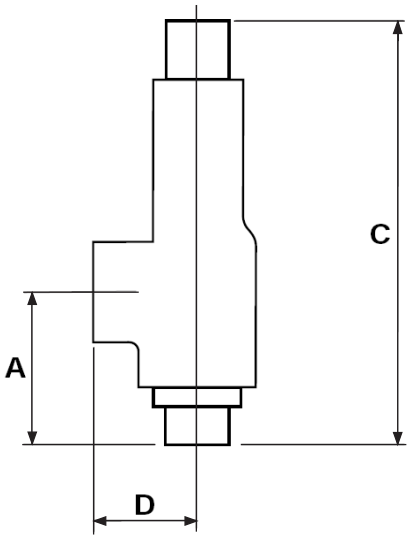
Valve Type	Valve Size	Inlet *BSP	Outlet *BSP	A	'C' Dome	D	Weight (kg)
Male x Female	DN15 /1	1/2"	3/4"	52	173	40	1.0
	DN15 /2M	1/2"	1"	52	173	45	1.0
	DN20 /2R	3/4"	1"	70	191	45	1.0
	DN20 /2	3/4"	1"	70	191	45	1.0
	DN20 /3	3/4"	1-1/4"	63	231	55	1.6
	DN25 /2M1	1"	1"	70	191	45	1.0
	DN25 /4	1"	1-1/4"	73	241	55	1.6
	DN32 /5	1-1/4"	1-1/2"	78	265	60	2.1
	DN40 /6	1-1/2"	2"	84	323	70	4.0
	DN50 /7	2"	2-1/2"	95	371	81	7.0

* Other threaded options are also available.
All dimensions in mm.

FIGURE NUMBERING DIMENSIONS

Fig.	Size	Trim	Connections
776/1	DN15 x 20		
776/2M	DN15 x 25		
776/2R	DN20 x 25		
776/2	DN20 x 25	Soft Seat	*Screwed
776/3	DN20 x 32	Kel F	BSP
776/2M1	DN25 x 25		
776/4	DN25 x 32	(PCTFE)	Male x
776/5	DN32 x 40		Female
776/6	DN40 x 50		
776/7	DN50 x 65		

DIMENSIONS



AIR CAPACITY CHART (l/s) @ 0.3 Barg or 10% overpressure* and 15°C

Set Pressure (Barg)	Valve Type 776 (AD MERKBLATT A2)							
	/2R DN20	/1 /2M DN15	/2 /2M1 DN20	/3 DN20	/4 DN25	/5 DN32	/6 DN40	/7 DN50
0.35								
1.0	14	26.9	26.9	71.3	77.5	103	163	265
2.0	21	40.3	40.3	107	116	153	244	397
3.0	30.5	58.7	58.7	155	169	224	356	579
4.0	38.2	73.4	73.4	205	211	279	444	723
5.0	45.8	88.0	88.0	246	253	335	533	868
6.0	54	103	103	287	296	391	621	1012
7.0	61	117	117	328	338	446	710	1156
8.0	69	132	132	369	380	502	798	1301
9.0	76	147	147	410	422	558	887	1445
10.0	84	161	161	451	464	613	976	1589
12.0	99	190	190	533	548	725	1153	1878
12.5	103	198	198	553	570	752	1197	1950
14.0	115	220	220	614	633	836	1330	2166
16.0	129	249	249	696	717	948	1507	2455
18.0	145	278	278	778	801	1059	1684	2743
20.0	160	307	307	860	886	1171	1862	3032
22.0	175	337	337	942	970			
24.0	190	366	366	1024	1054			
26.0	205	395	395	1106	1139			
28.0	220	424	424	1187	1223			
30.0	236	454	454	1269	1307			
32.0								
34.0								
36.0								
38.0								
40.0								

* Minimum overpressure = 0.07 Barg at set pressure less than 1.0 Barg.

The 746 can be sized/certified to ASME VIII and AD Merkblatt A2 - contact factory for details.

INSTALLATION

Safety Relief Valves should always be installed in an upright position with their spring chamber vertical.
All packing materials should be removed from the valve connections prior to installation.

Pressure Vessels

When fitting a Safety Relief Valve onto pressure vessels, the inlet connection pipe should be as short as possible and the bore should be at least equivalent to the nominal bore size of the valve.
The pressure drop between the vessel and the valve should be no more than 3% at rated capacity.
A pressure-tight dome should be specified when:
1) A back pressure must be contained within the relieving system.
2) A head of liquid is built up within the valve body and consequently needs to be contained.
3) The relieving medium is toxic, corrosive or environmentally unfriendly.

Pipelines

When fitting a Safety Relief Valve into a pipeline, the inlet connecting pipe leading from the main pipeline to the Safety Relief Valve should be as short as possible, so that the inlet pressure drop is no more than 3% of rated capacity. In addition, it is advised that the Safety Relief Valve is placed a sufficient distance downstream of the pressure source. This will protect the valve from the adverse effects of pressure pulsations.

Discharge Pipelines

These should be equal to or larger than the valve outlet, with adequate supports, minimum number of bends and overall length. Unless balanced bellows valves are installed, the maximum built up backpressure should not exceed 10% of the set pressure, although the 746, 756 and the 766 can handle higher back pressure if required. Steam service valves should be adequately drained.
Alignment of the discharge or drain should present no risk to persons or property. Protection from the collection of rainwater or condensation in the discharge pipe is advisable.

