PENTAIR

LUCEAT

Features and Advantages

- High seat tightness - As the force that holds the disc on the nozzle increases with the pressure, the valve remains fully tight very close to the set point.
- Full opening - At set point the pressure in the main pressure chamber is eliminated almost instantaneously, resulting in a sharp opening under the thrust of the pressure beneath the disc.
- Sharp closing - Like the opening, the reseat of the valve is controlled by the pilot and occurs at a predetermined and adjustable value (normally 3-7% below the set pressure) which only depends upon the pressure in the tank. The anti-vibration ring prevents any fluttering of the disc, which usually occurs as the valve tries to reseat.
- Accuracy - The pressure in the tank is applied on the pilot diaphragm which has a large surface area to amplify any small variation in the tank pressure.
- Vacuum setting - As required the valve can also be used as a combined pressure and vacuum safety valve, with the vacuum setting being obtained either by adjusting the weight of the internals or by adjunction of a vacuum pilot.
- Icing - In the unlikely event of frost formation, the large and sudden lifting force on the disc will easily break any icing, which might otherwise interfere with the operation of the valve.
- Rugged construction - Because the pilot is fully integrated into the main valve cap, the valve is very sturdy and can withstand the heavy seas.
- Blocked vacuum - When it is not acceptable to have air flowing into the tank under any circumstances, a simple check valve device keeps the valve tight under vacuum.
- Additional setting - Temporary change of the set pressure can easily be done by simply screwing an additional setting device on top of the pilot.
- Very large flow rates - The type EXPON has been specially developed to bring certified extra-large capacities within a smaller valve.

General application

Luceat's pilot operated safety valves were used on the World's very first LNG carriers, and have been constantly improved to meet the ever-changing requirements of the highly demanding applications on liquified gases.

Technical data

Temperature (°C)	: -200 to +80
Pressure (bar)	: +10 mbars to +2bar
Vacuum (bar)	: - 10 mbars to -200 mbars
Sizes	: 2" x 2" to 12" x 16"

Temperature (°C)	Pressure (mBarG)	Vacuum (mBarG)		Type	Sizes	Pressure sensing
-200 to +80	+10 to +50	Blocked	–	R1101	2”, 6”	External
-200 to +80	50 to 1500	-5 to -20 Below -20 Blocked	Weight Pilot –	R2101	2”, 6” 8”, 10” 12” x 16”	Internal or External
-200 to +80	50 to 2000	-5 to -20 Below -20 Blocked	Weight Pilot –	EXPON	6” x 8” 8” x 10” 10” x 12” 12” x 16”	Internal or External

On low pressure applications, the difference between the inlet pressure and the outlet pressure is usually so small that the flow through the valve is not chocked. We use therefore the usual formula for subsonic flow.

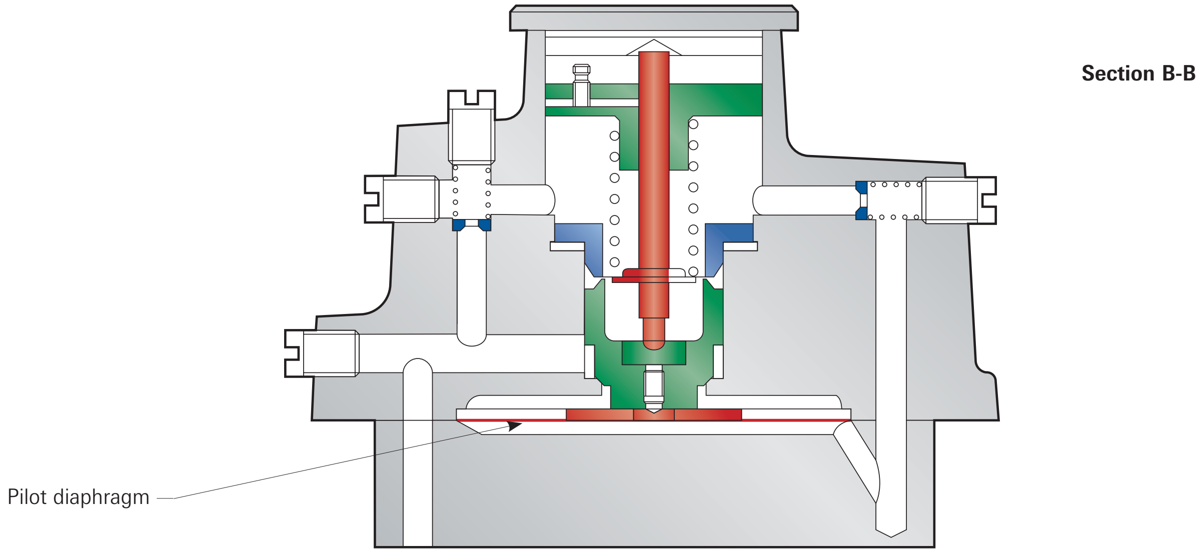
$$A = \frac{V\sqrt{MTZ}}{12510 K_d P_1 \sqrt{\frac{k}{k-1}\left[\left(\frac{P_2}{P_1}\right)^{\frac{2}{k}} - \left(\frac{P_2}{P_1}\right)^{\frac{k+1}{k}}\right]}} = \frac{W\sqrt{TZ}}{558.4 K_d P_1 \sqrt{M\frac{k}{k-1}\left[\left(\frac{P_2}{P_1}\right)^{\frac{2}{k}} - \left(\frac{P_2}{P_1}\right)^{\frac{k+1}{k}}\right]}}$$

