A new concept in the storage of liquefied chemical and petrochemical gases
• Zero leakage
• Zero fugitive emissions

Introduction

Industries involved in the handling of dangerous fluids have to answer increasing demands for security and reliability. , The problem concerning large capacity, liquefied-gas storage tanks is thus raised.

1. Liquefied gas constructions: physico-chemical features

1.1 Thermodynamical principles

Number 1:
The large majority of liquefied gases have a vapour pressure superior to atmospheric pressure at room temperature.
Number 2:
A liquefied gas, which has a vapour pressure superior to that of the atmosphere, evaporates instantly when it makes contact with atmospheric pressure. It increases significantly in volume.
Number 3:
Vaporisation due to a pressure drop creates a significant temperature drop.

1. 2 Chemical reactions

Some chemical liquefied gases react with atmospheric humidity to produce corrosive compounds. Materials used in the construction of installations resist corrosion when dry, but may be corroded when in contact with water.
Any laxity in the airtight sealing of a pressurised gas tank provokes
- a leak to the atmosphere
- evaporation of the liquid
- a significant temperature drop
- in some cases, creation of corrosive compounds caused by a reaction with atmospheric pressure

Other specific cases may be encountered such as:
- spontaneous combustion on contact with the air.

2. Particular conditions for storage tanks

2. 1 What is the problem?

Considering the large quantities involved, special attention should be brought to the security of the liquefied gas storage tanks.
E.g.: The storage of 100m^3 of liquid chlorine represents a potential risk of a gaseous chlorine cloud formation of 47.180m^3.

2.2 Tank security

The integrity of the storage tank is insured by strict calculation codes that determine materials to be used, thickness, operational guides and welding procedures, etc.
Safety valves usually protect the storage tank from any pressure increase superior to the rating pressure.
According to regulations, some storage tanks are installed in locked, airtight rooms equipped with a neutralising tower system.
The above mentioned guarantee:
- either the tank integrity
- or the confinement of potential leakage.

However, all tanks possess piping connections with the rest of the installation. These interfaces constitute a particular risk, depending on their number, their dimensions, their position and the isolation devices with which they are equipped.

The real weak point of a storage tank is the “interfaces”, which constitute the connections with the rest of the installation.

3. Particular risks of connection-pieces on storage tank

3.1 Different types of tank openings:

There are three types of connections (see Fig. 1)

a. liquid phase connection: The opening is situated below liquid-level (types A1 and A2). The regulations generally forbid this assembly but it is still often used on existing tanks.
   In case of leakage, the total volume of the liquid may leak out of the tank.
b. gaseous phase connection: The opening is situated in the “gaseous sky” of the tank (type B)
   When leakage occur, only gas leakage are induced.
c. gaseous phase connection with deep-pipe into liquid: These openings are used for filling/emptying in the liquid phase (type C)

Even though situated in the “gaseous sky”, these openings induce leakage of the liquid phase.
Note: The openings (type B and C) are generally regrouped on a bolted manhole manway cover.
The following accessories are also found on this plate: safety valve, pressure tapping, level measure, etc.

⚠ **The openings connected directly to the liquid phase of the tank, present a maximal risk in the case of leakage.**

3. 2 Assembly of different types of accessories for fittings: Risks analysis.

Each connection on the tank is fitted with an isolating device (valve). There are different assembly types.

a. assembly on a connecting part - Assembly type 1
   A bolted flange couples the valve with a gasket to an external connection piece, welded on the shell.
b. direct assembly on the plate: Assembly type 2
   The valve is linked by a bolted flange, with a gasket, to an external connection on the upper side of the manway cover.
c. assembly on the bottom of tank with double sealing: Assembly type 3
   Some valves assembled on the bottom of the tank are equipped with an internal double tightness mechanism controlled by an external valve situated at the top of the tank.

