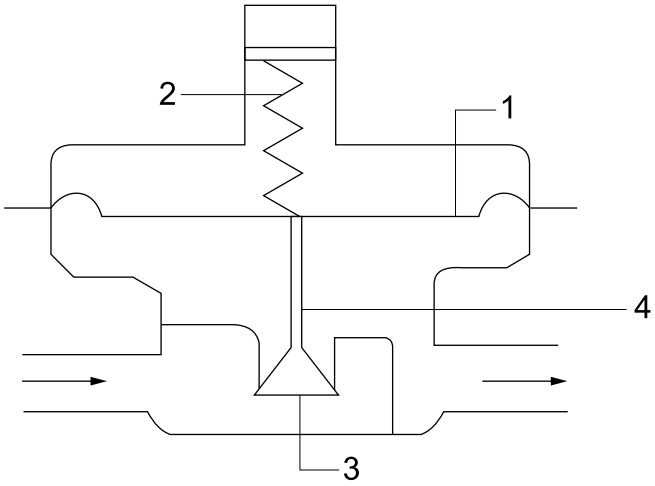
N° Rev.	Data	Descrizione modifica	Emissione	Verifica	Verifica	Approvaz.
0	14/02/05	First emission	SIS	SIS		

SUMMARY

1 NG2 PRESSURE REGULATOR DESCRIPTION

1.1 GENERAL INFORMATION

The pressure regulator is an essential part of a gaseous fuels injection system.
The regulator must guarantee the supply of gas in the amount and to the pressure demanded in all operational conditions, and function:
- To compensate the gradual changes of the inlet pressure.
- To withstand gradual or sudden changes of flow without altering the outlet pressure.
- To stop the supply of gas in the manner of a shutoff valve when the system does not demand any fuel supply.
The sensitivity and the precision of a pressure regulator are fundamental for the proper operation of a fuel supply system.
The pressure regulator, in its basic form, is described below:



1. Diaphragm or piston. This element divides the pressure regulator chamber in two parts.
The gas enters the lower part (stage). The upper part of the chamber is connected to either atmospheric or MAP reference pressure.
2. Loading element (spring). This is located in the upper chamber, and it maintains the regulated pressure. The spring - whose characteristics are determined by its diameter and by the stage pressure - acts on the diaphragm/piston, opposing the stage pressure.
3. Closing element (valve). This element provides to the adjustment of the gas flow in the stage.
4. Connecting device between diaphragm and closing element

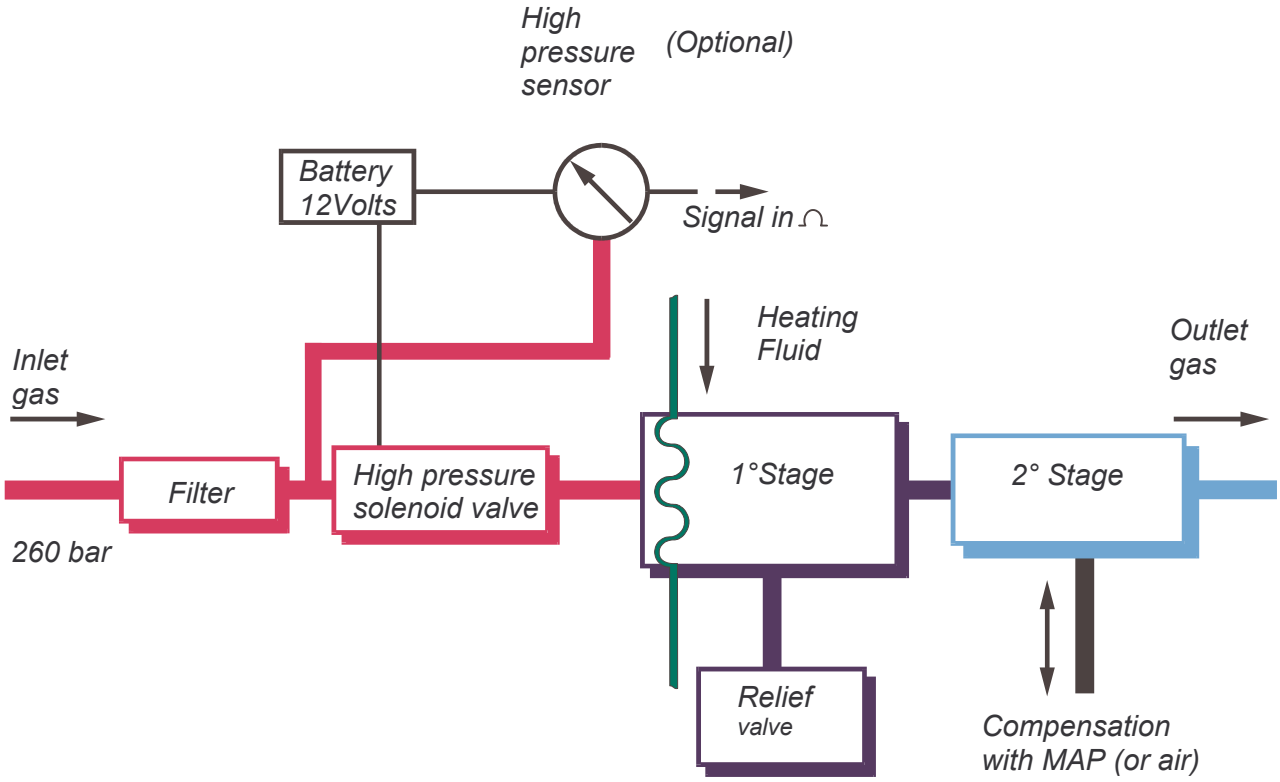
1.2 GENERAL CHARACTERISTICS

The N.G.2 pressure regulator for natural gas is designed to meet increasingly strict regulations (ISO 15500) in order to satisfy the requirements of gaseous fuel injection systems for automotive use.
It safely reduces the pressure of compressed natural gas in the cylinders to the pressure required by the injection system.
The pressure regulator is able to supply the amount of gas required under all engine operating conditions.
The sensitivity of the diaphragm allows a precise regulation of the outlet pressure.
All of the pressure regulator's components, particularly the seals and diaphragms, are designed to utilise natural gas with different compositions to achieve a greater durability and safety of operation.

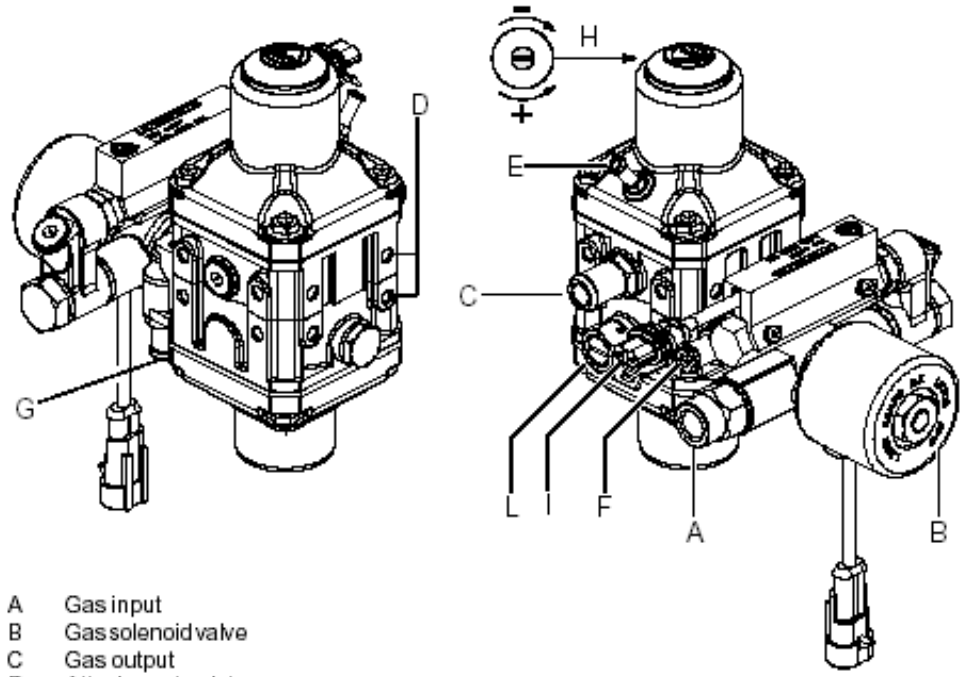
1.3 MAIN CHARACTERISTICS

a) *NG2 are two-stage pressure regulator in aluminum;*
b) *Both stages have a valve and diaphragm.*
c) *NG2 has a heating circuit where the engine coolant mean flows.*
d) *NG2 has a Sintered filter in the gas inlet group.*
e) *NG2 has a shut-off solenoid valve at the gas inlet.*
f) *NG2 has a pressure relief valve on first stage.*
g) *internal coolant circulation to prevent moisture and icing;*
h) *the second stage compensated with MAP or in air.*