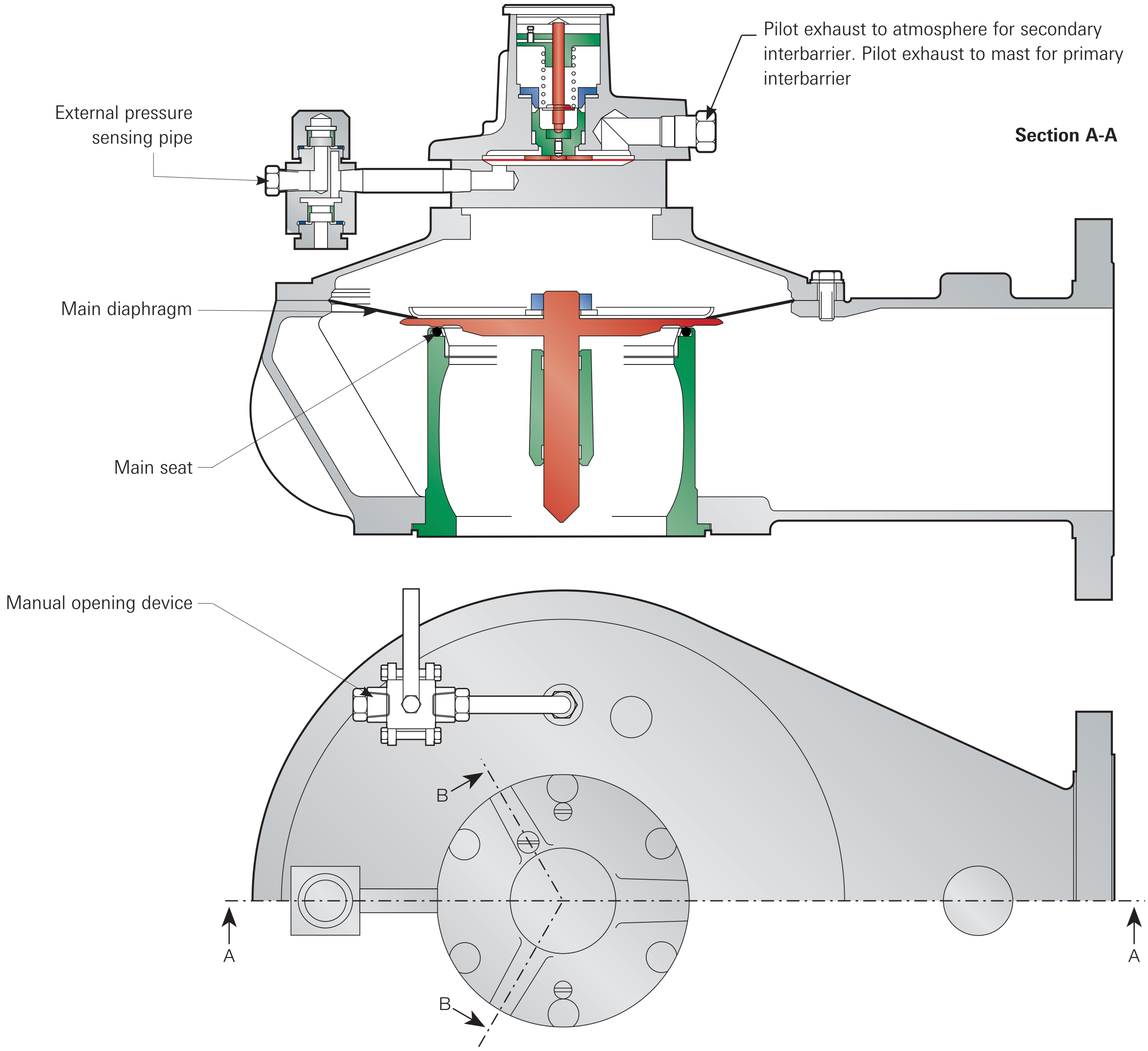
A = required nozzle area, in cm^2
V = required volumetric flow, in Nm^3/hr (at normal conditions, 0°C and 1013 mbar)
W = required mass flow, in kg/hr
M = molar weight of the gas or vapour
T = temperature at relief, in K
Z = compressibility factor of the vapour (if unknown, take 1)
K_d = actual nozzle coefficient of discharge (see below)
P_1 = absolute upstream pressure (set + accumulation + atmospheric pressure - inlet losses), in bar abs
P_2 = absolute downstream pressure (atmospheric pressure + back pressure), in bar abs
k = ratio of specific heats, C_p/C_v of the gas or vapour.

