



## GAS Cylinders

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**CNG Cylinders Manual**



*Ampliando Limites*



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We congratulate the consumer for this decision to convert their vehicles to CNG and appreciate their choice for MAT cylinders.

This intelligent decision is going to bring significant economy in your expenditure on fuel and mechanics maintenance.

**CONVERSION TO CNG.  
AN INTELLIGENT DECISION!  
MAT CYLINDERS  
THE BEST ALTERNATIVE!**

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MAT works since 1940 manufacturing cylinders. We are a genuinely Brazilian company and the first Latin America in the field of high pressure gas cylinders production. Our personal mark is the pioneering tradition of quality products. We service the Brazilian market and provide cylinders to other countries of Latin America, Asia, United States and Europe, where more than 3.0 million cylinders MAT circulate. Our factory produces cylinders, and supply cylinders with national and international certifications. MAT is also a company certified by Bureau Veritas Certification, according to the standards of ISO 9000 series that set strict criteria to be met, whose main goal is to meet the needs and expectations of the clients.





## 2 - Introduction:

### MAT Cylinders Quality:

The Storage of CNG (Compressed Natural Gas) in cylinders requires advanced technology, in which safety and quality appear in first place.

The MAT company, respecting all the rules and regulations national and international manufacturing, safety and technology, has developed products with high quality at a price within reach of all.

### Control of the Cylinder:

(Must be completed by the installer).

Serial Number:
Date of Purchase:
Stamp of Establishment:

It is worth noting that periodic inspection of its cylinder must be performed by properly certified entity and all activities covered by the standard.

Periodic Review at:
Stamp:

Periodic Review at:
Stamp:

Periodic Review at:
Stamp:

Periodic Review at:
Stamp:

**MAT CYLINDER:  
TECHNOLOGY, QUALITY AND COMMITMENT!**



XVI - Fire: In case of fire on your vehicle, do not try to suppress it. Immediately take the distance of 50 meters (minimum) and call the Fire Brigade. They must be informed that your vehicle is powered by natural gas. This is key information to improve the work of firefighters.

XVII - Read carefully: All cylinders have a sticker set with safety instructions. It should be read with attention.

### **XVIII Storage:**

1 - In case of no immediate use of the cylinder after its arrival, best storage practices should be considered such as: Keep the cylinder in sheltered place and free of corrosive atmosphere and protected from the weather, protect from the exposure to high temperatures of mechanical actions (strikes, crumples, scratches), excessive moisture and dust.

2 - Keep the cylinders permanently with plug on the neck, and preferably in a horizontal position on blocks of wood, avoiding direct contact with the floor and distanced from each other until the moment of their use.

3 - In case of storage for a long period, even if under appropriate conditions, the cylinders must be submitted to visual internal inspection before the final assembly in the vehicle.

**IN ANY SITUATION THAT BRINGS YOU DOUBT,  
CONTACT YOUR INSTALLER.**

## **3 - Quality Policy and Environment:**

**MAT is totally committed to product quality and to the attendance of its customers. The company's quality policy and environment is based on:**

1 - The total customer satisfaction through the achievement of their requirements, previously employed, anticipating their expectations from the moment of the first contact until the successful use of the product.

2 - The continuous quality improvement, through the commitment of its Highest Directors and a Quality Management System focused on investments in developing new products, procedures and team work, so that the Quality is the responsibility of all officials, working thus for the growing success of our customers.

3 - The continuous improvement of quality, through the commitment of its Senior Management and a Quality Management System, focused on productivity, costs and innovations, to achieve objectives, with all employees being responsible for quality.



4 - The conservation of the environment and the well-being of society, through measures to prevent and reduce environmental impacts, correct disposal of industrial waste, as well as the awareness of its human resources in the pursuit of a healthy life and correct environmental posture.

5 - The protection and processing of data of interested parties (customers, employees, suppliers and shareholders) through the evolution of the information security policy with restricted access rules and cybernetic countermeasures.

For this quality policy work even better, we expect the participation of our customers with suggestions and reviews.

## **PARTICIPATE!**

IX - Just fill authorized CNG stations.

X - Do not allow the manufacturing features of cylinders and valves to be changed. Do not let "curious people" modify the thread of the cylinder, the valves, security devices, the markings or so. In case of any question, please contact the installer or MAT service.

