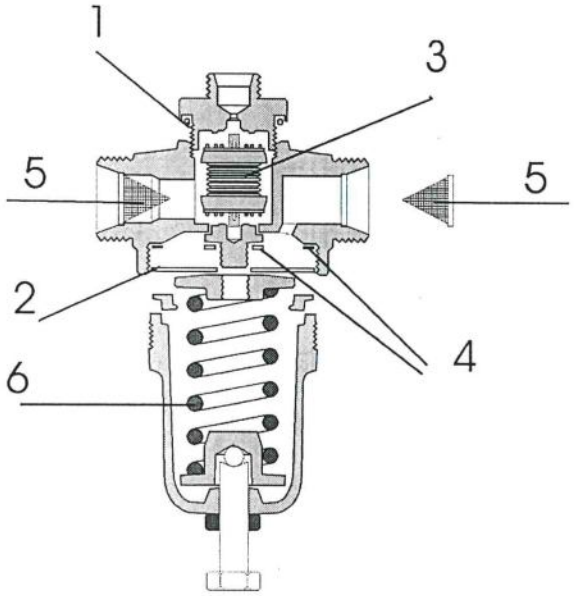
Арматура трубопроводная криогенная регулирующая / редукционная

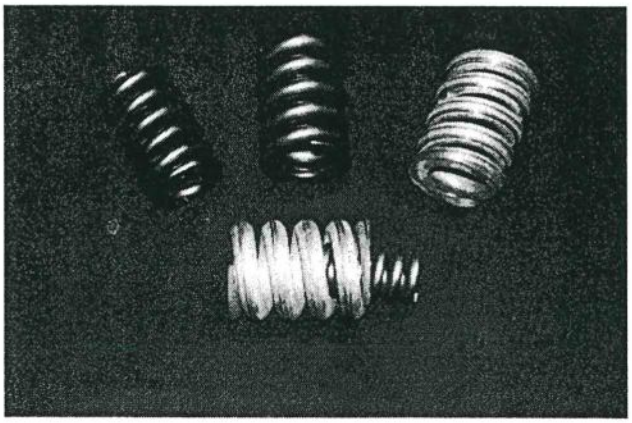
Регулятор постоянного давления / PER-регулятор

Основные технические характеристики:

- Тип **R14**
- Модель **600018562**
- Заводской / серийный номер **30157**
- Дата производства / изготовления / выпуска, [год] **2013**
- Условный проход / номинальный диаметр на входе, [мм] **DN20**
- Условный проход / номинальный диаметр на выходе, [мм] **DN20**
- Номинальное давление / максимальное рабочее давление, [bar] **PN40**
- Производитель / фирма **«AGA CRYO AB» (Швеция)**
- Диапазон регулировки избыточного давления, [bar] **5,0 – 13,0**
- Шаг регулировки избыточного давления, [bar] **+/- 0,5**
- Давление настройки по умолчанию, [bar] **10,0**

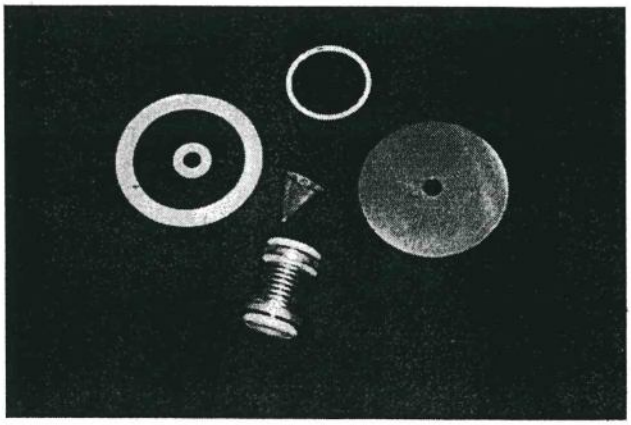
SPARE PARTS FOR PER REGULATOR





Part No	Description	Pos
(6000)50890R	Spring 2-6 bar	(6)
(6000)50876R	Spring 5-13 bar	(6)
(6000)58206R	Spring 10-20 bar	(6)
600013364R	Spring 15-30 bar	(6)

Part No	Description	Pos
600012707R	***Set of spares consisting of:***	
	Sealings 2 pcs	(1)
	Membranes 3 pcs	(2)
	Bellows 1 pce	(3)
	Set of sealings 2 pcs	(4)
	Strainer 2 pcs	(5)



8.4 SERVICING AND REPLACING PER REGULATOR R14 AND CHECK VALVE B16

The PER regulator can be serviced or replaced without depressurizing the tank or taking it out of operation. However, there is no pressure regulation while the work is being carried out.