1.4 FUNCTIONALITY SCHEME OF THE PRESSURE REGULATOR

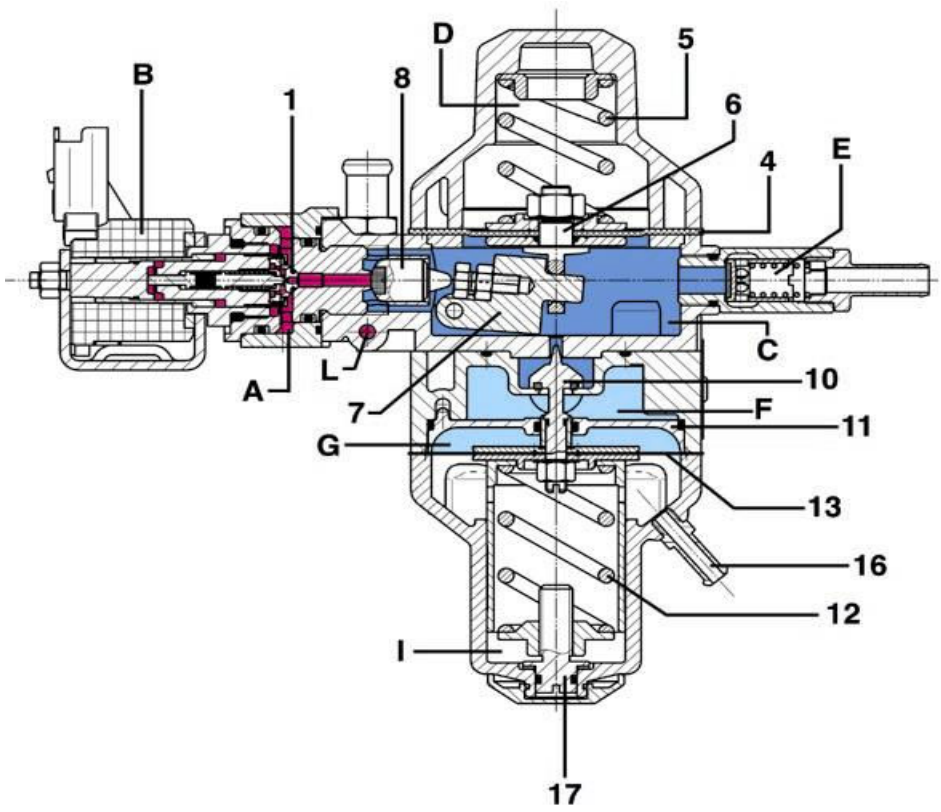


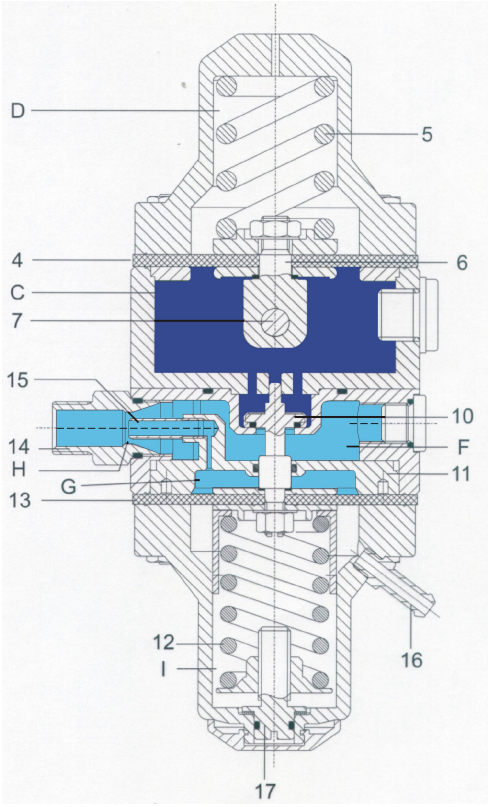
1.5 EXTERNAL LAYOUT OF THE REGULATOR



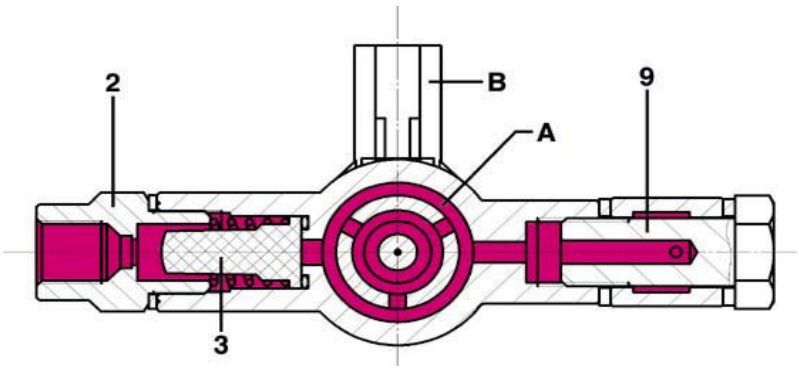
A	Gas input
B	Gas solenoid valve
C	Gas output
D	Attachment points
E	MAP compensation intake
F	Water output
G	Water input
H	2nd stage pressure regulation
I	Gas input pressure sensor
L	Safety valve

1.6 NG2 OPERATION





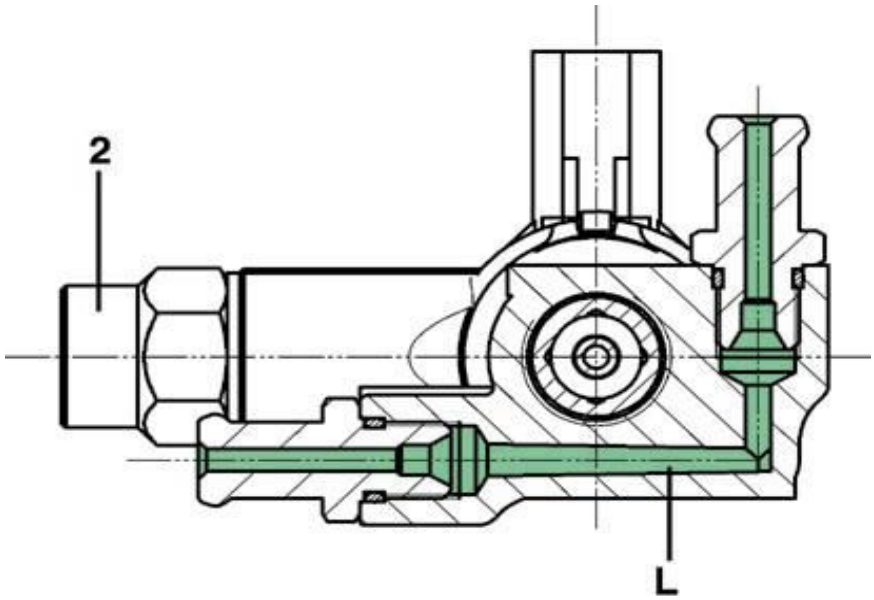
The gas coming from the cylinder enters the regulator's chamber (A), which is located upstream of the shutoff valve (1), through fitting (2) and filter (3).



By energising the partially driven electrovalve (B), valve (1) is opened and the gas from chamber (A) flows to the first stage (C).
Under fuel delivery conditions, the gas flow enters the stage and establishes a pressure that corresponds to the calibration pressure as a result of the balance of the forces exerted on diaphragm (4) by spring (5) [which is located in chamber (D) at atmospheric pressure], as well as by gas pressure in stage (C).
The system is regulated, because as the pressure decreases (i.e. when fuel is demanded), the force of the spring on the diaphragm prevails and causes the motion of the diaphragm towards the stage. This motion causes, through joint (6) and lever (7), an increase in the opening of first stage valve (8), which in turn causes a flow increase and consequently an increase in the pressure of the stage, resulting in the re-establishment of a pressure balance.

Conversely, when the pressure increases, the valve tends to close by means of the same mechanism. This causes a decrease of the flow and of gas pressure.
The operational principle of the first stage is called “blow open”, that is, the valve tends to open because of the gas pressure differential between inlet and first stage. In case of excessive pressure increase in the first stage, safety valve (E) opens and discharges gas.
This reduces the pressure of the stage to a value slightly lower than the calibration value of the valve itself.
It is possible to connect a high-pressure sensor upstream of the first stage.

In the next phase of operation, the gas moves through the second stage valve (10) and enters chamber (F) which, together with chamber (G), constitutes the second stage. The two chambers are separated by diaphragm (11) through which the valve stem operates.
The valve (of the direct opening type) is coaxial with spring 12 and diaphragm 13. The valve is connected to the diaphragm by means of its own stem. Under fuel delivery conditions, the gas flow reaches the stage and establishes a pressure corresponding to the calibration pressure.
This is a result of the balance of the forces exerted on the diaphragm by the spring and by the gas pressure in chamber (G).
The system is regulated, because as the pressure decreases, the force exerted by the spring on the diaphragm prevails and causes the motion of the diaphragm towards the stage.
This motion of the diaphragm acts directly on valve (10) and increases its opening by causing an increase of flow, thus an increase of stage pressure, which in turn re-establishes a condition of balance in the system.
Conversely, as the pressure increases, the valve tends to close by means of the same mechanism, thus decreasing the flow and the gas pressure.
The operational principle of the second stage is of the “blow closed” type; that is, the valve tends to close because of the gas’s pressure differential between first and second stage.
To maintain a constant pressure drop through the injectors when the position of the engine butterfly changes, the second stage can be compensated by connecting the chamber (I) through fitting (16) with the engine’s intake manifold.
The second stage is provided with a screw adjustment system (17), which allows the fine-tuning of the pressure in a narrow field.



In order to prevent the formation of ice and/or humidity in the N.G.2 pressure regulator caused by the cooling of the expanding gas (Joule-Thomson effect), a heater circuit (L) is provided. This circuit normally utilises the engine’s coolant.
The circuit is positioned close to the area where the greatest pressure drop takes place, in order to optimize heat exchange. To prevent the gas from reaching excessively high temperature, it is possible to adjust the coolant flow by means of thermostatic valves. These valves are available in two versions:
- Wax version. The valve is activated by the coolant exiting the pressure regulator.
- Electronic version. The coolant flow is regulated in function of the gas temperature exiting the regulator.

1.7 NG2 SPECIFICATIONS

1. The N.G.2 pressure regulator is a two-stage unit. When compared to a single stage regulator, it offers:
- greater precision of the regulated pressure.
- less influence of the pressure in the gas cylinder.

2. The selection of the diaphragm (rather than the piston) as a measuring element has been dictated by:
- greater sensitivity of the element.
- smaller hysteresis.
- less possibility of gas leaks due to wear and tear of the sealing components.

3. Location of the valves in the two stages:
- The combination of the two valve systems ("blow open" in first stage and "blow closed" in the second) further contributes to the stabilisation of the outlet pressure. This is because the two stages are affected in opposite ways by their upstream pressure.

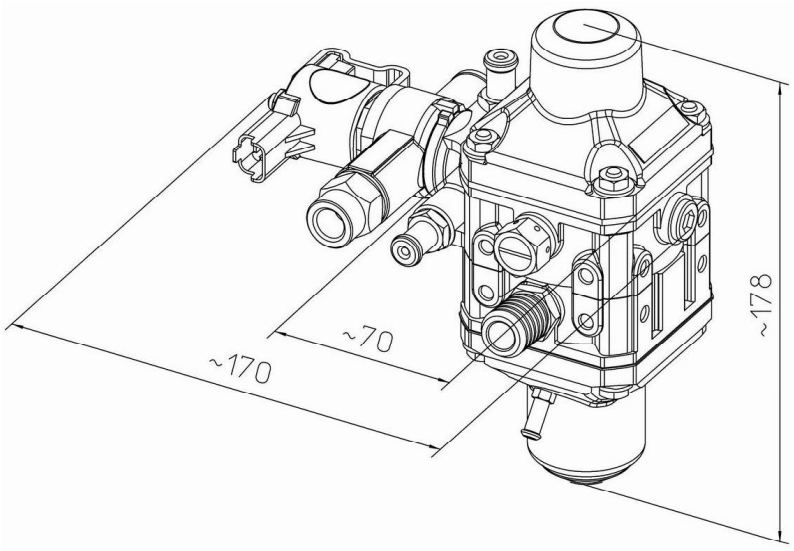
4. The unbalanced second stage valve ensures:
- the avoidance of leaks in the balancing chamber through the seal gasket due to wear and tear.
- a lower hysteresis.

5. Partially driven electrovalve:
- differently from a totally piloted valve, this valve obtains the opening stopper action not only through pneumatic effect, but also through mechanical effect.
- it allows fast opening times with both high and low pressure upstream of the valves.

