

CNG FILLING STATIONS STANDARD

**COMPRESSION EQUIPMENT FOR
COMPRESSED NATURAL GAS FILLING STATIONS**

GE N1-141

GAS DEL ESTADO

GE N° 1-141 STANDARD

COMPRESSION EQUIPMENT FOR CNG FILLING STATIONS

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1.1. GENERAL ASPECTS

1.1. SCOPE

This regulation shall be applicable to all the companies complying with the requirements for their registration at GAS DEL ESTADO Manufacturers and Importers Registry, besides the conditions specifically stated herein.

1.2. REGULATION

1.2.1. Definitions

1.2.1.1. Natural Gas compression equipment

Set of elements including: pulsation damper tank, piping, compressor storage cylinders, cooling system, condensate separators, condensate manifolds, valves, lubrication systems, motor, motor-compressor coupling, electrical system, vibration isolators, safety system, instrumentation and storage to be mounted on the Filling Stations for the compression of Natural Gas to be used as vehicles fuel.

1.2.1.2. Supplier

Person that manufactures or imports compressor components or equipment.

1.2.1.2.1 Manufacturer of Natural Gas compression equipment

Physical or legal entity with enough civil, technical, economic and financial responsibility for mounting / assembling the set of essential components for the assembly of compression equipment for CNG refueling stations.

1.2.1.2.1.1

The compressor Technical Representative shall be a university professional empowered to act as such, registered at the pertinent Professional Association and at GAS DEL ESTADO who shall request the approval of GAS DEL ESTADO on behalf of the manufacturer.

Such professional shall be permanently in contact with GAS DEL ESTADO as regards any potential modification of the equipment.

He shall also be responsible for damages arising from accidents that may occur due to deficient materials or to incorrect equipment installation and maintenance.

- 1.2.1.2.1.2 GAS DEL ESTADO approvals shall be granted based on safety and efficiency concerning CNG dispensing and on the standards and specifications drafted by the pertinent departments of Gas del Estado or else, those considered applicable by that company, which must be IRAM or those standards or specifications of the countries which are highly technologically developed or experienced in CNG use, compatible with national standards, specially those related to the installation of Filling Stations.
- 1.2.1.2.1.3 Components selection and mounting for operating as a set shall be considered for each compression equipment. Furthermore, components supplier shall ensure safety issues and the equipment manufacturer shall verify them through adequate tests. Safety issues are considered for the homologation granted by GAS DEL ESTADO to the pertinent prototypes.
- 1.2.1.2.1.4 The manufacturer of the compression equipment shall obtain the preliminary homologation with the standards in force and the necessary approvals when the issues specified in the pertinent standard may be affected by changes to the equipment.
He shall also guarantee the smooth operation of the equipment.
- 1.2.1.2.2. Manufacturer of components for Natural Gas compression equipment
- Physical or legal entity with enough civil, technical, economic and financial responsibility that manufactures components of compression equipment for CNG refueling stations.
- 1.2.1.2.2.1 The Technical Representative shall be a university professional empowered to act as such, registered at the pertinent Professional Association and at GAS DEL ESTADO who shall carry out, on behalf of the components manufacturer, the necessary proceedings for GAS DEL ESTADO approval of manufactured products he is responsible for.
- 1.2.1.2.2.2 The manufacturer of components shall verify quality standards during manufacturing processes and carry out the tests indicated in the pertinent standards, either with own equipment or else, at recognized laboratories or institutes.

1.2.1.2.3. Importers of natural gas compression equipment or components

Physical or legal entity with enough civil, technical, economic and financial responsibility that imports components for compression equipment or Natural Gas compression equipment to be installed in CNG Refueling Stations.

1.2.1.2.3.1. The Technical Representative shall be a university professional empowered to act as such, registered at the pertinent Professional Association and at GAS DEL ESTADO who shall be the Technical Responsible before GAS DEL ESTADO as regards imported components and equipment, on behalf of the importer.

He shall also be responsible for damages arising from accidents that may occur due to deficient materials or to incorrect equipment installation and maintenance.

1.2.1.2.3.2. The importer shall request homologation of the imported prototypes.

1.2.1.2.3.3. He shall also control, certify and guarantee the quality of all the elements of the batch. For this, certificates issued by recognized foreign laboratories or institutes or local entities may be accepted.