XI - Do not change the cylinder color. Its color should be maintained as it is a standard.

XII - Take care in the maintenance and repairs. Before any type of maintenance or repair involving the vehicle or solders sources of heat, the cylinder must be removed and depressurized.

XIII - Avoid mechanical damage. Protect your cylinder, so it will last longer.

XIV - Periodic inspection should be done every five years, or when it is reinstalled in another vehicle. Resettlement can only be achieved by certified companies. Shortly after the services of inspection, the company should set a certifying inspection seal on the cylinder's shoulder.

XV - Check your equipment. The valves must have some relieving pressure device or the pressure relief valve pressure valve of flow excess, as regulations say. Check with your installer.





V - Do not expose the cylinder to corrosive products. Beware of the acids and avoid leaving it next to batteries, for example. Keep the painting of your cylinder in good condition, avoiding corrosion due to weather (rain, excessive moisture, etc).

VI - Never mess with the arrangements for relieving pressure or safety valve: As the name says, is to bring security. If there is any problem, call a technician and he will change the valve.

VII - Never fill up the cylinder with higher pressure than of 220 Kgf/cm<sup>2</sup>, equivalent to 215.7bar, 21.75MPa or 3129psi. This is the pressure supply permitted by ANP - Agency National Petroleum, Natural Gas and Biofuels. The CNG MAT cylinders, are designed for working with the maximum pressure of 200bar, equivalent to 196Kgf/cm<sup>2</sup>, 20MPa or 2845psi recital - considering the standard temperature of 21°C. The service pressure is achieved when the gas temperature stabilizes, after the supply of the vehicle.

**ATTENTION: Supplying the cylinder with higher pressures than the thresholds set by the ANP, can reduce its and the rest of the kit components of conversion lifetime.**

VIII - Installation and removal of the cylinder can only be performed by registered technician. The user must not allow not entitled people to handle this equipment. If the removal of the cylinder becomes necessary, it must be fully depressurized.

## MAT's Quality and Technical Certification



**EXAMPLE**



## 4 - CNG [Compressed Natural Gas]:

Natural gas was approved as fuel for vehicles because of the economy that it brings to users and to the country and because it reduces environmental pollution and the wearing of the engines. Until then its application was limited to the household and industrial use. The use of natural gas for vehicular use, although recent, improved and modernized transport system. Several countries have already adopted the trend is that more and more countries will join this program, due to safeguard the environment and /or economy for the population and the country. The CNG is undoubtedly the most safe, clean and economic fuel available today.

The MAT cylinders store this fuel at a pressure of 200bar (20MPa). The CNG is lighter than air and, in case of leakage, spreads itself quickly in the atmosphere, reducing the risk of explosion or fire. Also, for the CNG to ignite, it must be subjected to a temperature of approximately (\*) 620°C, while gasoline ignites at the temperature of approximately 200°C.

(\*) Source: [www.gasbrasil.com.br](http://www.gasbrasil.com.br)

## 9 - Care:

**For your safety, it is essential to follow this instructions carefully:**

I - Do not try to transfer gas from one cylinder to another: It is a high risk operation. Do not attempt to withdraw the gas cylinder without suitable equipment for the depressurization, as this will involve risks. The cylinder should be handled by technically trained people.

II - Avoid the exposure of your vehicle cylinder to any source of excessive heat or solder. Do not weld cylinders. Exposed to high temperatures, they change their strength features and become fragile. In such cases, the cylinders can not be reused and should be destroyed.

III - By no means replace the cylinder by another tank. Other tanks of compressed air can not be used with CNG cylinders or replace them. MAT CNG cylinders are designed and tested to safely withstand the storage of high pressure (200bar or 20MPa), while other types of cylinders are not able to that.

IV - Do not use the cylinder to other types of gases. The gases behavior may vary. Some are even corrosive and may internally damage the cylinders, causing cracks or so. This reservoir (cylinder) was developed specifically for CNG.



It is worth to highlight the obligation of inspection in every five years to revalidate the use of the cylinder, from the date of manufacture or in case of/corrosion (rust), thermal damage causes (fire on the vehicle, for example) or mechanical (crumples, strokes), or even when the cylinder is transferred from a vehicle to another.