Check valve B16 and isolation valves V3 and V4 prevent gas flowing out of the tank and allow some repair work to be carried out with the tank in operation. However, B16 can only be replaced with the atmospheric gas tank depressurized or CO_2 tank completely drained.

Instructions common to all types of work:

1 Close liquid phase valve V3.

2 Wait 5 minutes.

3 Close gas phase valve V4.

4 Carefully disconnect the three pipe connections by the PER regulator to completely depressurize it.

5 **NOTE!** Do not disconnect check valve B16 located directly above the regulator.

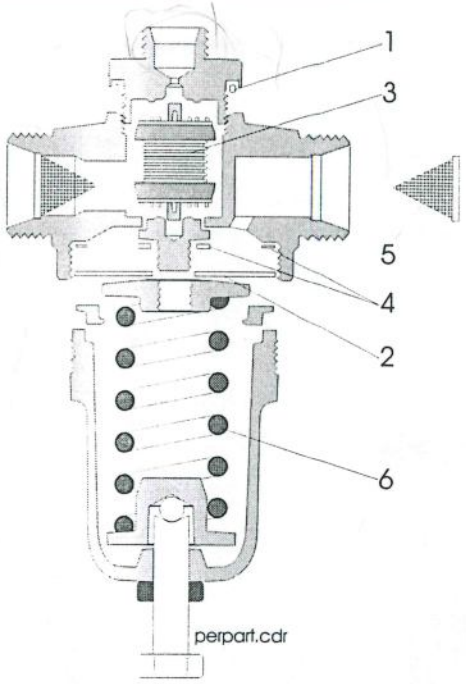


Figure 8.4 PER regulator

8.4.1 PER REGULATOR COMPONENTS

The PER regulator can be ordered as a unit from our spare parts department. Its main components can also be ordered according to the following tables.

Complete PER regulator	
Type	**Part no.**
PER 2-6 bar	**600018564**
PER 5-13 bar	**600018563**
PER 10-20 bar	**600018562**
PER 15-33 bar	**600018561**

Table 8.4.1.1 PER regulator, complete

PER regulator spare parts kit Part no. 600012707			
Pos.	**Part no.**	**Designation**	**Quantity**
1	600050888	Seal	1
2	600050881	Membrane	3
3	600050849	Bellows	1
4	600050880	Gasket kit	1
5	600050878	Strainer	2

Table 8.4.1.2 PER regulator spare parts

PER regulator springs			
Pos.	**Part no.**	**Designation**	**Quantity**
6	**600050890**	Spring 2-6 bar	1
	600050876	Spring 5-13 bar	1
	600058206	Spring 10-20 bar	1
	600013364	Spring kit 15-33 bar	1+1

Table 8.4.1.3 PER regulator springs

3.4 PER REGULATOR

Under normal operating conditions the PER regulator has a pressure build-up capacity (that will compensate for a gas withdrawal from the tank) of 600-700 Nm^3/h. For higher withdrawal rates the PER regulator can be installed on the liquid side of the pressure build-up coil, or a dual-regulator system, described later in this Chapter, can be installed on the tank.

See Chapter 5 for capacity calculations.