Potential risks analysis (see fig. 2)

Assembly type	Potential leakage source	Consequences	
		Liquid phase	**Gaseous phase**
Type 1	1. Connection piece 2. Welding on the top of plate 3. Flange gasket 4. Isolation valve	Liquid leakage	Gas leakage
Type 2	1. Flange gasket 2. Isolation valve	Liquid leakage	Gas leakage
Type 3	1. External valve with flange gasket 2. Internal valve with flange gasket 3. External isolation valve 4. Internal isolation valve	Limited liquid leakage	Gas leakage

These devices present major leakage risks, particularly in the liquid phase. This risk is even greater when a leak occurs, as the access to the isolation device becomes difficult, if not, impossible.

Figure 1

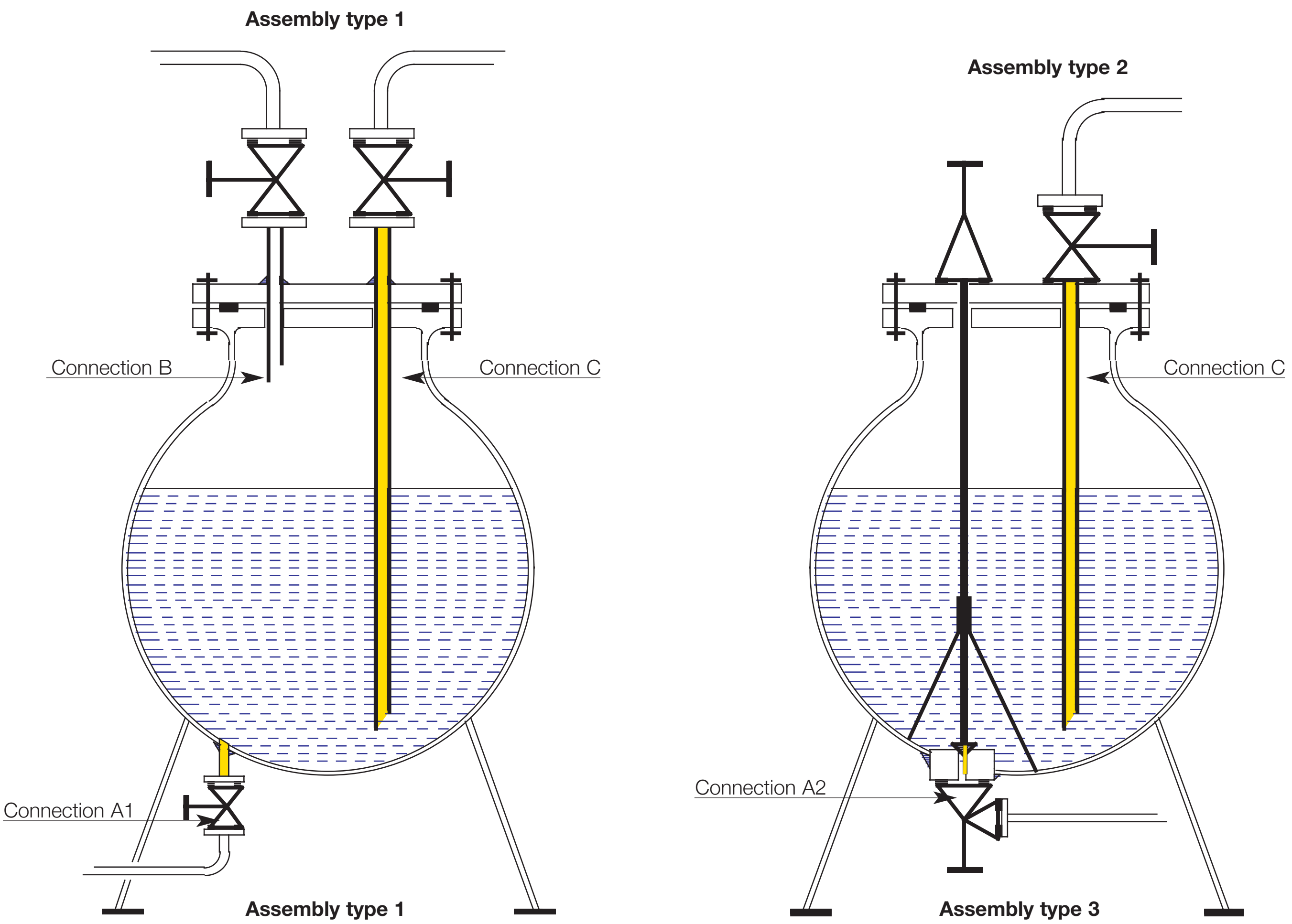
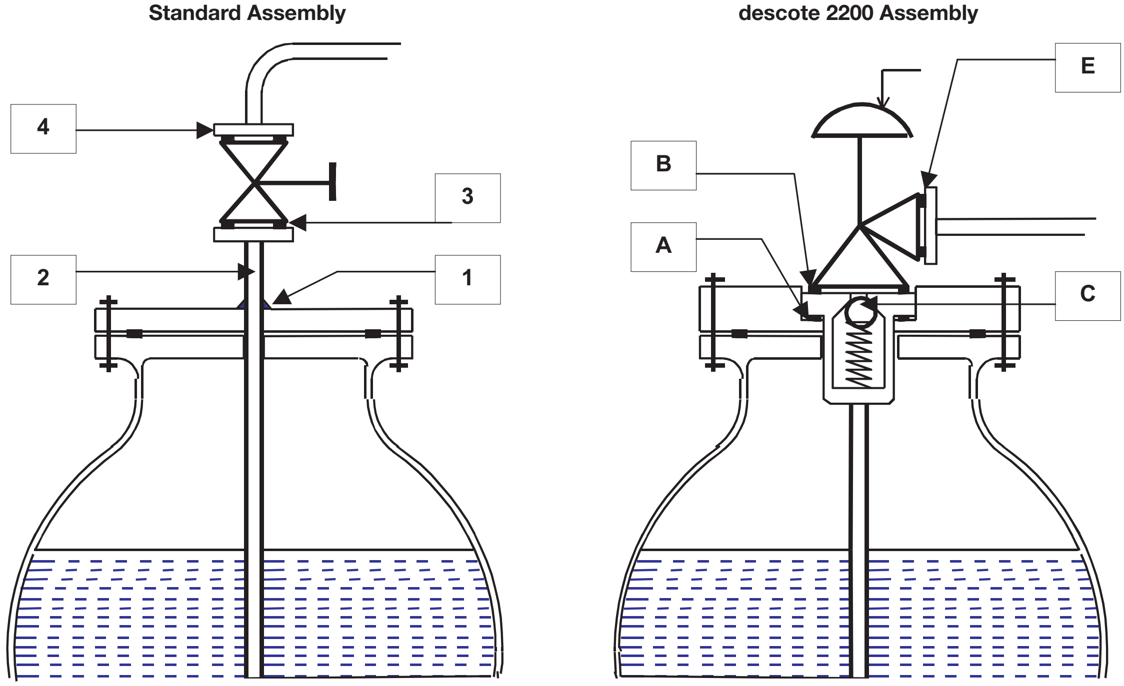