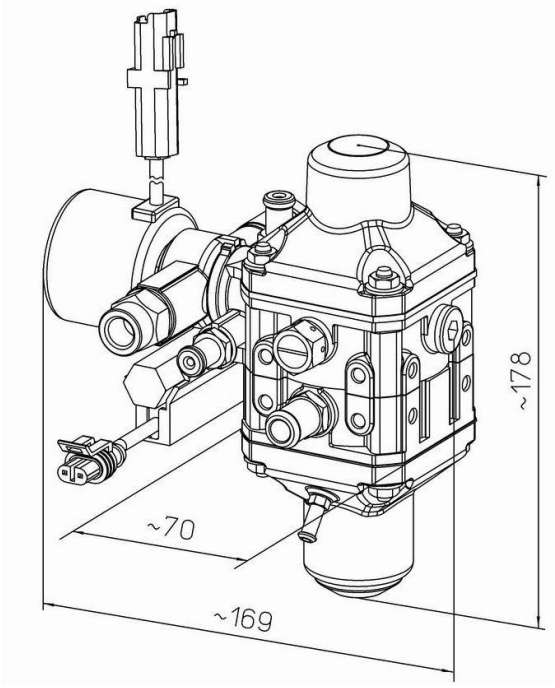
6. Second stage compensation:
- it maintains a constant pressure drop through the injectors when the position of the engine's butterfly changes.

2 PRODUCT EXECUTION

2.1 OVERALL DIMENSION



NG2 (–40°C) version

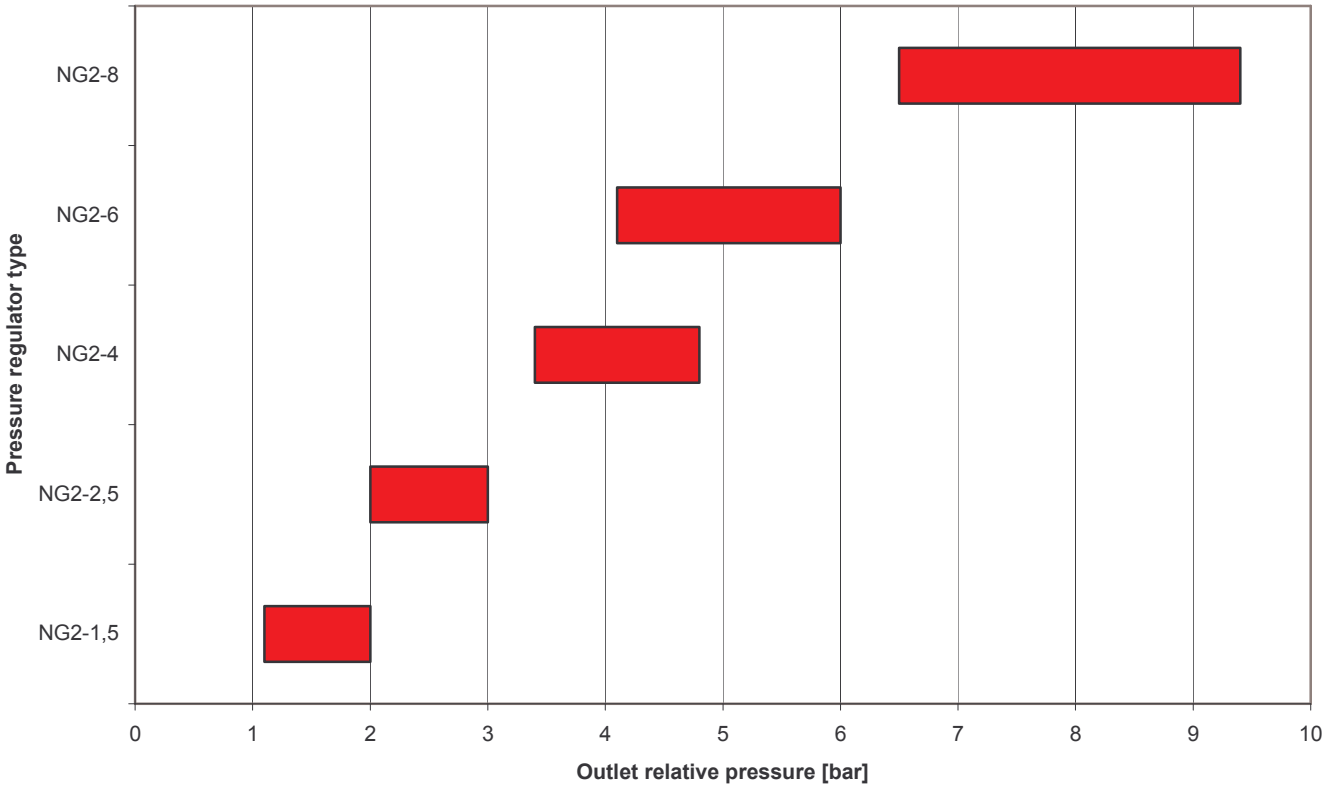


NG2 (–20°C) version

2.2 OUTLET PRESSURE RANGE

- *NG2 is a family of CNG pressure regulators used for injection systems.*
- *All of them supply gas at different outlet pressures, always higher than atmospheric pressure.*
- *Outlet pressure can be compensated in different applications respecticely with manifold Absolute Pressure, Atmospheric pressure, or else.*
- *Applications can have the outlet pressure varying from 1 to 10 bar.*
- *There are NG2 versions customized for OEM customers that include our product in their cars.*

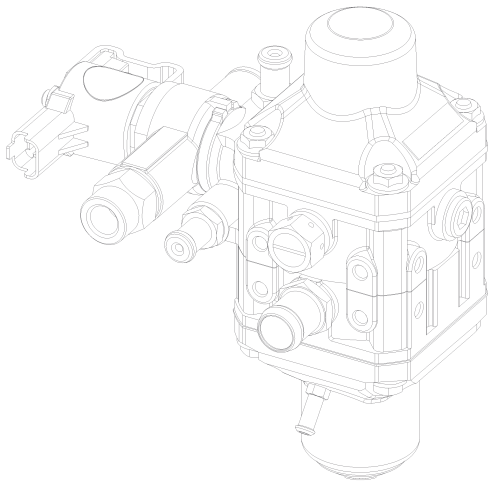
Regulators NG2 outlet pressure range



2.3 NG2 REGULATOR VERSIONS

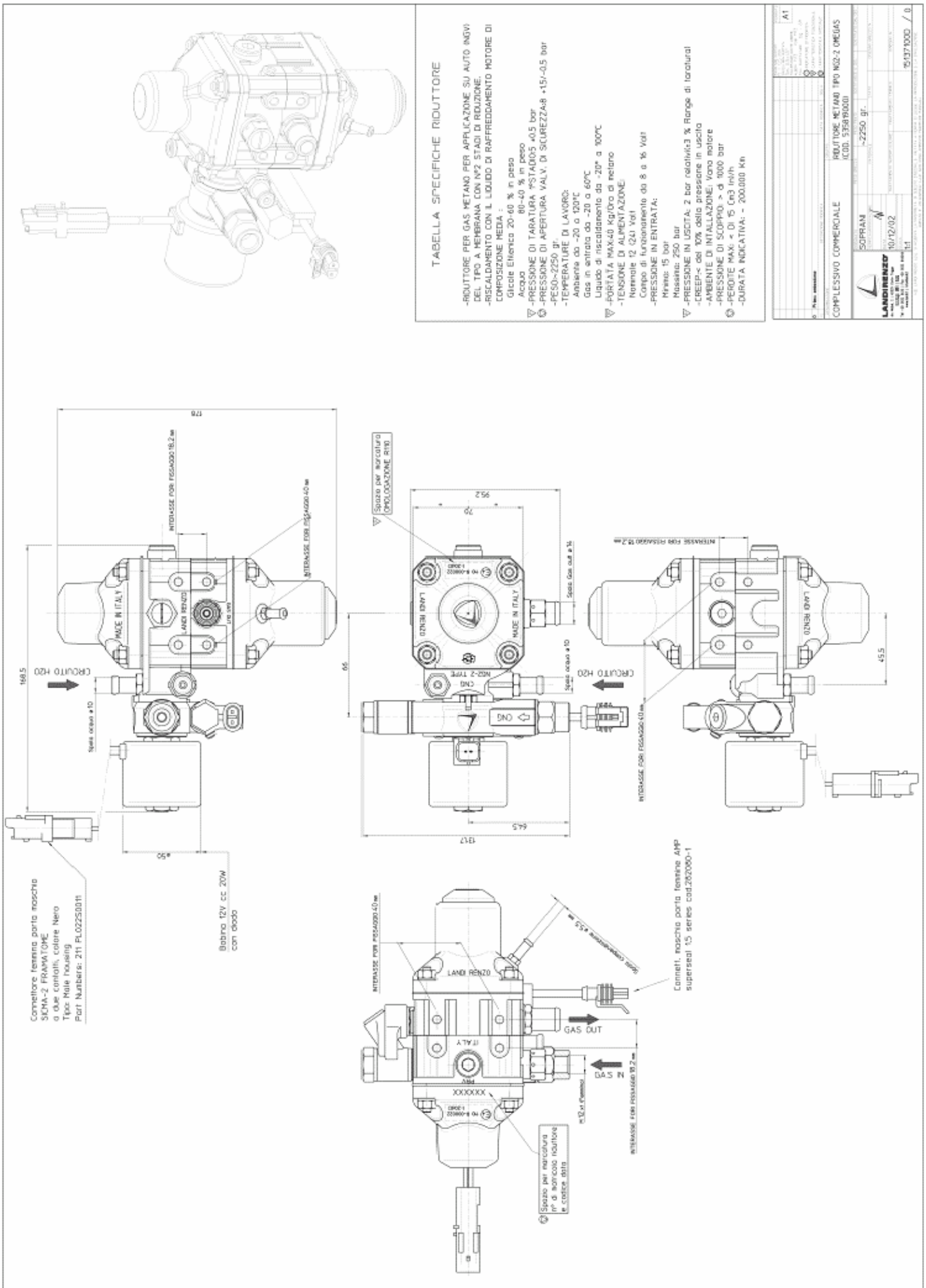
NG2 Series
Pressure regulators for Natural Gas

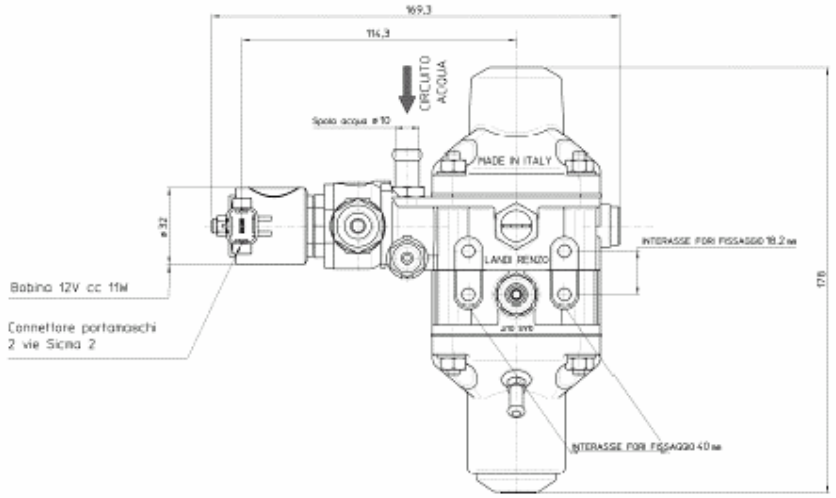
Main characteristics:
- *two-stage pressure regulator in aluminum*
- *shut-off valve incorporated upstream the first pressure reduction*
- *sintered filter element integrated*
- *pressure relief valve (1st stage)*
- *internal coolant circulation to prevent moisture and icing*