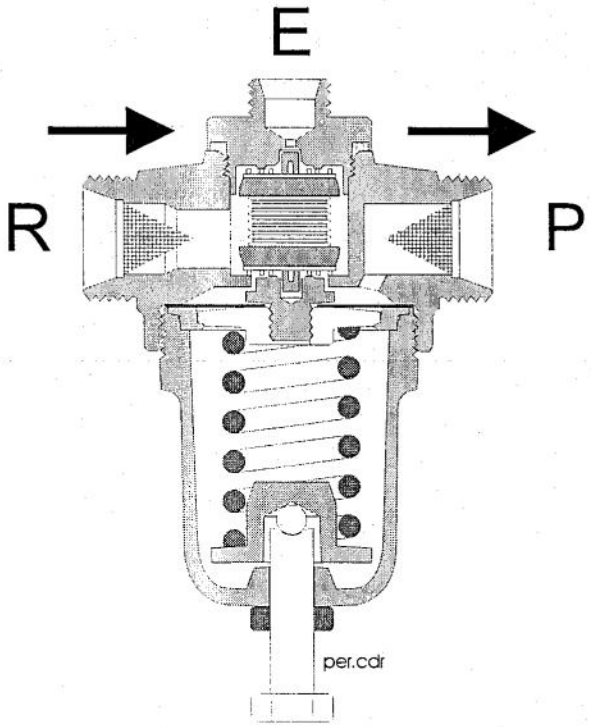


Figure 3.4.1 PER regulator

The R14 PER regulator has three functions:

P-function (Pressure build-up)

E-function (Economizer)

R-function (Relief).

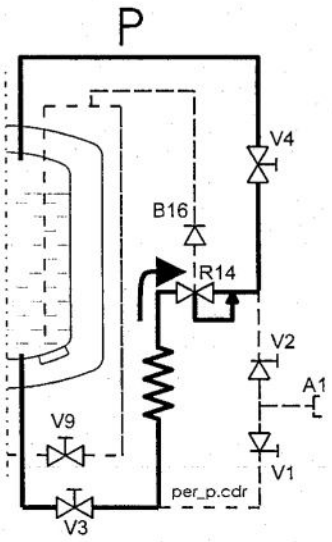


Figure 3.4.2 Pressure build-up function

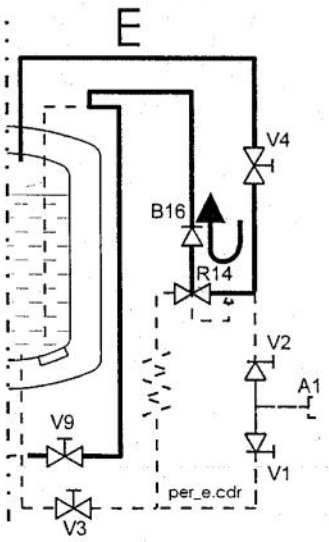


Figure 3.4.3 Economizer function.

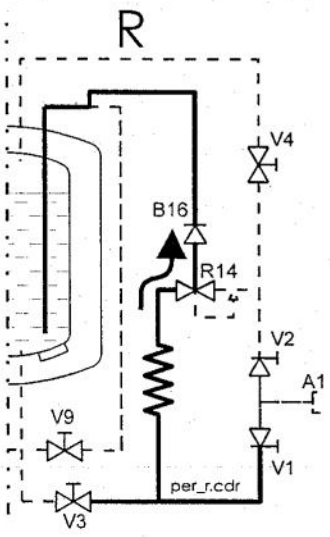


Figure 3.4.4 Relief function..

P-FUNCTION

At tank pressures lower than the regulator set pressure the P function is open and liquid flows through V3, is vaporized in the PRC pressure build-up coil and flows as gas through R14 and V4 to the top of the tank. The gas flowing to the top of the tank means that pressure is maintained at a constant level while product is being withdrawn from the tank.

E-FUNCTION

At tank pressures greater than the set pressure the P function is closed and the E function open. *When product is being withdrawn* through V9 the gas from the gas phase flows through V4, R13 and B16 to the user. Tank pressure will drop rapidly to set operating pressure. Gas in gas form at normal operating pressure has approximately a 100 times greater volume than the same amount of gas in liquid form.

R-FUNCTION

If the condensed gas is trapped between V3, V1 and R14 and the pressure upstream of the regulator rises to more that approximately 5 bar above tank pressure, the R function opens, relieving the pressure through R14 and B16 back to the tank.

3.5 REGULATOR SYSTEM WITH TWO REGULATORS

For large withdrawal capacities the PER regulator can be replaced with a dual regulator system consisting of a high capacity pressure build-up regulator R3 and an economizer regulator R2.

Pressure regulator R3 provides the pressure build-up "P" function and the economizer regulator R2 provides the "E" function. The set pressure for R2 is approximately 1 bar above the set pressure for R3. This system provides the same functionality as for the PER regulator but its capacity is greater. See Chapter 5 for capacity calculations.