Figure 2



Valve risk analysis - valve closed

	Standard assembly	descote model 2200
Major liquid risk	-	-
Minor liquid risk	2 - 3	-
Gas risk	1	A - B

Valve risk analysis - valve opened

	Standard assembly	descote model 2200
Major liquid risk	2 - 3 - 4	-
Minor liquid risk	-	B - E
Gas risk	1	A

4. Design criteria applicable to a safety device

Considering the afore-mentioned analysis, the following principles must be considered:
1. the sealing device, particularly in the liquid phase must have a double tightness system.
   - a primary external tightness system
   - a secondary internal tightness device
2. the internal tightness device must be actuated and located INSIDE the tank, which thus becomes an integral sealed unit.
3. the external tightness device MUST be remote-controlled.
4. the entire equipment must be assembled in the "gaseous sky"of the tank.

5. The solution proposed by descote

descote, in close contact with its customers in the chemical industry, has developed simple equipment, in response to the above-defined criteria:
descote valves Model 2200 & 2300

5.1 Description (see Fig. no. 3)

The equipment includes:
a. an internal safety valve (rep A) incorporated into the tank (generally at plate level), made up of a metallic ball, operated by a spring, coming to bear on a seat/receiver. The stem of the main valve insures the opening.
b. an isolation valve (rep B), globe-type, angle-shaped, with bellows and safety packing.
c. a remote control, by means of an air-operated actuator, with closure by springs.
d. a manual safety override (rep D) - optional.
e. accessories such as position indicator, bellows leakage detector, solenoid valves, micro-switches, etc.

5. 2 Description of functions

5.2.1 Closed position

The springs maintain valve C1 in a closed position (high position), as the actuator is not supplied with compressed air. The ball (C2) of the internal valve is equally tightened on its seat by the effect of spring R1. Tightness towards the exterior is insured by main valve C1 and the internal ball valve.

5.2.2 Opened Position

The actuator, fed by compressed air, opens valve C1. The valve stem tightens on the ball C2, and internal valve opens.

5.3 Safety function

In the safety position, the entire internal valve is in a closed position. Effective safety is operational in the following cases:
- lack of air - control of the actuator
- lack of electric energy - by using a solenoid valve or an air dispenser with automatic draining activation
- emergency control – activation may be local (hand touch) or remote (control- room)
- detection of an in-line pressure drop – i.e. by using a pressure switch.
- detection of all other physical measures associated with leakage (level, discharge, temperature, flow rate, etc)

5.4 Safety criteria linked to the design of the device

Besides the basic safety functions mentioned above, descote valves model 2200 and 2300 are designed and manufactured to insure optimal safety in operation.
- robust manufacturing, able of withstand any potential shocks, as well as pipework stress and external corrosion.
- compact manufacturing, with a voluntary rupture area of the external valve body level.
- manufacturing price-list based on EuroChlor's requirements for liquid chlorine.
- raw materials selected according to the handled media
- use of a metallic bellows, doubled with safety packing, for tightness along the stem.
- fire safe and anti-ejection internal ball valve. The diameter of the ball is superior to that of the metallic seat.
- "chemical series" actuator is of a particularly robust manufacturing, with tightness VITON O-rings, that withstand corrosive atmosphere.
- easy maintenance.
- design & manufacturing ISO 9001 Quality approved.
- tightness of the internal valve can be checked by opening the main valve 2 to 3 mm (manual control)

⚠ **descote valves guarantee the safety and reliability of your liquefied gas storage tanks**

6. descote manufacturing range

Since 1988, descote has equipped numerous storage tanks, the majority of them for liquid chlorine applications.
Our standard production range includes (Fig. 4):

- Valve DN 25 to DN 200
- Pressure class: ISO PN 16 - 25 - 40 - 50 - 100 / ANSI class 150 - 300 - 600 lbs.
- **Valve model 2200**: with bellows located out of the main- flow, for assembly on the top of the tank.
- **Valve model 2300**: with bellows located in the main- flow, without retention, for assembly at the bottom of the tank.
- Materials: the basic materials are selected according to the fluid handled - carbon steel, low temperature carbon steel, stainless steel, duplex alloys, alloy 20, Monel 400/k500, nickel alloys (INCONEL, INCOLOY, HASTELLOY) and generally all metallic materials.
- Products other than standard range: This device may be adapted to fit existing installations.