System Cleansing

It is essential that new installations are fully flushed and all debris removed prior to installing the valve as serious damage can be caused to valve seats, resulting in subsequent leakage.

Pressure Adjustment

Every valve is fitted with a suitable spring and tested before leaving the factory. Valves can be preset on request but to alter the set pressure, the adjusting screw, when viewed from the top, should be screwed downwards in a clockwise direction to increase the set pressure and upwards in an anti-clockwise direction to decrease it. Set pressure adjustment must be carried out by experienced and approved personnel. Any change in set pressure must be within the range of the existing spring, if it exceeds the range, a new spring will be required. The cap lead seal must be re-made after any adjustment to the set pressure.

Blow-down Adjustment (POP, 756 & 766 valves only)

The blow-down ring (part no. 8) is set before the valve leaves the factory and normally no further adjustment will be necessary. However, if the reseating pressure has to be altered in service, the blow-down ring should be screwed (downwards) clockwise to raise the re-seat, popping and simmer pressures. If the blowdown ring is screwed (upwards) anti-clockwise the re-seat, popping and simmer pressures will lower. When re-inserting the setting screw (part no 9.) it should always be placed to engage a slot in the blow-down ring. The standard blowdown is 5% for 756, 10% for 766 and 10% for a POP type valve (minimum 0.3 Barg for all three valve types).
For recommended settings, please contact our technical sales office who will be pleased to help.

COLD DIFFERENTIAL TEST PRESSURE

When setting a valve intended for use at high temperature on a test rig using a test fluid at ambient temperatures, it is necessary to set the valve at a slightly higher pressure, so that it will open at the correct set pressure under operating conditions. The necessary allowance is shown in the following table.

Operating temperature	Increase in set pressure at ambient temperature
Up to 121°C	None
122°C to 316°C	1%
317°C to 427°C	2%

700 SERIES TECHNICAL SPECIFICATION

Fig. No	706	716	746	756	766	776
Body Material	Bronze	Bronze Cast Iron Stainless Steel	Cast Steel Stainless Steel	Cast Iron	Cast Steel Cast Steel	Bronze
Code **Approvals** Part	1, 2, & 3	**BS6759** 1, 2, & 3	1, 2, & 3#	1	1	**ADMERKBLATT** **A2**
Top Guided	Yes	Yes	Yes	Yes	Yes	Yes
Lift	High Lift	Full Lift	Full Lift	Full Lift	High Lift	Full Lift
Size Range	DN15-50 1/2" – 2"	DN15-50 1/2" – 2"	DN25-100 1" – 4"	DN25-80 1" – 3"	DN40-80 1-1/2" – 3"	DN15-50 1/2" – 2"
Orifice Areas (mm2)						
DN15	126	109	—	—	—	
DN20	364	314	—	—	—	
DN25	481	415	415	415	—	Sizing data
DN32	791	660	660	660	—	to TUV
DN40	1240	1075	1075	1075	2280	available
DN50	1943	1662	1662	1662	4054	on request.
DN65	—	—	2827	2827	6334	
DN80	—	—	4301	4301	9121	
DN100	—	—	6648	—	—	
Pressure Range† (Barg)	0.35 to 12.5	0.35 to 32	0.35 to 40	0.35 to 24	0.35 to 24	1 to 41.3
Temp Range (°C) (with suitable material)	–59 to +220	–90 to +260	–40 to +427	–29 to +300	–29 to +230	–196 to +60
Connection	Screwed Flanged	Screwed Flanged	Flanged	Flanged	Flanged	Screwed
Trim Options	Brass EPDM (WRC) Viton	Stainless Aflas EPDM	Stainless Aflas EPDM	Stainless EPDM	Stainless EPDM	KEL F (PCTFE)
Cap Options	Dome Open lever	Dome Open lever	Dome Open lever Packed lever	Open lever	Open lever	Dome
Kdr. Cert. Coeff. Steam/Hot Water/Gases	0.173	0.7	0.7	0.716	0.4	—
Kdr. Cert. Coeff. Liquids	0.149	0.46	0.46	—	—	—
Pressure	Brz 5.5 Barg	SS 5.5 Barg	SS 16 Barg	CS 12 Barg	CS 12 Barg	SS 5.5 Barg
Maximum Constant	80%	80%	80%	—	—	80%
Back Built-up	10%	10%	10%	50%	50%	10%
Pressure* Variable	—	—	40%	—	—	—

*For higher back pressures consult factory. **Resilient 766 is limited to 10%.
†For maximum pressure per size and material refer to capacity and spring charts, pages 14 to 23.
††716 EPDM Seat, max pressure of 12.5 Barg on DN 15, 20, 25 and 18 Barg on DN 32, 40, 50.
#746 is also available ASME VIII and AD Merkblatt A2 certified, details available on request.

Material	Seat		Body□	
Temperature	EPDM (WRC)	-40 °C to 95 °C	Bronze BSI 400 - LG2	-196 c to 232 °C□
Limitations	EPDM	-50 °C to 150 °C	Cast Iron BSI 452-260	-10 C to 300 °C□
	Aflas	-10 °C to 200 °C	Carbon Steel SA216-WCB	-29 C to 427 °C□
	Brass	-59 °C to 232 °C	Stainless Steel 316/CF8M	-90 C to 427 °C□
	Stainless Steel	-90 °C to 232 °C	□	