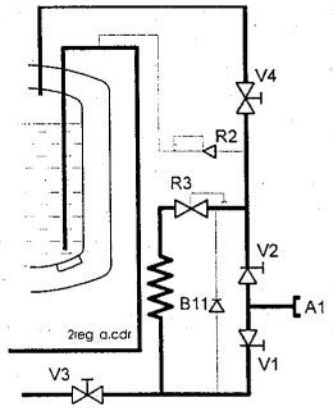


Figure 3.5 Regulator system with two regulators

3.6 PER-REGULATOR INSTALLED ON THE LIQUID SIDE

As an alternative to a dual regulator system for large withdrawal capacities, a PER regulator can be installed on the liquid side upstream of the pressure build-up coil. This increases regulator capacity by five times or more compared with its normal location downstream of the pressure build-up coil.

3.7 PERP REGULATOR

The PERP regulator was previously used instead of the PER regulator for large withdrawal capacities, but has now been withdrawn from our range. It is usually superseded by the dual regulator system described in Chapter 3.5.

3.8 SEPARATE PRV PRESSURE BUILD-UP VAPORIZER

The pressure build-up coil PRC may not have enough capacity (vaporizing enough gas to maintain tank pressure) for large product withdrawal from atmospheric gas tanks. The first measure to take is to install a PRC 2S double pressure build-up coil. If this is not sufficient, a separate pressure build-up vaporizer PRV should be connected. See Chapter 5 for capacity calculations and Chapters 4.8 and 6.4.9.

3.9 RECOMMENDATIONS FOR DIFFERENT APPLICATIONS

The following should only be viewed as suggestions about suitable equipment for different applications. Your own experience of similar installations are just as important when selecting suitable equipment for the installation.

The following applies primarily to atmospheric gas applications while sections also apply to CO_2 installations.

3.9.1 CONSUMPTION IN GAS FORM AT NORMAL OPERATING PRESSURE

For normal installations where the gas customer needs gas to be supplied at an operating pressure of up to a maximum 12-13 bar with no large withdrawals expected, a standard VCSP tank with a suitable vaporizer or vaporizer group is recommended. See Chapter 5 for capacity calculations for tanks and vaporizers. Suitable piping kits for connecting the modules are available from AGA-CRYO. See also Chapter 6 and the AGA-CRYO spare parts catalogue for further information.

For large withdrawal capacities the tank regulator and/or pressure build-up coil must always be modified. The regulator can either be a PER regulator installed on the liquid side of the pressure build-up coil or a dual regulator system installed on the tank. Both alternatives provide greatly increased regulator capacity.

3.9.2 CONSUMPTION IN GAS FORM AT HIGH OPERATING PRESSURE

Special tanks have been developed for applications with a higher operating pressure than normal (for laser cutting applications for example). There are vaporizers and pressure build-up coils available for pressures up to 40 bar. However, at high tank pressures the capacity (expressed as the amount of liquid gas withdrawn from the tank) of the pressure build-up function drops dramatically, as the requirement for pressure compensation increases with tank pressure. This means that special attention needs to be paid to pressure build-up coil capacity in high pressure installations.

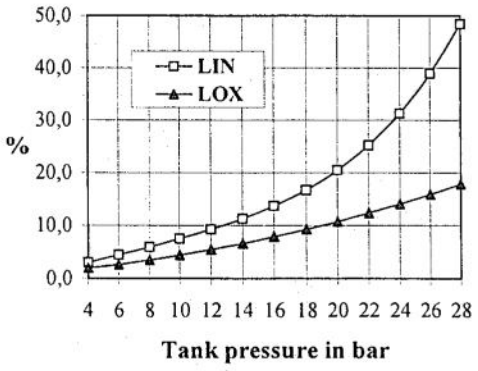


Fig. 3.9.2 Requirement for pressure compensating gas

The graph shows the requirement for pressure compensating gas expressed as a % of the amount of gas withdrawn from the tank. It shows clearly that at high pressures LIN especially needs greater amounts of gas through the pressure build-up coil.

In addition, liquid level gauging is not reliable at high pressure. Normal liquid level gauging is based on the pressure differential between the top and the bottom of the tank - this gives the "weight" of the liquid column. This presumes that the weight of the gas column in relation to the liquid column is negligible. At very high pressures (close to critical pressure) this assumption is no longer necessarily true. The weight of the gas column affects the reading and means that the liquid level gauge reading is lower. This means that the liquid level gauge reading is too low with increased pressure in the tank and increased temperature of the liquid.