1.2.1.2.3.4. Likewise, the importer of compression equipment shall submit before GAS DEL ESTADO, a manufacturer's certification appointing him as the company's representative in Argentina for commercializing its equipment. The manufacturer may appoint more than one representative.

1.3. OBLIGATIONS OF THE TECHNICAL REPRESENTATIVE

1.3.1. To submit in due term all the documentation required by GAS DEL ESTADO.

1.3.2. To inform GAS DEL ESTADO about potential modifications to the equipment.

1.3.3. He is also responsible for damages.

1.4. RIGHTS OF THE TECHNICAL REPRESENTATIVE

- 1.4.1. Once the agreed technical service period for the compressor equipment expires, the Technical Representative appointed by the supplier may be relieved of his duties, only as regards that equipment. Upon such expiration, the Filling Station owner shall appoint – within ten (10) days – a new Technical Representative who shall comply with the same requirements of the previous one.

1.5. REQUIREMENTS FOR HOMOLOGATION

- 1.5.1. Supplier is bound to clearly inform the buyer about the scope and other significant aspects of the guarantees granted according to the guidelines of Resolution SCI N° 495/88 and conditions exclusively agreed by the parties. Supplier shall also provide the user with a plain and complete manual with the instructions for a correct installation, operation and recommended maintenance program.

- 1.5.2. Supplier shall provide GAS DEL ESTADO with a plain and complete manual of each compressor model, specifying all the issues related to the use and maintenance. The following shall be attached:

- 1.5.2.1. A worksheet with the following data:

Compressor

Make:

Model:

Type:

Rpm or cycles / min.:

Maximum suction pressure (absolute): (bar)

Minimum suction pressure (absolute): (bar)

Maximum discharge pressure (absolute): (bar)

First stage cylinder diameter: (mm)

First stage piston stroke: (mm)

Number of stages:

Stage pressure (absolute): (bar)

Suction flow – pressure curve or equivalent table.

Description of shut down, alarm and signaling systems of the compressor.

Information about compressor ancillary systems:

a) Internal extinguishing system

CO₂

N₂

Others

None

- b) Extinguishing system activation
 - Automatic
 - Manual
 - Local
- c) Compressor pulsation damper systems
 - Yes
 - No
- d) Vibration insulators of:
 - Rubber
 - Springs
 - Others
 - None
- e) Air injection in packaged enclosed compressors:
 - Permanent
 - With active compressor
 - By high temperature
 - By gas detection
 - Others
 - None
- f) Sound proof systems:
 - Yes
 - No
- g) Detectors of:
 - Smoke
 - High temperature
 - Gas
 - Others
 - None

Compressor is driven by:

- a) Electrical motor:
 - Make:
 - Type:
 - Model:
 - Rpm:
 - Explosion proof:
 - Increased safety:
 - Intrinsic safety with tight installation:

- b) Internal combustion engine
 - Make:
 - Type:
 - Model:
 - Number of emergency shut downs:

1.5.2.2. The supplier shall submit before GAS DEL ESTADO a worksheet of each commercialized equipment including the following data:

- Make:
- Model:
- Type:
- Rpm or cycles / min.:

Driven by:

- a) Electrical motor
 - Explosion proof
 - Increased safety
 - Intrinsic safety with tight installation

b) Internal combustion engine

Pressure Storage:

Yes

No:

If affirmative, state:

Internal

External

Cylinders position

Capacity of each of them in water liters

Maximum storage pressure

Each cylinder is fitted with:

Manual valve

Drain valve

Burst disc and fusible plug

Venting valve: YES / NO

Activation:

Local

Remote

Electrical

Pneumatic

Date of the first cylinder Hydrostatic test certificate.

Copy of each cylinder manufacturing certificate

Number of the corresponding cylinder

List of makes

- 1.5.2.3. The supplier shall also provide the user and GAS DEL ESTADO with the components list and the motor and fittings catalog. The following diagrams shall also be provided:
- General layout
 - Flow
 - Electrical operation
 - Safety
- 1.5.3. GAS DEL ESTADO reserves the right of demanding certificates of different tests and also the calculation report of those parts that may affect the system safety.