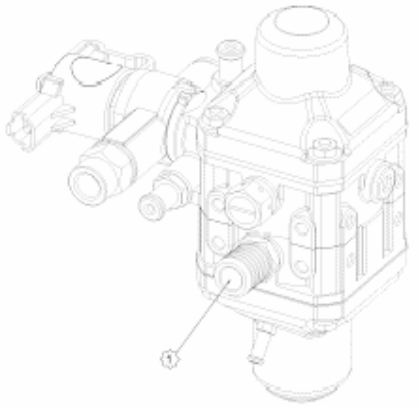


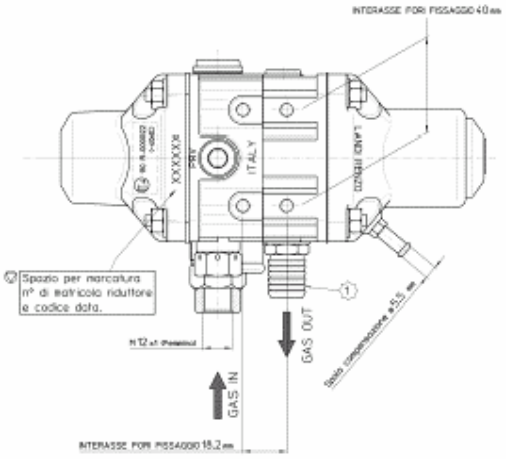
Regulator Type		**NG2-1,5**	**NG2-2,5**	**NG2-4**	**NG2-6**	**NG2-8**
product code	**(R110 @ -20dC)**	*536813000*	*536809000*	*536806000*	*536808000*	*536807000*
	(R110 @ -40dC)	*536814000*	*536815000*	*536816000*	*536817000*	*536818000*
Homologation		*ECE/ONU n°110 @ -20dC and –40dC minimum temperatures*				
Regulated media		*natural gas*				
Service pressure [bar]		*15 to 260*		*20 to 260*		
Output relative pressure	**Nominal (+/-3% absolute of pressure range) [bar]**	*1,5*	*2,5*	*4*	*6*	*8*
	calibration range [bar]	*1,1 to 2*	*2 to 3*	*3,4 to 4,8*	*4,1 to 6*	*6,5 to 9,4*
1st stage relative pressure (@ min flow + high service pressure) [bar]		*3 +/- 0,5*	*5 +/- 0,5*	*7 +/- 0,5*	*11,5 +/- 0,5*	*12,7 +/- 0,5*
Maximum CNG flow rate [kg/h]		*30*	*40*			*45*
Pressure Relief Valve opening pressure [bar]		*6,5 +1,5/-0,5*	*8 +1,5/-0,5*	*10,5 +1,5/-1*	*18 +2/-1*	
Creep @ no flow		*< 10% of output absolute pressure*				
Hysteresis		*< 1% of output absolute pressure*				
Operating temperatures	**environment [C°]**	*-20 to +120 (R110 @ -20°C) ; -40 to +120 (R110 @ -40°C)*				
	input gas [°C]	*-20 to +100 (R110 @ -20°C) ; -40 to +100 (R110 @ -40°C)*				
	heating fluid [°C]	*-20 to +100 (R110 @ -20°C) ; -40 to +100 (R110 @ -40°C)*				
Burst pressure	**of high-pressure part**	*> 1.100 bar*				
	of 1st stage	*> 4 times working pressure*				
	of 2nd stage	*> 4 times working pressure*				
Solenoid valve supply voltage	**nominal [V]**	*12 (available 24 too)*				
	operating range [V]	*8 to 16 (16 to 32)*				
Maximum allowed CNG leakage		*< 15 Ncm3/h*				
CNG inlet filter		*50 μm*				
Fittings	**gas inlet**	*M12x1 or 3/8"–18NPTF or UNF 7/16-20 SAE-MS or ¼-18 NPTF or Swagelok for 6mm pipe*				
	gas outlet	*¼" gas or ¼"–18NPT or ϕ14 / ϕ16 mm fitting for rubber pipe*				
	heating fluid circuit	*ϕ8 / ϕ10 mm fitting for rubber pipe*				
	MAP	*ϕ5,5 / ϕ8 mm fitting for rubber pipe*				
Solenoid valve electrical connector		*SICMA_2 Framatome (2 pins) or AMP (2 pins)*				
Weight [g]		*2.250 (R110 @ -20dC) ; 2.000 (R110 @ -40dC)*				
Recommended installation place		*engine compartment*				
Durability		*200.000 km*				

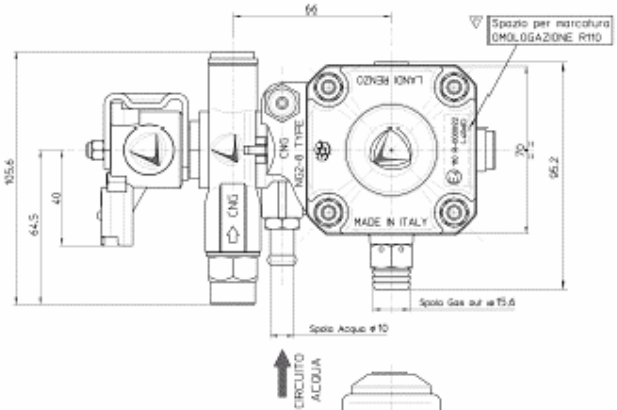
2.4TECHNICAL DRAWING











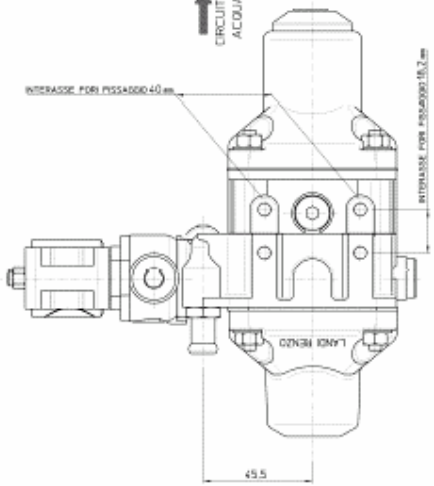


TABELLA SPECIFICHE RIDUTTORE

-RIDUTTORE PER GAS METANO PER APPLICAZIONE SU AUTO (NGV) DEL TIPO A MEMBRANA CON N°2 STADI DI RIDUZIONE.
-RISCALDAMENTO CON IL LIQUIDO DI RAFFREDDAMENTO MOTORE DI COMPOSIZIONE MEDIA :
Glicole Etilenico 20-60 % in peso
Acqua 80-40 % in peso
▽ -PRESSIONE DI TARATURA 1°STADIO: 12,7 +0,5 bar
Ⓢ -PRESSIONE DI APERTURA VALV. DI SICUREZZA: 18 +2/-1 bar
-PESO: ~ 2000 gr.
-TEMPERATURE DI LAVORO:
Ambiente da -40 a 120°C
Gas in entrata da -40 a 60°C
Liquido di riscaldamento da -40° a 100°C
▽ -PORTATA MAX: 45 Kg/Ora di metano
-TENSIONE DI ALIMENTAZIONE:
Nominale 12 (24) Volt
Campo di funzionamento da 8 a 16 Volt
-PRESSIONE IN ENTRATA:
Minima: 20 bar
Massima: 250 bar
▽ -PRESSIONE IN USCITA: 8 bar relativi (±3 % Range di taratura)
-CREEP: < del 10% della pressione in uscita
-AMBIENTE DI INTALLAZIONE: Vano motore
-PRESSIONE DI SCOPPIO: > di 1000 bar
Ⓢ -PERDITE MAX: < Di 15 Cm3 In/h
-DURATA INDICATIVA: ~ 200.000 Km

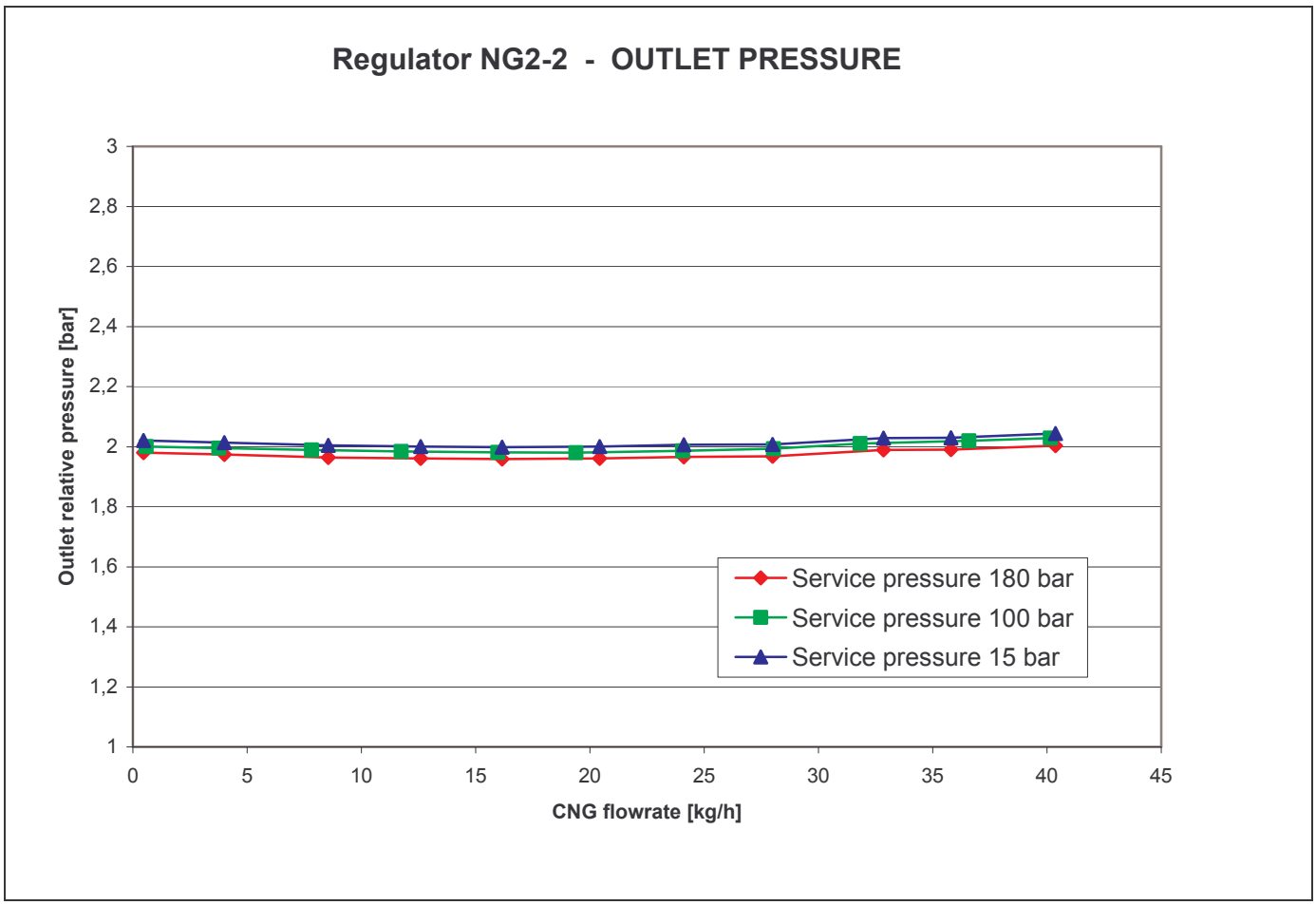
1	Sostituito lo spezzone uscita gas 276095100 con la nuova 276096000	10/06/2004	Pitt. P.		A0