3.9.3 LIQUID CONSUMPTION

In installations where liquid product is to be used (supplying nitrogen to a freezer tunnel for example) the pressure in the tank should usually be as low as possible. Withdrawal from the tank can be done in three ways:

3.9.3.1 WITHDRAWAL VIA V9

Normally liquid withdrawal can be made through the normal connection at valve V9. The advantage is that there are no pressure waves in the connected installation when the tank is being filled. A small disadvantage is that at the beginning of each withdrawal, a somewhat larger amount of gas comes out in gas form before there is an even liquid flow in the customer's line. However, this disadvantage is quite negligible.

To adapt the pressure maintenance function for this type of withdrawal it is recommended that the PER regulator be equipped with a 2-6 bar spring and that the regulator housing be turned the "wrong way around" (reversed) - so that the arrow points towards V3. This means that the regulator measures and regulates the pressure at the bottom of the tank instead of in the gas phase. The result is a constant pressure at the bottom of the tank and therefore in the withdrawal pipe, no matter how full the tank is. However, the manometer reading will be lower when the tank is full - bottom pressure minus liquid column pressure when the manometer normally measures the gas phase pressure. In a type 275- or 526-VC tank the liquid column pressure will be approximately 1 bar for nitrogen with the tank full. If the regulator is not reversed, the pressure at the bottom of the tank, and therefore the pressure in the withdrawal pipe, will be approximately 1 bar higher when the tank is full than when the tank only contains a residual amount of liquid. In certain cases this pressure difference in the withdrawal pipe between a full and empty tank can cause problems in equipment connected to the system. For example, when the pressure drops as the contents of a tank decrease a freezer tunnel may not receive sufficient liquid product simply because the supply pressure is too low.

If the PER regulator is reversed the tank economizer pipe must be plugged and the regulator's economizer connector must be equipped with a safety valve or a thermal relief valve. This protects the piping between V1,V2 and V4. Further we recommend that a gas withdrawal valve V26 and a pressure limiter regulator R11 is mounted on the line to the safety valves, see also chapter 4.3.3. This is to prevent the pressure to increase to high during periods with very little or no withdrawal. Overpressure is by this released into the atmosphere in a controlled way unless the gas can be used elsewhere in the installation.

Complete relief unit sets are available from AGA-CRYO.

To summarize the recommendations for a tank for use with a freezer application:

1. Install a V26 gas phase withdrawal valve.
2. Install a pressure limiter valve R11, set to 0.5-1 bar above the PER regulator set pressure.
3. Install a 2-6 bar spring in the PER regulator.
4. Reverse the PER regulator, with the arrows towards V3.
5. Remove the economizer pipe between the PER regulator and the tank's lead-in plate. Plug the economizer connector on the tank. This must be done while the tank is empty.
6. Install a safety valve or thermal relief valve on the PER regulator economizer connector.

3.9.3.2 WITHDRAWAL VIA AN EXTRA LIQUID WITHDRAWAL VALVE V27

The customer line is connected to an extra liquid withdrawal valve on the bottom pipe between V1 and V3. The advantage is that a standard cold converter can be used. The disadvantage is that when the tank is being filled the pressure waves from the filler pump may have a negative effect on the installation connected to the tank (a freezer tunnel for example).

In this type of installation the PER regulator economizer function does not work. To limit tank pressure during periods when little or no product is being withdrawn, the tank can be equipped with a pressure limiter valve R11 installed downstream of a gas phase valve V26. Pressure in the tank is released into the atmosphere in a controlled way unless it can be used elsewhere in the installation. A PER regulator with a 2-6 bar spring can be used as a pressure build-up regulator. We also recommend the measures described above in Chapter 3.9.3.1 (such as the reversed PER regulator).

3.9.3.3 WITHDRAWAL VIA V82

Connect the customer line to a separate liquid withdrawal valve V82. This connection cannot be made on tanks that have already been constructed and must be ordered before construction starts.

Otherwise we recommend the pressure maintenance measures described in 3.9.3.1 above.

The circumstances and requirements of the installation and your own experience will determine which of the above installation methods is suitable for each individual case.