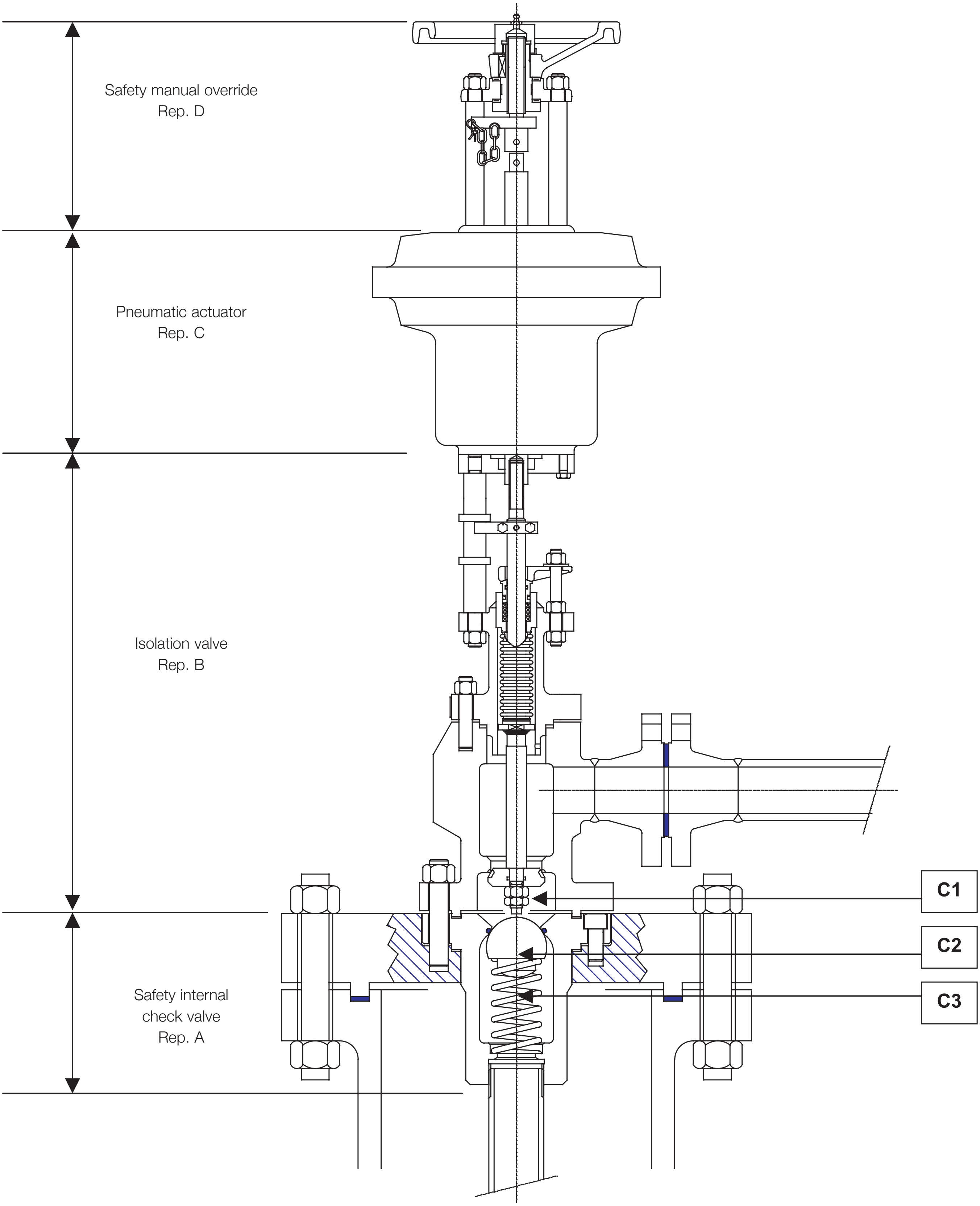
7. Potential utilisation

This device is available for use on all pressurised liquefied gas storage tanks with one or more of the following characteristics: corrosive, noxious, unstable, dangerous, explosive, inflammable, reactive to atmospheric humidity, and generally, any product for which leakage to the atmosphere can not be tolerated.
Special reference to: Chlorine (Cl_2), A HCl and A HF, NH_3, H_2S, SO_3, CVM, F, $COCl_2$ (carbonylchloride), HCN, ethylene oxide, etc.