Type	Size	Nozzle area, cm^2	Nozzle coefficient of discharge, K_d
R1101	2”	20.27	0.600
	6”	182.4	0.600
R2101	4”	81.1	0.600
	6”	182.4	0.600
	8”	324.3	0.600
	10”	506.7	0.600
	12” x 16”	729.7	0.746
EXPON	6”x 8”	182.4	Given by the formula:
	8” x 10”	324.3	
	10” x 12”	494.8	$K_d = -0.374(P_2/P_1)^3 + 1.248(P_2/P_1)^2$
	12” x 16”	729.7	$-1.501(P_2/P_1) + 1.387$

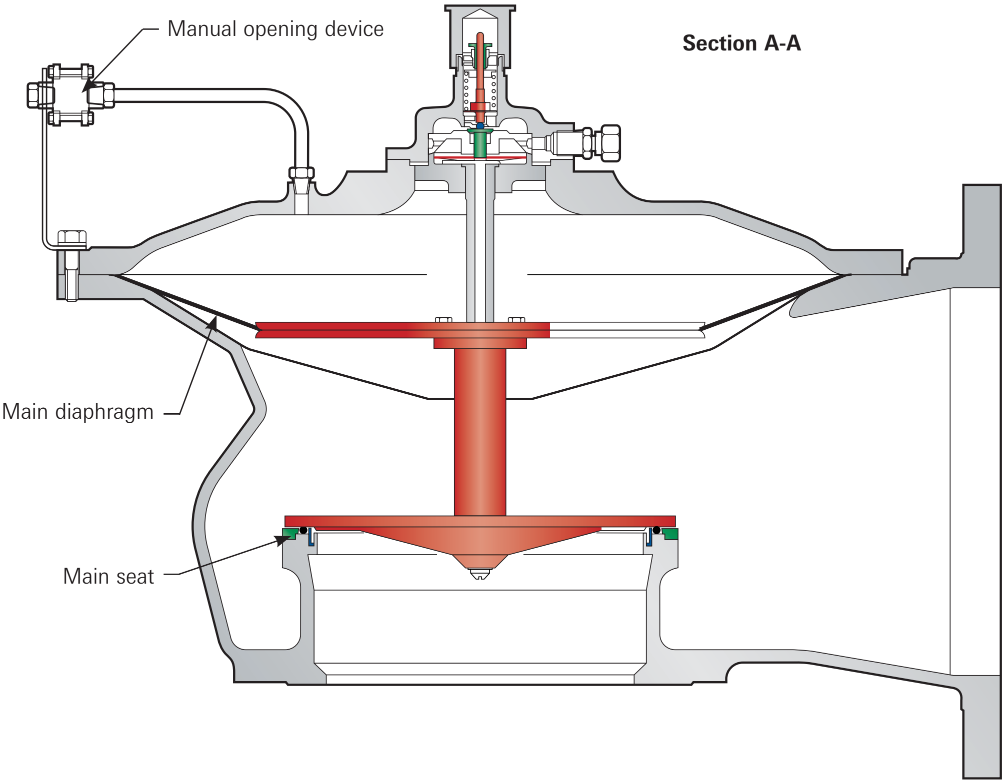
In short, when it comes to manufacturing specialist Pressure Safety Valves for low pressure and cryogenic applications, Luceat sets the standard for the industry around the World.
Total reliability, high accuracy and the capability to withstand the harsh conditions at sea are the keys to providing complete protection for the cargo containment systems of liquified gas carriers.
They are also the most important characteristics of our R1101 relief valve, designed specifically to protect the hold and interbarrier spaces from very low pressures, and our R2101 or EXPON relief valves which are used to protect the cargo tanks. These valves include a specially developed pilot, fully integrated with the main valve, whilst for some applications, the valve can even be configured without any external tubing - bringing even more safety and reliability at sea.
But nothing is taken for granted. We’re continually carrying out extensive testing, including full capacity tests and cryogenic functional tests, to insure that at any time and under any conditions your Luceat valve will never let you down.
As Luceat is now integrated into the Pentair Group of companies, after being part of the FMC Group for many decades, production and development of the valves are centralised in our UK safety valves factory.
What’s more, with an extensive network of repair centres and maintenance engineers, Luceat is able to provide you with the highest standards of support and assistance all over the World.