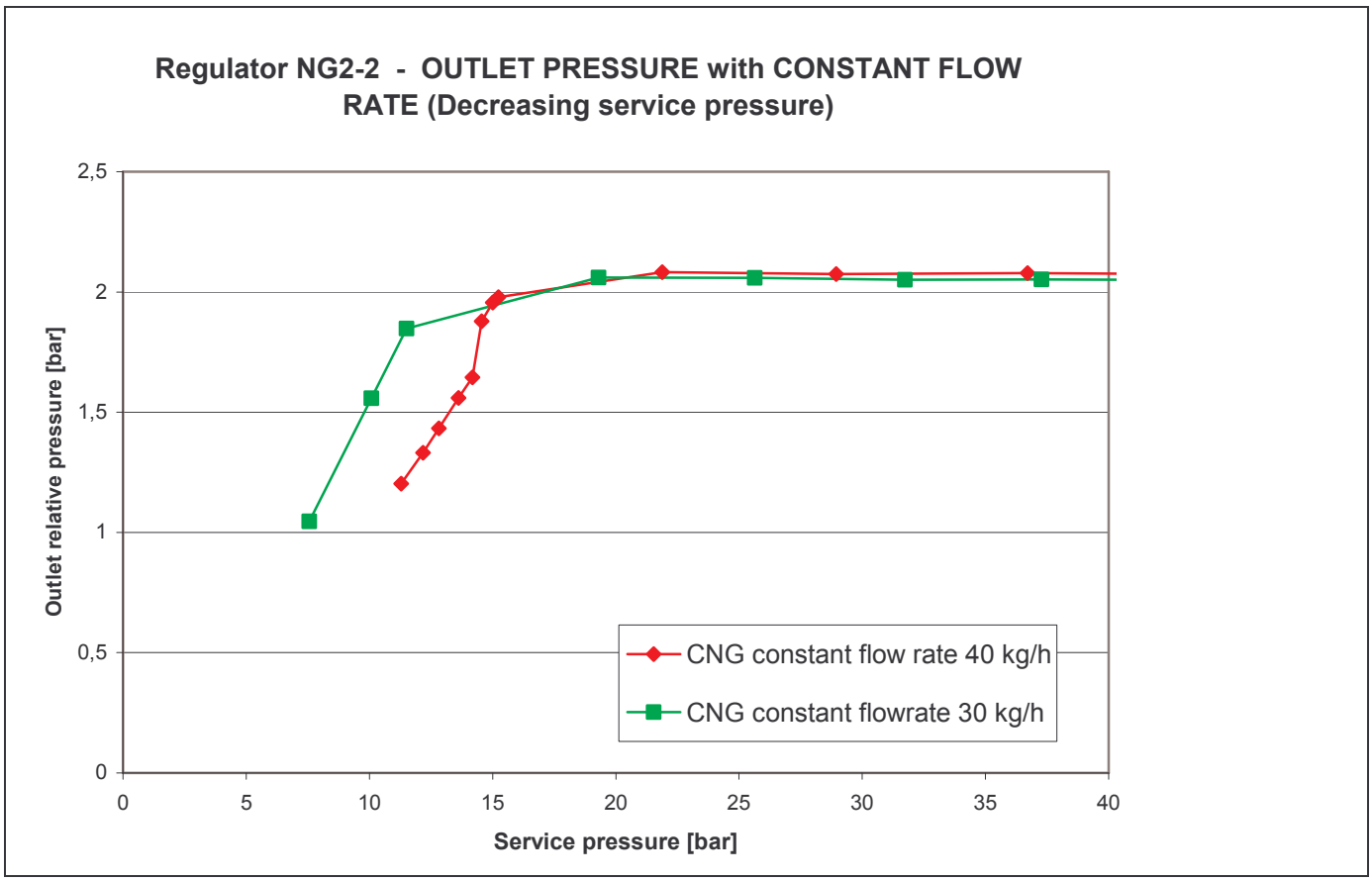
COMPLESSIVO COMMERCIALE — RIDUTTORE METANO TIPO N02-8 (-40°C) (COD. 535818000)