8. Conclusion

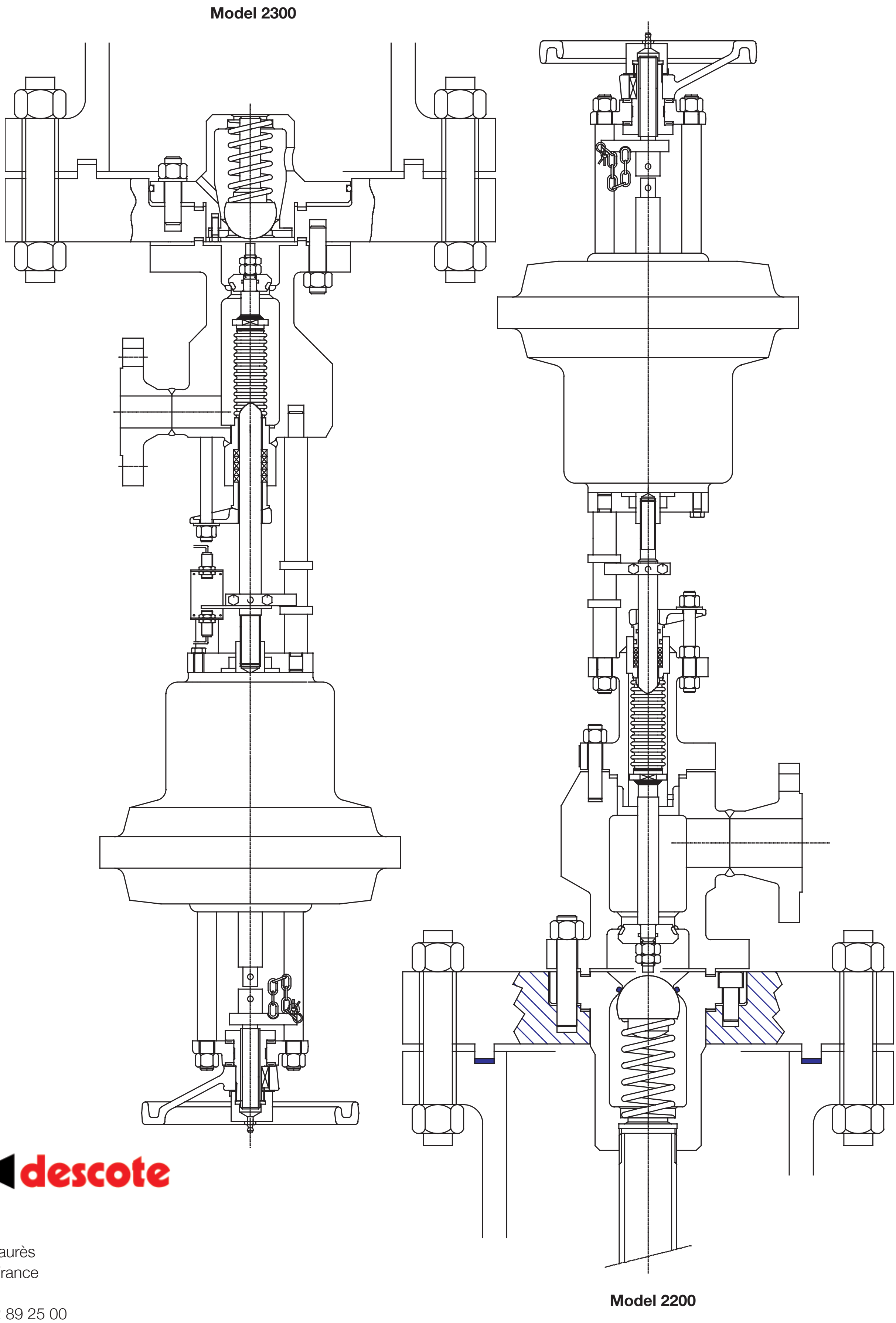
Particular attention must be brought to the safety of liquefied gas storage. Available solutions have been tested and proven.

Figure 3



Safety manual override
Rep. D
Pneumatic actuator
Rep. C
Isolation valve
Rep. B
Safety internal
check valve
Rep. A
C1
C2
C3

Figure 4



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