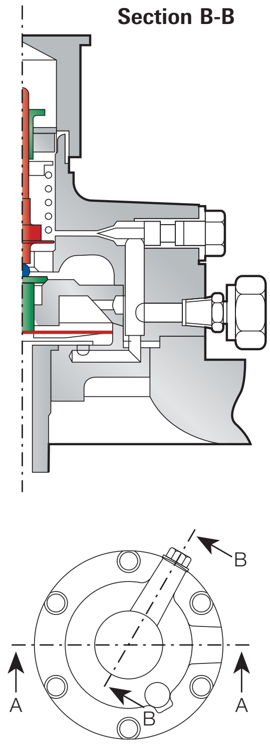
Typical valve configuration for protection of the interbarrier spaces of membrane type LNG Carriers

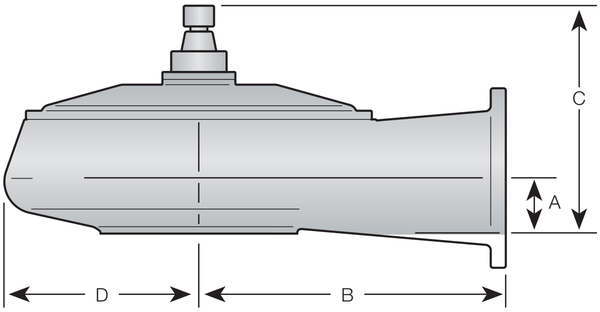


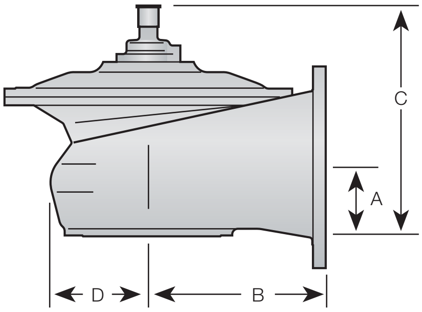


Typical valve configuration for protection of the cargo tanks of liquified gas carriers







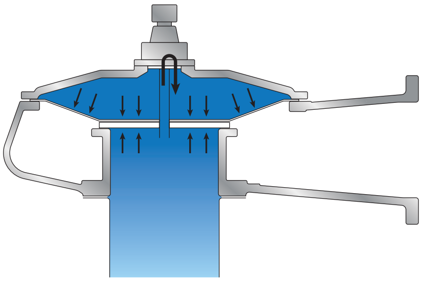


Type R1101 / R2101

Inlet	Outlet	A (mm)	B (mm)	C (mm) One set	C (mm) Double set	D (mm)	Weight Aluminium	Weight Stainless Steel
2″	2″	35	150	222	-	97	-	20
4″	4″	56.5	324	300	380	166	16	44
6″	6″	93.5	400	392	472	224	32	90
8″	8″	105	540	420	500	300	45	125
10″	10″	113	680	460	540	390	84	232
12″	16″	153	800	590	670	460	180	460

EXPON

Inlet	Outlet	A (mm)	B (mm)	C (mm) One set	C (mm) Double set	D (mm)	Weight Aluminium	Weight Stainless Steel
6″	10″	110	306	427	507	205	35	90
8″	10″	135	356	510	590	205	50	130
10″	12″	169	457	557	637	358	80	210
12″	16″	203	510	680	760	415	160	390

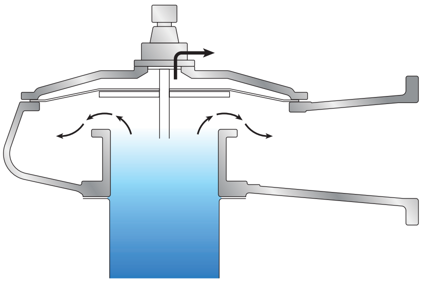


Valve closed

The Luceat valve is a Pilot Operated Safety Valve: the main valve is the flow element while the pilot is the pressure sensing element. The pilot will control the opening and closing of the main valve.