Please note that, from this moment on, the safety of this product depends on specific care that the user should take during its use. So, stay tuned to the instructions of this section of the manual.

**THE CONVERSION OF YOUR VEHICLE MUST BE MADE  
IN COMPANIES TRAINED TO MAKE A GOOD JOB THAT  
GUARANTEES SECURITY AND THE ECONOMY DESIRED.**

## 5 - What is a CNG Cylinder?

A cylinder is a reservoir developed in accordance with national and international manufacturing technical standards. MAT cylinders are made of tubes of special seamless and without welds (which is prohibited) alloy steel, to ensure resistance on high pressure services. These cylinders work in a pressure of 200bar (20MPa). They also have high resistance to shocks and collisions. For this, the MAT cylinders go through many trials and tests during the manufacturing process, and are randomly separated and some destroyed parts are used for mechanical tests made by the company's Quality Assurance and the Product Certification Body (OCP) accredited by INMETRO. It is noteworthy that the mechanical strength of the MAT cylinders is enhanced after the implementation of specific and advanced treatments in our factory.

### Service Life:

The service life for which cylinders are safe on the basis of use under service conditions specified here in the maximum 20 years.

### Design Number of Filling Cycles:

The cylinder is designed to be suitable for a pressure of 200bar at a settled temperature of 15°C and designed to be filled up to 1000 times per year of service.

**Settled Gas Temperature:**

Settled temperature of gas in cylinders, which may vary from a minimum of -40°C to a maximum of +65°C.

**Cylinder Temperatures:**

Cylinders are designed for service conditions involving temperatures of between -40°C and +82°C.

Cylinder material temperatures over +65°C are expected to be sufficiently local, or of short enough duration, that the temperature of gas in the cylinder never exceeds +65°C.

**Gas Composition:**

Cylinders are designed to tolerate being filled with natural gas meeting the specification of ISO 15403-1 and ISO/TR 15403-2, and either of dry gas or wet gas as described below. Methanol and/or glycol shall not be deliberately added to the natural gas.

NOTE: Where it is suspected that wet-gas conditions may exist, it has been found that a minimum of 1mg of compressor oil per kg of gas has prevented the corrosion of steel cylinders.

**Dry Gas:**

Water vapour shall be limited to less than 32mg/m<sup>3</sup> (i.e. a pressure dewpoint of -9°C at 200bar).

Constituent maximum limits shall be:

Hydrogen sulfide and other soluble sulfides	23mg/m <sup>3</sup>
Oxygen	1% (volume fraction)

Hydrogen, when cylinders are manufactured from a steel with an ultimate tensile strength exceeding 950MPa.

**Wet Gas:**

For gas that has a higher water content than of dry gas, constituent limits shall be:

Hydrogen sulfide and other soluble sulfides	23mg/m <sup>3</sup> maximum
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## 8 - Safety:

The safety of MAT cylinders is guaranteed by the Quality Management System (see item 3), the certificates of quality, the seal of INMETRO, the adhesive dressed in cylinders and the Certificate of Compliance that accompanies all cylinders. However, much of the responsibility with the cylinder safety is in the use after leaving the factory, in which the customer has an important participation. Hence, follow properly the operating instructions contained in documents mentioned in this manual.

**Documents:****Quality Certificates [see item 3].**

**Certificate of Compliance MAT:** Attached each cylinder, certifies the perfect state of it (in normal conditions) and ensures that all tests required by the manufacturing standard of the product were executed.

**Sticker on the Cylinder:** Contains the instructions for use. More important in the handling of MAT cylinders, after leaving the factory.



## 7 - Valves:

**7.1 - Valve of the cylinder shoulder:** Is designed to adjust and interrupt the of gas supplied to the system. It has a security system provided with a combination of fuse and league record of rupture, that operates when the cylinder is subjected to temperatures above 100°C (one hundred Celsius degrees) and its internal pressure exceeds 300bar (30MPa). In this case, the league is based and the disc is broken by the pressure of the gas, allowing its output, rescuing the security of the system. It is also equipped with the excess flow valve, which comes into operation restricting the output of the gas cylinder, if there is an accident followed by disruption of high-pressure tubing.