2. DEFINITIONS

- 2.1. CNG (COMPRESSED NATURAL GAS): Hydrocarbon mainly constituted of methane, which is dispensed at a maximum pressure of 200 bars.
- 2.2. SAFETY DEVICES IN CNG COMPRESSION EQUIPMENT: Mechanisms for protecting persons and integrity of the CNG compression equipment.
- 2.2.1 Burst disc and Fusible Plug: It consists of a burst disc combined with a fusible plug. The disc is manufactured and tared to rupture at a pressure which is higher than the cylinder hydrostatic test pressure but lower than that of the burst disc.
- 2.2.2 Pressure relief safety valve: Usually a spring-loaded valve that opens the outlet and vents to the atmosphere in case of overpressure and closes it when the pressure in the container decays to normal values.
- 2.3. COMPRESSION EQUIPMENT: Assembly of components for compression, storage and dispensing of CNG, installed in Filling Stations.
Equipment may not have storage.

- 2.3.1. Packaged Equipment: Assembly of compression and storage systems usually mounted on the same metal structure.
- 2.4. PROTOTYPE: First unit of a specific compressor model manufactured for being subjected to tests for obtaining its approval.
- 2.5. CNG DISPENSER: Installation that combines a metering system and other essential components for filling motor vehicles cylinders with CNG.
- 2.6. CNG STORAGE UNIT: Cylindrical vessels which shall be permanently fixed, vertically or horizontally on special structures manufactured to that effect, but dismountable.
- 2.7. FORCED VENTILATION: Pressurized air flow from outside entering the compressor enclosure through a fan. Its volume shall be such as to prevent explosive mixture build up in case of leaks.
3. INSPECTIONS
- 3.1. Before start up, equipment shall be inspected and approved by GAS DEL ESTADO. This inspection shall be performed so as to verify that the equipment has the same characteristics as the approved prototype. The Commercialization Company technical representative shall be present.
- 3.2. GAS DEL ESTADO reserves the right of inspection at any time, so as to verify that the equipment is in good maintenance and operating conditions.
4. MINIMUM, TECHNICAL AND SAFETY SPECIFICATIONS
- 4.1. Components subjected to pressure shall be so designed as to withstand a pressure 20% higher than the maximum discharge operation pressure of each stage.
If its value is lower than 20%, it shall be verified according to the regulation in force in the country of origin.
- 4.2. Components subjected to pressure shall be hydrostatically tested at a pressure of 1.5 times the maximum working pressure of each stage.
- 4.3. The initial temperature at each stage and of storage shall be 50° C maximum and discharge temperature at each stage shall be 200° C, considering a room temperature of 20° C.

- 4.4. GAS DEL ESTADO recommends the use of inter-stage separators and condensate drainage when the gas composition so requires them.
- 4.5. Compressors shall be fitted with a venting relief valve for each stage gauged 15% above discharge pressure; except at the last stage in which the value shall change to 10% above discharge pressure.
In case of values that differ those specified on this point, it must be certified that they comply with the regulations of the country of origin.
Calibration must be checked annually.
- 4.6. These relief valves shall comply, at least, with the design requirements of API RP 520.
- 4.7. A check valve shall be located at the compressor discharge.
- 4.8. GAS DEL ESTADO reserves the right to request tests of any equipment welding, and it may accept certificates of recognized Laboratories or Institutes.
- 4.9. Law 19.587 and municipal regulations as regards noise and vibration shall be complied with. Noise and vibration shall not affect "in situ" installations or neighboring constructions. A report of the maximum sound level produced by the equipment must be submitted before GAS DEL ESTADO.
- 4.10. If the compressor is located in weather and sound proof enclosure, such enclosure must be manufactured as of non-flammable materials.
The enclosure shall be fitted with upper ventilation openings which total surface shall be such as to avoid the accumulation of CNG potential leaks.
- 4.11. Compressors shall include a pulsation damper tank, which volume shall be at least, 30 times the first stage piston stroke; furthermore, its capacity shall be such as to prevent gas venting when the machine is idle. In case of a lower volume, it shall be duly accounted for. Such tank shall be fitted with an overpressure relief valve venting to the atmosphere.
- 4.12. Equipment shall be adequately supported so as to avoid displacements.