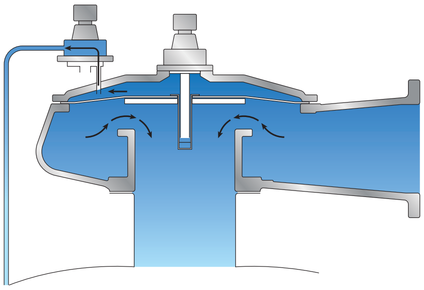
The pilot is sensing the tank pressure either internally by the guide passing through the main valve disc, or remotely by external tubing. When the pressure is lower than the set pressure, the pilot is closed and the tank pressure goes into the main pressure chamber.

Because the seat area is smaller than the pressure chamber area, the pressure creates on the disc assembly a downward force which is directly proportional to the pressure: the closer the pressure goes to the set point, the tighter the valve is.



Valve opens

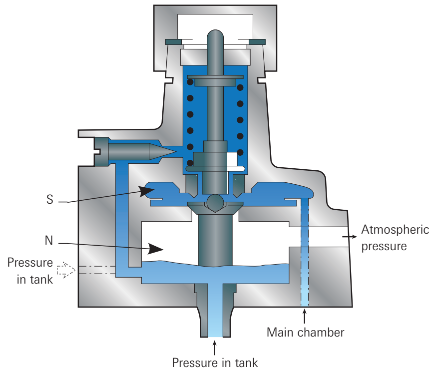
When the set point is reached, the pilot switches on and relieves the pressure from the main chamber to the atmosphere. The full tank pressure can then lift the disc assembly: the main valve is opened and flows. At reseat pressure, the pilot re-closes and re-loads the main pressure chamber to close the main valve.



On vacuum

As the pressure decreases in the tank, it also decreases in the main pressure chamber. When the vacuum is low enough, the atmospheric pressure will then lift the disc assembly and allow air to enter into the tank. The opening pressure is set by weights on the disc assembly. To improve the operation or to ensure perfect tightness, close to the vacuum set, a vacuum pilot can be fitted to the valve. In that configuration, the vacuum pilot usually keeps atmospheric pressure in the main pressure chamber. When the vacuum set is reached, the pilot switches on and allows the vacuum to enter the main pressure chamber to open the valve.

The pressure is coming beneath the pilot diaphragm either through the guide or by the external sensing pipe and into the spring chamber via the adjustable orifice.
The chamber S communicates with the main pressure chamber and as the pressure is low, the pilot seat is closed and the main pressure chamber isolated from the exhaust N.
When the pressure is high enough to lift the spindle against the spring force, the seat opens and discharges from the main pressure chamber to the atmosphere via the chambers S and N. The adjustment of the stroke of the spindle determines the reseat pressure, while the adjustable orifice acts on the responsiveness of the valve.



Accessories

Check-valve for blocked vacuum
When fitted, this device keeps the valve tight when the tank is under vacuum. Normally when the pressure in the protected tank becomes negative, the valve opens, as the vacuum is also present in the main pressure chamber and will allow air to come into the tank. If this is not desirable, this check-valve assembly will force the main valve to remain tight by allowing atmospheric pressure to enter into the pressure chamber. Depending on the pressure range, the check-valves are fitted with a diaphragm or a pallet.

Additional setting device
To temporarily increase the set pressure easily to a pre-determined pressure, this cartridge unit, set and sealed in our factory, is screwed on the top of the pilot. No further adjustment is necessary, all settings remain sealed.

Isolation unit
This consists of a needle valve maintained opened by a spring. When necessary, by simply maintaining it pushed down, the main pressure chamber will be isolated from the pilot to ensure the valve remains closed during operations like the fitting of an additional setting device.

Opening device
Directly connected on the main pressure chamber, this device allows the operator to open the main valve by using a pressurised bottle of Nitrogen, independently from the pressure in the tank.

Field test kit
This consists of an extra 3/8-inch NPT connection on the pilot along with the necessary fittings, pipes and a pressurised bottle of Nitrogen. It allows to check the set point with high accuracy while the valve remains in service.

Pilot exhaust
As standard the pilot exhaust is done through a little piece of 3/4-inch elbow directed downwards. For marine applications however, it is usually preferred to connect the exhaust to the mast or any recovery system. In that case the back pressure into the pilot exhaust must not be higher than 3-4%. For large valves, we can also provide a device allowing connection of pilot exhaust to the main valve outlet, even with back pressure up to 20% of the set point.

External pressure sense
When the pressure losses upstream the main valve can exceed 5% of the set pressure, it is recommended to use an external pressure sense. In this case the loss in the external pressure sensing pipe must not exceed 2.5% of the set pressure.

Note

It is possible to connect the check valve to a source of pressure (Nitrogen bottle, etc) to force the valve to stay closed.