**7.2 - Supply Valve:** Responsible for the vehicle supply, has anti-return system that prevents the output of gas to the atmosphere at the end of operation of filling the cylinder.

Oxygen	1% (volume fraction maximum)
Carbon Dioxide	3% (volume fraction maximum)
Hydrogen	0,1% (volume fraction maximum)
Compressor Oil	1 mg/kg natural gas minimum

### External Surfaces:

It is not necessary for cylinders to be designed for continuous exposure to mechanical or chemical attack (e. g. leakage from cargo that may be carried on vehicles or severe abrasion damage from road conditions). However, cylinder external surfaces is designed to withstand inadvertent exposure to mechanical or chemical attack consistent with their installation being carried out in accordance with the instructions to be provided with the cylinder.

Mechanical or chemical attack may result from environments such as:

- a) Water, either by intermittent immersion or road spray;
- b) Salt, due to the operation of the vehicle near the ocean or where ice-melting salt is used;
- c) Ultraviolet radiation from sunlight;
- d) Impact of Gravel;
- e) Solvents, acids and alkalis, fertilizers;
- f) Automotive fluids, including petrol, hydraulic fluids, battery acid, glycol and oils;
- g) Exhaust gases.



## 6 - Storage Capacity of Gas in the Cylinder:

### How to check the ability of cylinders? [Table]

Looking up at the gas volume in m<sup>3</sup> (cubic meters) that fits in a cylinder depending on the temperature, we can notice that there are some variations. Let's see, for example, the MAT cylinder of 62 liters.

Its capacity in liters of water is 62 liters, therefore, inside it, at a temperature of 15°C (fifteen degrees Celsius), will be approximately 15.0 m<sup>3</sup> of CNG

We must emphasize that the cylinder holds a gas that behaves different from liquids. If the temperature rises, gas expands and occupies more space, so, the cylinder would have less gas in then at 15°C. In a situation of high temperature (36°C for example), the same cylinder should pack of approximately 13.5 m<sup>3</sup> gas (see chart).

Because of that, the storage capacity in liters of water, which is constant, is used worldwide to identify the cylinders, and not the storage capacity of gas, which is variable, because depends on the temperature, among other variables. Thus, the capacity of the cylinder in liters of water, is marked the at the shoulder of MAT cylinders, as the rules governing manufacturing.

**Table on the ability of cylinders:**

Temperature	Volume Capacity of CNG (Natural Gas Vehicle)	
°C	62 liters	100 liters
0° (zero Celsius degree)	17,23m <sup>3</sup>	28,13m <sup>3</sup>
3° (three Celsius degrees)	16,61m <sup>3</sup>	27,50m <sup>3</sup>
6° (six Celsius degrees)	16,32m <sup>3</sup>	26,88m <sup>3</sup>
9° (nine Celsius degrees)	15,95m <sup>3</sup>	26,25m <sup>3</sup>
12° ( twelve Celsius degress)	15,59m <sup>3</sup>	25,63m <sup>3</sup>
<b>15° (fifteen Celsius degrees)</b>	<b>15,33m<sup>3</sup></b>	<b>25,00m<sup>3</sup></b>
18° (eighteen Celsius degrees)	14,99m <sup>3</sup>	24,38m <sup>3</sup>
21° (twenty-one Celsius degrees)	14,74m <sup>3</sup>	23,75m <sup>3</sup>
24° (twenty-four Celsius degrees)	14,42m <sup>3</sup>	23,13m <sup>3</sup>
27° (twenty-seven Celsius degrees)	14,19m <sup>3</sup>	22,50m <sup>3</sup>
30° (thirty Celsius degrees)	13,89m <sup>3</sup>	21,88m <sup>3</sup>
33° (thirth-three Celsius degrees)	13,67m <sup>3</sup>	21,25m <sup>3</sup>
<b>36° (thirty-six Celsius degrees)</b>	<b>13,46m<sup>3</sup></b>	<b>20,63m<sup>3</sup></b>
39° (thirty-nine Celsius degrees)	13,18m <sup>3</sup>	20,00m <sup>3</sup>
42° (forty-two Celsius degrees)	12,98m <sup>3</sup>	19,38m <sup>3</sup>