4.13. An original or a duly authenticated copy of the tests certificates submitted shall be issued by recognized entities.

4.14. Deflagration-proof or explosion-proof enclosure of devices, fittings or electrical components shall count with IRAM quality certificate granted by IRAM or other national recognized entity.

An authorized entity recognized by IRAM shall certify the quality of imported materials.

Likewise, each component shall bear indelibly, either embossed or in a non-removable plate, a permanent inscription, indicating:

- a) Manufacturer or trading company registered name.
- b) Enclosure type.
- c) Certification of explosion-proof material and certificate number.
- d) Gas or vapor group.
- e) Certification of quality.

Components of other electrical systems suitable for Class I, Division 1 and 2 environments, such as intrinsic safety, pressurized, in oil bath, tight, etc. shall count with the certificates of approval issued by a recognized laboratory or entity.

4.15. ELECTRIC MOTOR COMPRESSORS

4.15.1. Packaged Compressors without built in storage

- a) If there is no forced ventilation in the enclosure, the area shall be considered as Class I – Division 1; thus, the installation of explosion proof motor and fittings is necessary.
- b) If there is permanent and positive ventilation in the enclosure, the area is considered as Class I – Division 2; thus, the installation of increased safety motor and shielded fittings is necessary.

4.15.2. Packaged Compressors with built in Storage

- a) If there is no forced ventilation in the enclosure, the area shall be considered as Class I – Division 1; thus, the installation of explosion proof motor and fittings is necessary.
- b) If there is positive ventilation in the enclosure, the area is considered as Class I – Division 2; thus, the installation of increased safety motor and shielded fittings may be possible, and the installation of an explosive mixture detector is mandatory so as to produce a power cut when a maximum Lower Explosion Limit (LEL) of 20% is detected.

4.15.3. Non-packaged Compressors in Closed Room

If there is good natural ventilation (zenithal or right below the roof on the sides) in the room, it is considered as Class I – Division 2; thus, the installation of increased safety motor and shielded fittings is necessary.

If the room's volume is lower than 160 m³ or if natural ventilation is not enough, the motor and electrical installation shall be Class I – Division 1. If ventilation is improved with forced air systems the area shall be Class I – Division 2.

4.15.4. Non-packaged Compressors in Open Air Room

Those areas are considered as Class I – Division 2; therefore, increased safety motor and gas-tight shielded fittings shall be installed.

4.16. COMPRESSORS DRIVEN BY AN INTERNAL COMBUSTION ENGINE

4.16.1. If the engine start-up system is electrical, it must be enclosed in a tight box pressurized with air coming in from outdoors. This air vents outdoors too.

If the engine is not enclosed in a tight box, it shall be located in a separate room from the compressor room; which shall be ventilated by natural air coming in from outdoors

Furthermore, the start-up motor battery shall be located outdoors.

Party wall between the compressor and motor rooms shall be gas-tight.

4.16.2. If the engine start-up system is pneumatic, it may be installed in the compressor room. For this, GAS DEL ESTADO shall request internal or external engine ventilation through pressurized air.

4.16.3. An explosive mixture detector operating on the emergency shut down shall be installed in the room where the engine is located.

5. INSTRUMENTATION

5.1. The compressor shall include the following instruments:

- Suction pressure gauge
- Inter stage gauge
- Discharge pressure gauge
- Storage gauge
- Oil pressure gauge
- Temperature indicators
- Oil meter

5.2. It shall also be equipped with automatic shut downs which shall activate under the following excess conditions:

- Low and high inlet pressure
- High discharge pressure
- Discharge temperature rise
- Low oil pressure
- Low oil level

5.3. GAS DEL ESTADO recommends the use of indicators so as to show the failure that triggered the compressor shut down.

5.4. Whenever GAS DEL ESTADO deems it convenient, supplementary instruments for reassuring system's safety shall be required.

6. SAFETY INTERLOCKING DEVICES

6.1. CNG compressor equipment shall have a duly identified emergency stop palm button switches that will shut down the equipment, close line valves, cut off dispensing and any other operation related to safety sequence.

It shall be located within the compressor room or over the packaged enclosure.