LANDIRENZO — S.T. — ~2000 gr. — 21/01/03 — 1:1 — 15137000D / 1

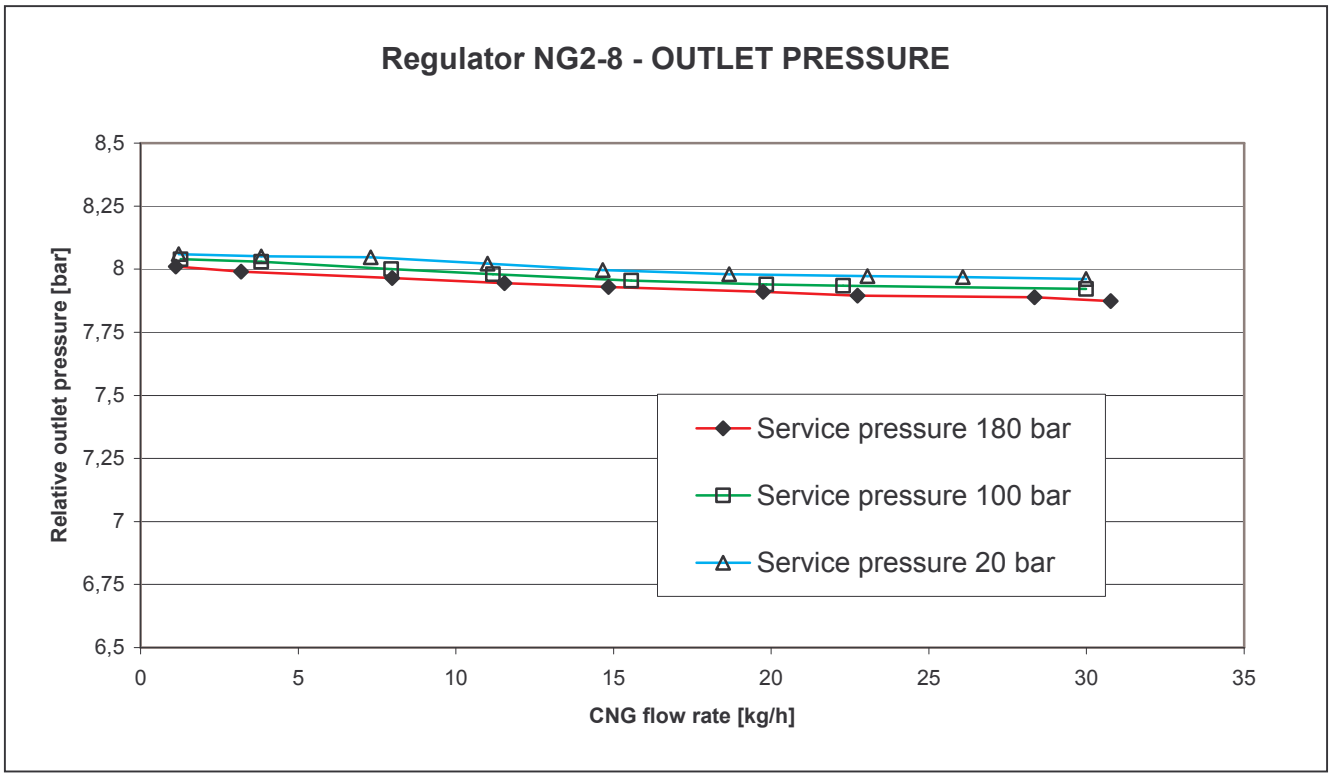
3 WORKING CHARACTERISTICS

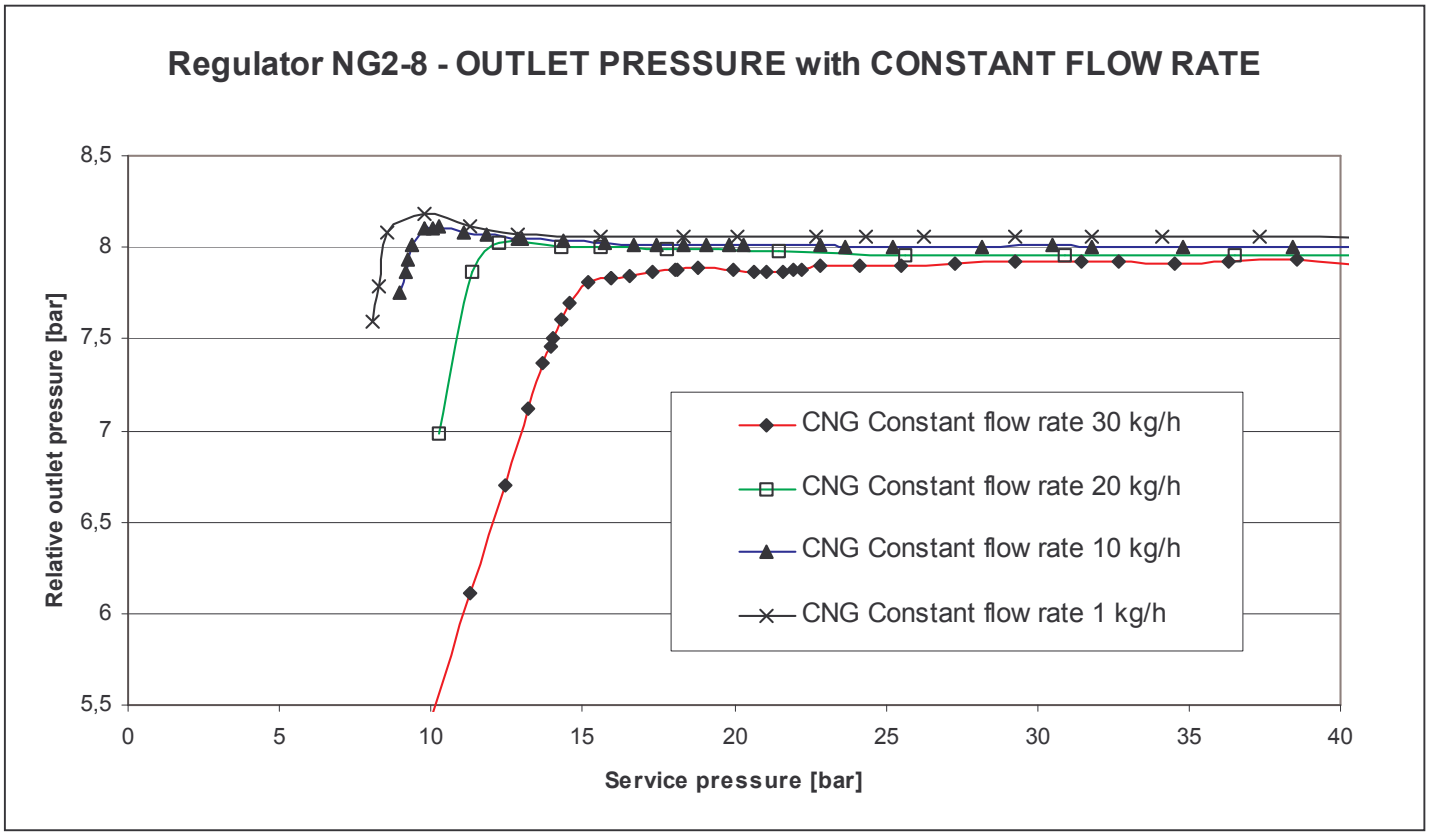
3.1 NG2-2 VERSION GRAPHS





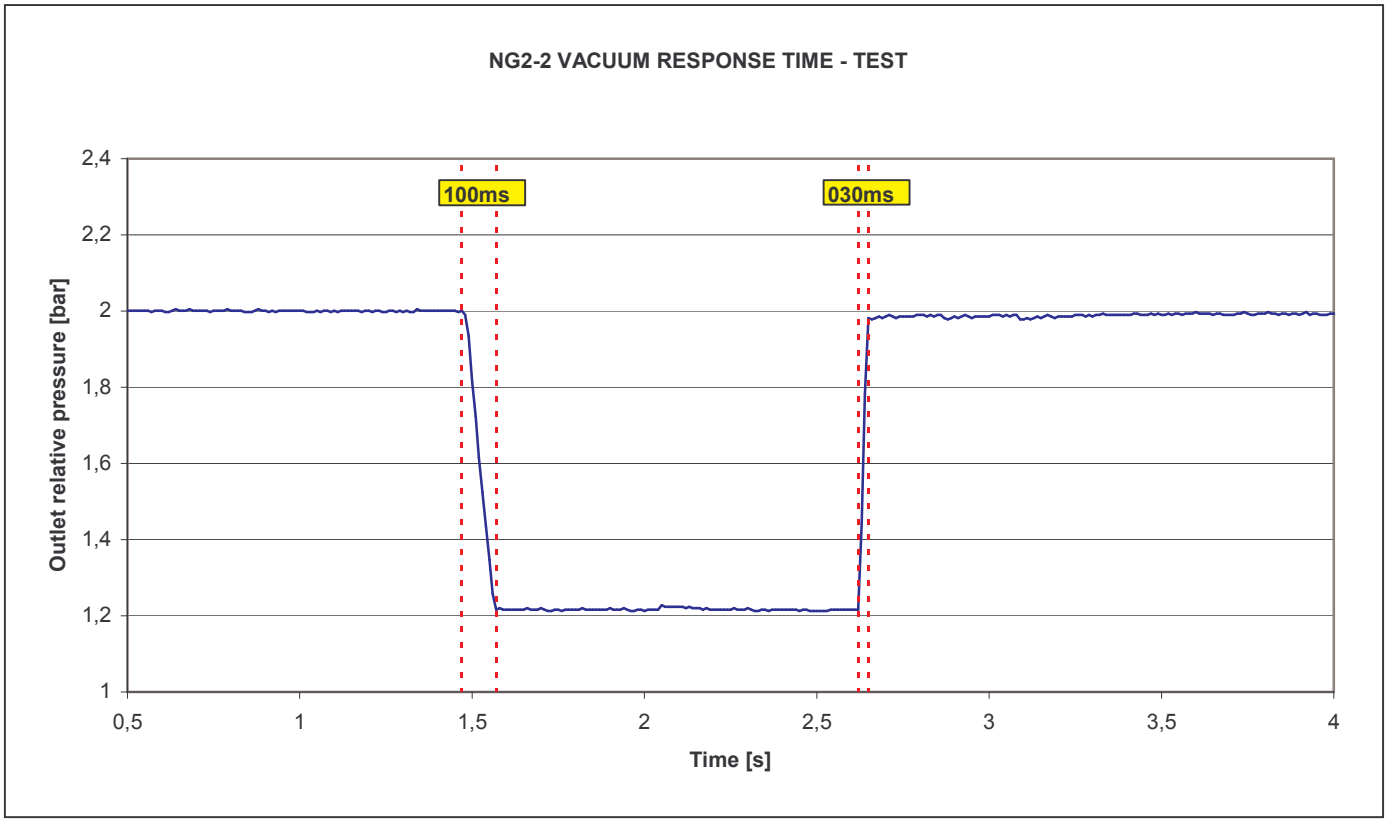
3.2 NG2-8 VERSION GRAPHS



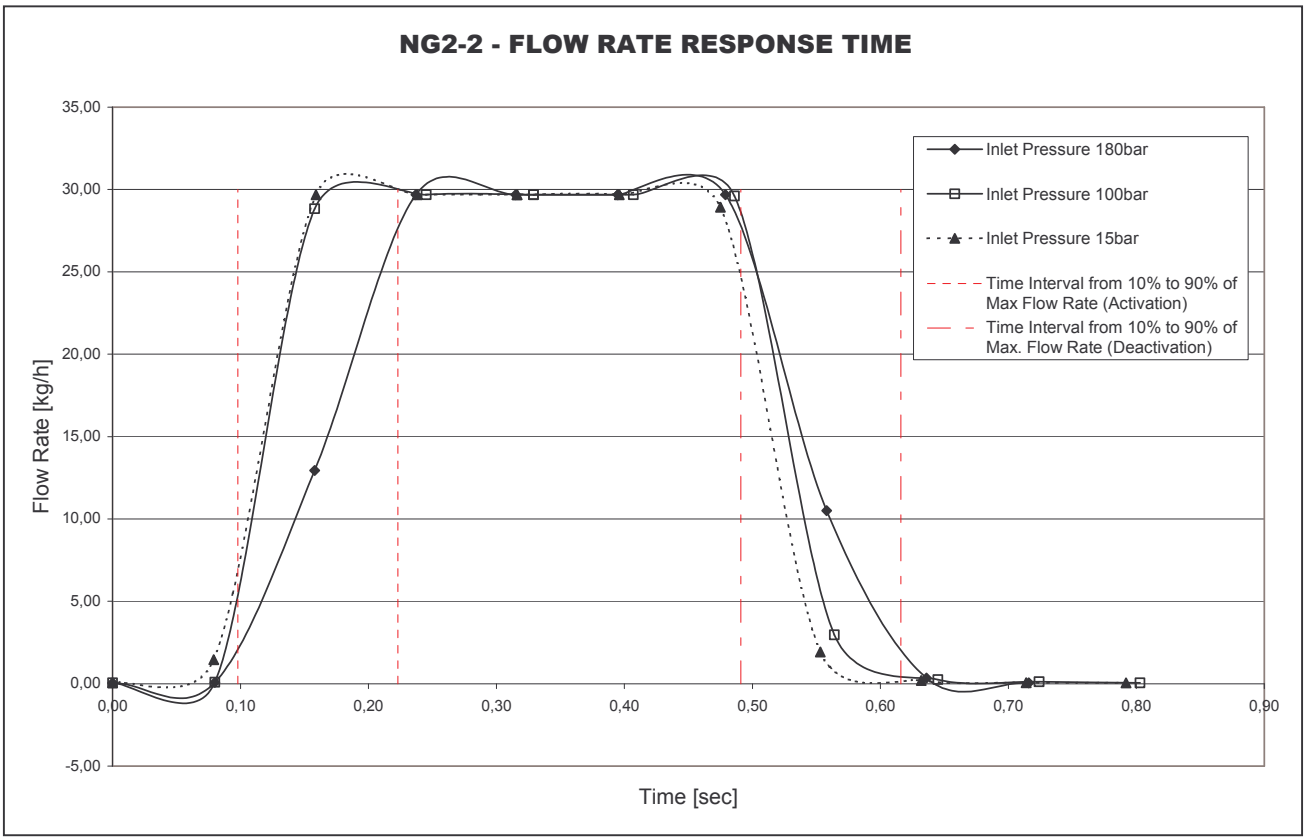


3.3 RESPONSE TIME

3.3.1 VACUUM RESPONSE TIME



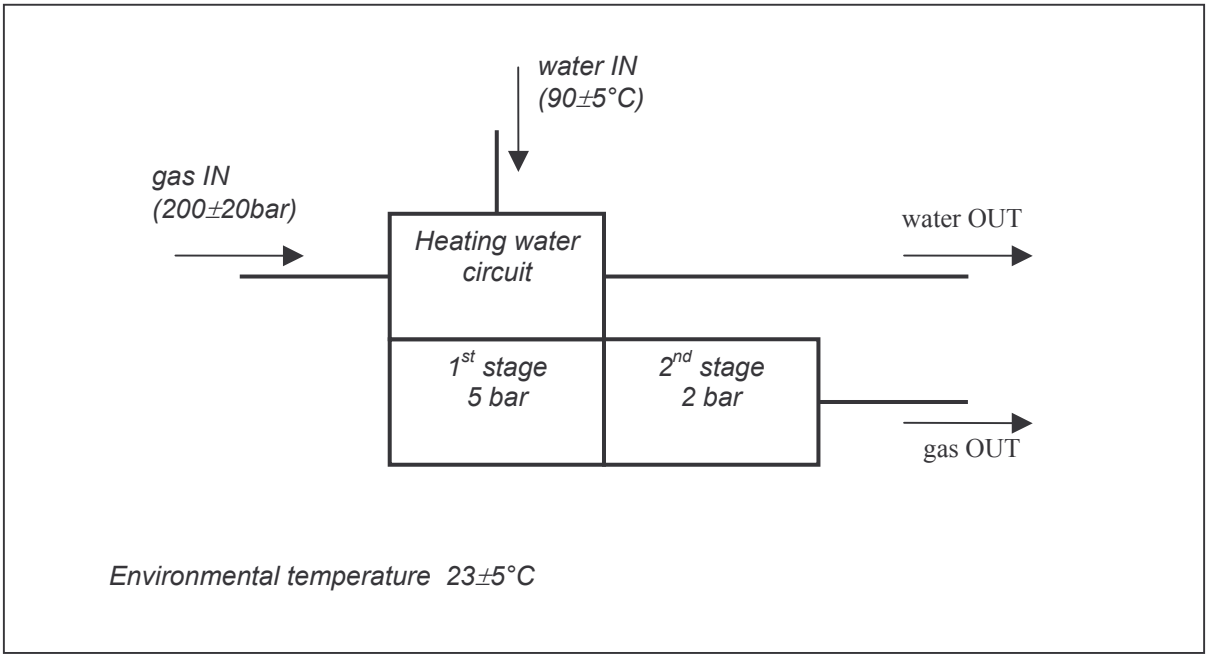
3.3.2 FLOWRATE RESPONSE TIME



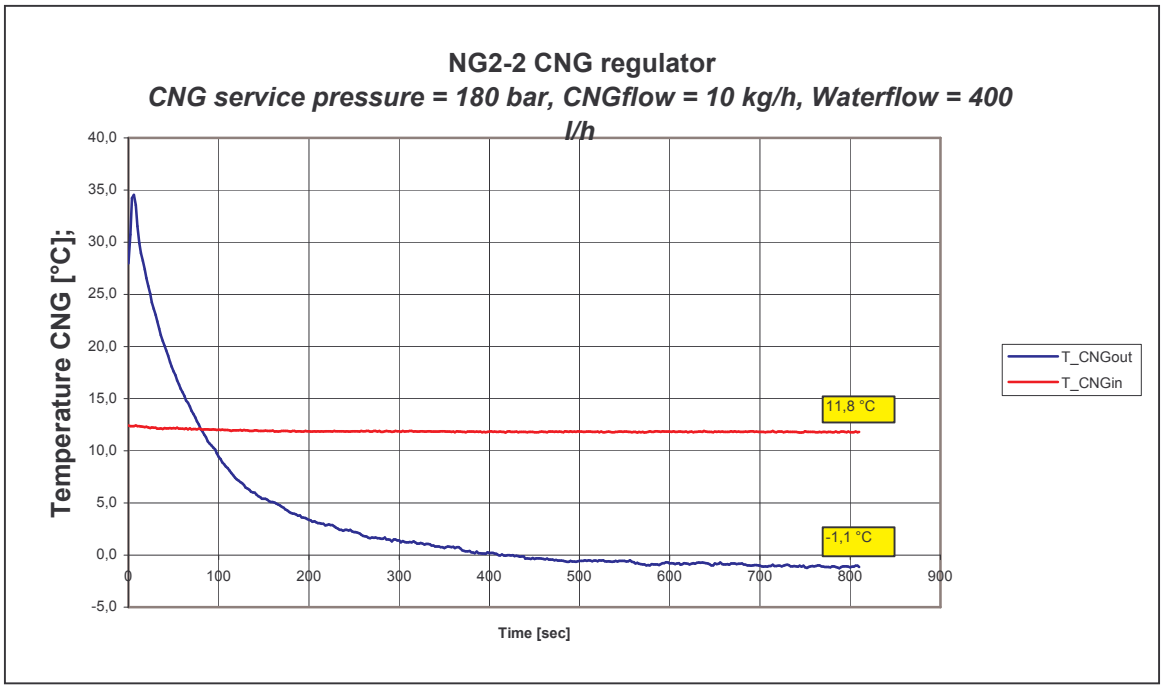
3.4 HEAT EXCHANGE WITH CNG

The heat exchange test was done to verify the heating condition of the regulator in working condition.

TECHINICAL SCHEME OF THE TEST



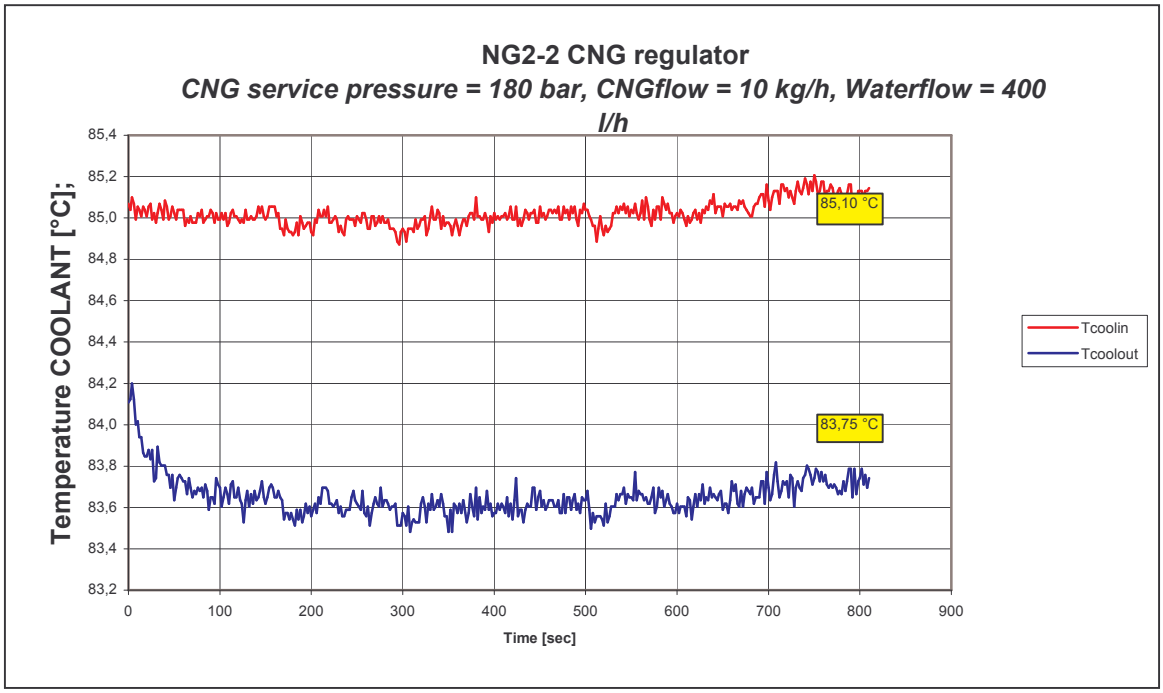
CNG TEMPERATURE WORKING CONDITIONS



As it's possible to verify from the table with the outlet temperature of the CNG (T_CNG_{out}) , the regulator is warmed enough to avoid icing condition especially in the 1°stage, where the pressure drop from the service pressure to the 1°stage working pressure is high.

It has to be considered that the test has been done with an environment temperature of 23°C; in reality the temperature in the engine compartment is higher than this value (80 - 90°C): these values will also favor the heat exchange inside the regulator.

WATER TEMPERATURE WORKING CONDITIONS



4 NG2 CNG PRESSURE REGULATOR – DESIGN VALIDATION

4.1 DESIGN VALIDATION TEST

N° test	Validation tests *performed in Landi Renzo*	*ECE / ONU n°110* *homologation tests*	Test performed for OEM applications *(on "Proto B" regulator)*
1	***1.A) Endurance test:*** *500.000 total cycles:* – *5s: period (3s max flow; 2s zero flow),* – *180bar: service pressure,* – *85dC: heating water circuit temperature.*	***1.B) Durability tests*** *20.000 total cycles:* – *10s: cycle period,* – *2% of cycle at –40dC,* – *2% of cycle at 120dC.*	***1.C) Durability tests*** *2.000 hours continuous operation:* – *variable values of service pressure, flow rate, reference pressure, during the test* – *85dC: heating water temperature.*
2	***2.A) Vibration test resistance*** – *44 hours: test duration for each of 3 main axis,* – *5÷50Hz and 0.000319÷0.132G^2/Hz : ranges of parameters that define vibration profile for each axis.*	***2.B) Vibration resistance*** – *2 hours: test duration for each of 3 main axis,* – *17Hz: frequency,* – *1,5mm: amplitude.*	***2.C.1) Vibratory / Thermal Test*** *Complex test procedure structured as:* – *48 different working conditions,* – *100 seconds of vibration for each working condition.* ***2.C.2) Vibratory / thermal fatigue test*** *Complex test procedure divided on:* – *phase 1: 8 hours,* – *phase 2: 20 hours,* – *phase 3: 1 hour.*
3	***3.A) Overpressurizing test*** – *650bar during 5 minutes with regulator gas outlet closed,* – *800bar during 20 seconds with solenoid valve closed.*	***3.B) Overpressure or strength*** – *pressure of 1,5 times the specified service pressure,* – *test duration 1 minute.*	***3.C) Overpressurizing test*** – *650bar during 5 minutes with regulator gas outlet closed,* – *800bar during 20 seconds with solenoid valve closed.*
4	***4.A) Dropping test*** – *1m: drop height,* – *18 total drops (3 times along 2 directions of 3 axes).*		***4.C) Dropping test*** – *1m: drop height,* – *18 total drops (3 times along 2 directions of 3 axes).*
5		***5.B) Temperature cycle*** – *96 hours: test duration,* – *120 minutes: cycle period,* – *-40 / 120 dC: temperature cycle extremes.*	***5.C.1) Extreme Temperature test*** – *16 hours oscillating between 130 and 140dC with a period of 15 minutes,* – *16 hours at –30dC.*
	5.A.2) Thermal Shock test *300 cycles as follow:* – *30 minutes at 120dC,* – *5 seconds to move the regulator,* – *30 minutes at –40dC,* – *5 seconds to move the regulator.*		***5.C.2) Thermal Shock test*** *300 cycles as follow:* – *30 minutes at 120dC,* – *5 seconds to move the regulator,* – *30 minutes at –40dC,* – *5 seconds to move the regulator.*