Emergency shut down shall be restarted manually from the control panel.

6.2. If the electrical installation is Class I, Division 2 and the ventilation is permanent and positive, there shall be at least two air flow sensors interlocked with the fan contactor, the three of them serially connected, for enabling electrical power for the entire installation. If there is no forced ventilation, no voltage shall exist.

6.3. In case detection of explosive mixture is required, the detector equipment may be calibrated for the first level at 10% of the Lower Explosion Limit (LEL) with sound alarm. For the second level at 20% of the LEL, the compressor shall be shut down and the electrical power inside the packaged equipment shall be stopped and valves closure shall be interlocked.

In case of a non-electrical driving motor, it must be shut down by cutting supply to ignition and startup system by means of a battery or pneumatic electro valve, if corresponds.

7. STORAGE

7.1. Storage may be performed in tanks or cylinders. The ideal volume is that corresponding to approximately one hour of compressor operation.

7.2. Submission of cylinders and tanks manufacturing certificate shall be required.

7.3. TANKS STORAGE

- 7.3.1. CNG storage tanks shall be designed such as to be fitted for 250 bar working pressure and shall comply with the requirements of ASME code, Section VIII – Division 1, or others accepted by GAS DEL ESTADO.
- 7.3.2. Each tank shall be fitted with an overpressure safety valve that shall open when the pressure does not exceed 20% over the normal working pressure and venting at a pressure not exceeding 15% over the opening pressure.
- 7.3.3. Storage shall contain only one glycerin pressure gauge
- 7.3.4. Tanks shall be mounted such as to avoid concentration of excessive loads in supports.
- 7.3.5. Additional welding shall not be accepted in tank zones exposed to internal pressure.
- 7.3.6. Tanks shall be interconnected and, in turn, connected to manifolds through stainless steel AISI 304 or 316 type, omega tubes.
- 7.4. CYLINDERS STORAGE
- 7.4.1. Cylinders shall be manufactured such as to operate at a working pressure of 250 bar, according to the construction and tests requirements of IRAM 2526 Standard. They shall be placed vertically or horizontally in groups.
- 7.4.2. Each cylinder or a reduced group of cylinders shall have a valve, so as to separate the group in areas for enabling partial venting in case of interconnections failure or for operative reasons. GAS DEL ESTADO shall determine the group size.
- 7.4.3. One or more overpressure safety valves designed according to API RP 520 – Annex D shall be used. Their calibration must be checked annually.
- Those valves shall open at a pressure not exceeding 20% over working pressure and shall vent at a pressure not exceeding 15% of the opening pressure.
- 7.4.4. For packaged equipment, relief valves must be connected to a common manifold which in case of overpressure shall vent the gas outdoors.

- 7.4.5. The manifold shall have a section not lower than the addition of relief valve outlet sections. Only the last compressor stage may be connected to this manifold; the previous stages must be connected to other individual manifolds.
- 7.4.6. Optionally, for each cylinder, a burst disc and a fusible plug may be used; disc shall be regulated at a pressure equal to the test pressure. It shall vent outdoors.
- 7.4.7. Cylinders shall be adequately secured and protected from corrosion.
- 7.4.8. The cylinder groups shall be placed on concrete platforms adequately constructed such as to prevent water accumulation below them.
- 7.4.9. Cylinders shall be interconnected by AISI 304 or 316 type stainless steel tubes, omega, so as to absorb expansions.
- 7.4.10. Such cylinders shall be protected with two coatings of anticorrosion paint and two of white or aluminum finishing.
- 7.4.11. Horizontal groups of cylinders shall be installed orienting valves towards areas whereby their projections do not offer any risk.
- 7.4.12. Also, for horizontal cylinders, valves mechanical protection shall be required. They may be performed with a detachable grid.
- 7.5. Each storage bank or level shall have its own fast activation valve, $\frac{1}{4}$ turn. It shall be designed such as to be sealed in close position and to prevent opening.
- 7.6. Each bank shall also have an excess flow valve mounted immediately downstream of the valve.
- 7.7. If the dispenser is not fitted with check valves, they shall be fitted in the medium and low pressure banks delivery line to the dispenser.
- 7.8. Priority panel controlling valve opening and closure shall have a system for preventing backflow towards storage banks.

- 7.9. Besides the overpressure venting through relief valves, storage shall have a fast activation manual venting (1/4 turn), by means of a valve that may be opened and closed from the outside.
These valves shall enable the bypass of a flow equal to the relief valves flow when pressure is higher or equal to 250 bar.
- 7.10. Those cylinders and tanks of a filling station which may have been affected by an incident must be reported.
- 7.11. A servo valve connected to the emergency shut down shall be installed in the piping line connecting the compressor equipment to the dispenser.
- 7.12. Semi-rigid interconnection piping shall be AISI 304 type stainless steel or other internationally recognized specification.
- 7.13. Piping bending test shall comply with IRAM 2618 Standard or any other deemed adequate by GAS DEL ESTADO.
- 7.14. Compressor and storage installation shall be performed according to the art rules and good engineering practice.

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ANNEX N° 1

MINIMUM SPECIFICATIONS FOR CNG DISPENSERS

1. REGULATIONS

- 1.1. Dispenser Supplier shall comply with the requirements specified in points I-2-4 or I-2-5, of CNG Compressors Provisional Standard, as corresponds.
- 1.2. He shall submit before GAS DEL ESTADO, the following technical documentation:
- Specifications and use manual
 - Flow diagram
 - General layout plan
 - Fittings descriptive plan
 - Parts list
 - Fittings booklet

2. MINIMUM SPECIFICATIONS

- 2.1. Dispenser shall be fitted with a breakaway system at 200 bar pressure, with a maximum tolerance of 2.5%. It shall be sealed after calibration.
- 2.2. GAS DEL ESTADO may request a test of that system before its mounting on the dispensing station, so as to check that supply shuts down at the stated pressure.
- 2.3. Downstream of the breakaway system, each hose shall have a second breakaway system for preventing the maximum allowable fill pressure from being exceeded by a 7.5%. It must be sealed.
- 2.4. Dispenser valves shall bear a marking plate with the following data:

Make and Model:

Normal working Pressure:

Maximum Working Pressure:

Manufacture Date:

Test Date:

Working Flow:

- 2.5. The dispenser shall be fitted with a Class 0.5 or 1 gauge per each hose for checking dispensing pressure from the outside
- 2.6. Dispenser internal lines shall be AISI 304 or 316 type stainless steel or a more resistant material.
- 2.7. All dispensers, including hanging ones, shall include a control valve and an element for supporting the hose when idle.
- 2.8. They shall be fitted with an excess flow lock up system located immediately upstream of the dispensing hose.

This system shall be periodically inspected and approved by GAS DEL ESTADO. The method of test consists in closing the dispenser control valve and venting the gas contained in the hose and in the equipment internal lines. Then, control valve is opened abruptly, activating the excess flow blocking system.
- 2.9. The dispenser electrical installation shall be explosion proof or intrinsically safe according to Section 500, NEC Standard.
- 2.10. Dispenser hoses shall bear their manufacturing dates embossed at both ends.
- 2.11. Hoses shall be fitted for operating at a normal pressure of 200 bar and hydrocarbon resistant in their inner side and weather proof (humidity, ozone, etc.) in their external surfaces.
- 2.12. The specification applied for hoses approval shall require their subjection to hydrostatic test at 4 (four) times their working pressure.
- 2.13. Tests carried out on hoses for their approval shall comply with the guidelines included in Table Nr. 12, GE 1-117 Standard.
- 2.14. Likewise, hoses shall bear an exclusive serial number placed by the manufacturer.

- 2.15. The Dispenser Supplier shall submit before GAS DEL ESTADO the original certificate or authenticated copies of the certificate corresponding to the hydrostatic test performed on the equipment hoses.
- 2.16. Hose length shall avoid contact with the island floor.
- 2.17. When in good operation, the filling hose bending radius shall never exceed the allowed one.
- 2.18. The maximum acceptable error in dispenser calibration is $\pm 2\%$
- GAS DEL ESTADO reserves the right to inspect dispensers when deemed convenient.
- 2.19. Hose service life shall be limited by the condition of the external protection, meshes or terminals, according to GAS DEL ESTADO's criteria.