6			***6.C) Water Tightness test*** *repeated 3 times following procedure:* – *pulverization pressure: 80bar,* – *jet angle: 60°,* – *sprayed water temperature: 70°C,* – *sprayed water flow rate: 780 l/h,* – *angle between water jet and regulator axes,* – *jet start distance with regulator: 30cm,* – *pulverization time: 3 minutes,* – *2 thermal shocks (described on another paragraph).*

N° test	Validation tests *performed in Landi Renzo*	*ECE / ONU n°110* *homologation tests*	Test performed for OEM applications *(on "Proto B" regulator)*
7	***7.A) Humid Heat test*** – *48 hours: test duration,* – *60dC: test temperature,* – *90%: relative humidity.*	***7.B) Resistance to dry-heat*** – *168 hours: test duration,* – *+25%: allowed change in tensile strength,* – *+10% / -30%: allowed change in ultimate elongation.*	***7.C) Humid Heat test*** – *48 hours: test duration,* – *60dC: test temperature,* – *90%: relative humidity.*
8			***8.C) Dust exposure test*** – *regulator placed on a box of volume 1m^3 with inside 5kg of Portland cement,* – *box pressurized for 30 minutes,*
9	***9.A) Corrosion resistance*** – *5% NaCl: solution with distilled water,* – *600 hours: test duration,* – *35dC: test temperature.*	***9.B) Corrosion Resistance*** – *5% NaCl: solution with distilled water,* – *168 hours: test duration,* – *40dC: test temperature,* – *90÷95%: relative humidity.*	***9.C) Corrosion resistance*** – *5% NaCl: solution with distilled water,* – *600 hours: test duration,* – *35dC: test temperature.*
10	***10.A) Fluids exposure test*** – *window washing fluid, 24 hours at 70dC,* – *antifreeze, 24 hours at 118dC,* – *automatic gear oil box, 24 hours at 150dC,* – *manual gear oil box, 24 hours at 125dC,* – *engine oil, 24 hours at 125dC,* – *zinc chloride, 24 hours at 23dC,* – *acid fumes (ZnCl2 at 35% on water), 2 hours at 70dC.*		***10.C) Fluids exposure test*** – *window washing fluid, 24 hours at 70dC,* – *antifreeze, 24 hours at 118dC,* – *automatic gear oil box, 24 hours at 150dC,* – *manual gear oil box, 24 hours at 125dC,* – *engine oil, 24 hours at 125dC,* – *zinc chloride, 24 hours at 23dC,* – *acid fumes (ZnCl2 at 35% on water), 2 hours at 70dC.*
11	***11.A) External leakage*** – *max service pressure,* – *room temperature,* – *no bubbles during complete immersion on water of pressure regulator.*	***11.B) External Leakage*** – *15 scc/hr: leakage limit,* – *max working pressure,* – *environmental temperature, -40dC, 120dC (8 hours of conditioning)*	***11.C) External Leakage*** – *20 scc/hr: leakage limit,* – *max working pressure,* – *environmental temperature, -40dC, 120dC (8 hours of conditioning)*
12	***12.A) Internal leakage*** – *max service pressure,* – *room temperature,* – *no bubbles during immersion on water of pressure regulator gas outlet.*	***12.B) Internal Leakage*** – *ZERO leakage,* – *max working pressure,* – *environmental temperature, -40dC, 120dC (8 hours of conditioning)*	***12.C) Internal Leakage*** – *20 scc/hr: leakage limit,* – *max working pressure,* – *environmental temperature, -40dC, 120dC (8 hours of conditioning)*
13		***13.A) CNG Compatibility*** – *72 hours: test duration,* – *23dC: test temperature,* – *n-pentane: gas for the test,* – *20%: max change in volume,* – *5%: max mass decrease after 48 hours at 40dC.*	
14		***14.B) Ozone Ageing*** – *20%: elongation stress on sample,* – *120 hours: test duration,* – *40dC: test temperature,* – *50 parts per hundred million: ozone concentration,* – *No cracking is allowed.*	
15	***15.A) Torque Check After Temperature Cycles*** – *24 hours at 125dC,* – *24 hours at –40dC,* – *24 hours at 150dC,* – *24 hours at 125dC,*		

4.2 DESIGN VALIDATION PROCEDURE

ENDURANCE TESTS		*Design validation*			*Product validation*		
Description of the test	***N° test***	***N° of parts tested***	***Acceptance criteria***	***Conformity [%]***	***N° of parts tested***	***Acceptance criteria***	***Conformity [%]***
Endurance test	*1.A-1.B-1.C*	*5*	*No failure*	*100*	*10*	*No failure*	*100*
Vibration	*2.A-2.B-2.C.1-2-C.2.*	*6*	*No failure*	*100*	*6*	*No failure*	*100*
Overpressuring	*3.A-3.B*	*3*	*No failure*	*100*	*6*	*No failure*	*100*
Dropping	*4.A*	*3*	*No failure*	*100*	*6*	*No failure*	*100*
Thermal shocks	*5.A-5.B-5.C.1*	*3*	*No failure*	*100*	*6*	*No failure*	*100*
Water tightness	*6.C*	*3*	*No failure*	*100*	*6*	*No failure*	*100*
Humid heat	*7.A- 7.B*	*3*	*No failure*	*100*	*6*	*No failure*	*100*
Dust exposure	*8.C*	*3*	*No failure*	*100*	*6*	*No failure*	*100*
Corrosion resistance	*9.A-9.B*	*3*	*No failure*	*100*	*6*	*No failure*	*100*
Fluid exposure test	*10.A*	*5*	*No failure*	*100*	*6*	*No failure*	*100*
External leakage	*11.A-11.B-11.C*	*3*	*No failure*	*100*	*10*	*No failure*	*100*
Internal leakage	*12.A-12.B-12.C*	*3*	*No failure*	*100*	*10*	*No failure*	*100*
CNG Compatibility	*13.B*	*3*	*No failure*	*100*	*6*	*No failure*	*100*
Ozone ageing	*14.B*	*3*	*No failure*	*100*	*6*	*No failure*	*100*
Torque check after temperature cycles	*15.A*	*3*	*No failure*	*100*	*6*	*No failure*	*100*

5 NG2 HOMOLOGATION R110

Here below the R110 standard certificate for all NG2 version

RDW Vehicle Technology Division

THE NETHERLANDS
(NEDERLAND)

E4

COMMUNICATION

Concerning ~~APPROVAL GRANTED~~
APPROVAL EXTENDED
~~APPROVAL REFUSED~~
~~APPROVAL WITHDRAWN~~
~~PRODUCTION DEFINITELY DISCONTINUED~~

of a type of CNG component pursuant to Regulation No. 110

Approval No.: E4-110R-000022 **Extension No.:2**

CNG component considered :
~~Container(s) or cylinder (s)~~
~~Pressure indicator~~
~~Pressure relief valve~~
~~Automatic valve(s)~~
~~Excess flow valve~~
~~Gas-tight housing~~
Pressure regulator(s)
~~Check valve(s)~~
~~Pressure relief device~~
~~Manual valve~~
~~Flexible fuel lines~~
~~Filling unit or receptacle~~
~~Gas/air mixer (injector(s))~~
~~Gas flow adjuster~~
~~Gas/air mixer (carburettor)~~
~~Electronic control unit~~
~~Pressure and temperature sensor(s)~~
~~CNG filter(s)~~

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Vehicle Approval and Information

Approval No.: E4-110R-000022 **Extension: 2**

2	Trade name or mark	series NG2.
3	Manufacturer's name and address	Landi Renzo S.p.A. Via Nobel 2 42025, Corte Tegge Cavriago (RE) Italy
4.	If applicable, name of the manufacturer's representative	NA
5.	Submitted for approval on	February 2003
6.	Technical service responsible for conducting approval tests	Gastec Certification B.V. P.O.Box 137 7300AC APELDOORN The Netherlands
7.	Date of report issued by that service	May 2002 / June 2003
8.	Number of report issued by that service	120930 / 122127
9.	Approval	~~granted/refused~~/extended/~~withdrawn~~/
10	Reason(s) for extension	Increasing of working pressure, updating of drawings and adding of new types
11	Place	Zoetermeer
12.	Date	17 JUNI 2003
13.	Signature	ing.A.M. Boelestein
14.	The documents filed with the application or extension of approval can be obtained upon request.	

RDW

Documentation: 1 sheet and 18 drawings

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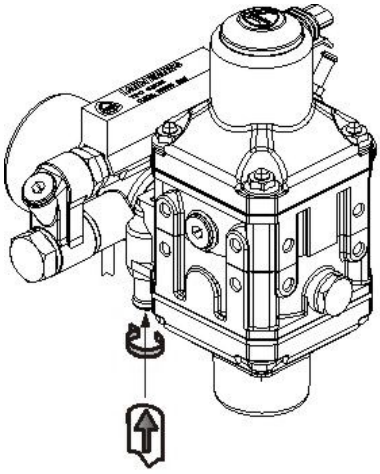
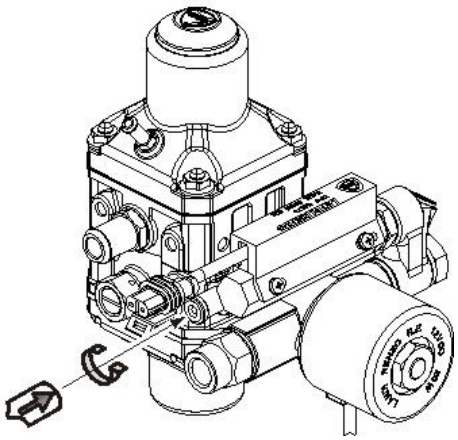
6 INSTRUCTION AND MAINTENANCE

6.1 INSTRUCTION FOR THE INSTALLATION

The following instructions must be observed for the installation of the reducer:
· Fix the reducer so as to make adjustment and maintenance easy.
· Attach the reducer/atomizer to the body of the vehicle, ***DO NOT*** *under any circumstances attach it to the engine or other components in their turn attached to the engine.*
· Position the water circulation tubes as shown in figure. The fittings on the pressure reducer can be rotated to create the most convenient positions for the water tubes.
· Using the clamps, make sure the heating tubes are connected to the water connections of the reducer as shown in figure.
· The other end of the water tube must be connected in parallel with the tubes of the vehicle heating system, by means of T junctions.
· Take care not to create kinks or tight curves when connecting the tubes. Good heating is necessary so that the CNG will evaporate.





· Fix the reducer below the level of the radiator so as to avoid the accumulation of air bubbles in the cooling system.
· Thoroughly clean the CNG tank and tubing before assembling in order to avoid the accumulation of dirt inside the reducer.
· When assembly is complete, start the engine and allow it to reach normal operating temperature, making sure that there are no water leaks and the reducer heats up quickly.
· Every time the cooling system is drained, it will be necessary to reset the level of the cooling system based on the OEM's specifications, making sure to eliminate any air pockets that could prevent the coolant liquid from circulating inside the reducer.

6.2 NG2 MAINTENANCE

• NG2 pressure regulator life time is ≥ 200.000 km
• Main check of NG2 must be foreseen every 100.000 km.
• Landi Renzo will provide parts to be eventually substituted during inspection.
• The inspection must be done by skilled technicians.
• After inspection, leak and high pressure tests are needed.
• NG2 is a very precise and accurate pressure regulator; its assembly and maintenance are not easy, requiring also some dedicated tools explained

•Every 50.000 km:
–Remove eventual oil present inside pressure regulator using dedicated plug on 1st and 2nd stage,
–Check eventual external leakage on the pressure regulator and on its gas pipes.

•Every 100.000 km:
–Check gas inlet filter status, clean or change it if needed,

•In case of malfunctioning (200.000 km) repair the pressure regulator using Spare parts kit. Use "trouble shooting" to detect the cause.

6.2.1 NG2 SPARE PARTS

NG2 must be dismounted from the car for inspection

- *If a trained technician is not present in site, NG2 assembly must be stored as spare part, to substitute the dismounted one.*
- *If trained technician and dedicated tools are present in the workshop, then the pressure regulator can be overhauled with the spare sub-parts and then re-mounted on the car.*

NG2 Spare Parts KIT – Part 1: consumable parts:

- *All pressure regulators O-Rings,*
- *All pressure regulators washers,*
- *1st / 2nd stage diaphragms,*
- *1st / 2nd stage valves,*
- *Plastic plugs for pressure calibration screw and HP sensor.*
- *Anti-vibration support device,*
- *Gas inlet shut-off valve mobile and sealing parts,*
- *Gas inlet sintered filter.*

NG2 Spare Parts KIT – Part 2: spare parts:

- *Coil 12 v 20w,*
- *1st / 2nd stage springs,*
- *HP potentiometrical pressure sensor,*

6.3 NG2 TROUBLE SHOOTING

Description of Effect	What do you have to do
Gas does not exit from reduction unit	• Check functioning of gas solenoid valve inlet and especially condition of coil.
Pressure regulator load insufficient	• Inlet solenoid valve filter blocked. •Solenoid valve not opening completely. •1st and 2nd stage pressures not as specified.
Pressure regulator operates at very low temperature.	• Check water circulation
Idling speed adjustment very difficult	• 2nd stage pressure not as specified. • Check correct connection of MAP compensation circuit.
Loss of gas to the exterior	• Check cover tightening torques •Check condition of seals/membranes
Loss of gas internally with engine off	• Check solenoid valve at gas inlet, especially condition of internal sealing elements.
Loss of water from reduction unit heating circuit	• Check condition of sealing elements on joints (O-rings)
Loss of gas from safety valve (safety valve opens and discharges gas)	• Check 1st stage pressure, check 1st stage valve and/or the membrane if necessary.