

SAFETY BULLETIN

USE OF REGULATORS ON COMPRESSED GAS CYLINDERS OVER 3000 PSI

Compressed gas regulators can safely be used on compressed gas cylinders; however, failure to follow the manufacturer's operating instructions can result in serious personal injury. Following the instructions listed below can reduce the possibility of incurring such injury. An explanation of the background of these instructions follows.

- **Do** read manufacturer's operating instructions and determine the maximum rated operating pressure before attaching a regulator to a cylinder;
- **Do not** use a regulator that is not designed for the specific gas or maximum inlet pressure it will be regulating;
- **Do not** remove CGA V-1, *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections*, inlet connections from a regulator (installed by the manufacturer) and replace them with different CGA connections or an adapter;
- **Do not** attach an adapter to the inlet of a regulator if the end result violates CGA V-1, which states, "Even for the same gas, adapters shall not be used that connect a high pressure source to equipment rated at a lower pressure." Adapters include such devices as rigid or flexible fittings, control valves, pressure adjusting valves, etc. [1];
- **Do not** use adapters to change the gas service of a regulator; and
- **Do not** modify a regulator to enable its use in a manner not intended by the manufacturer.

CAUTION: *An adapter regulator, e.g., a regulator designed to adapt a 3000 psi (20 680 kPa) rated regulator to a 5500 psi (37 900 kPa) cylinder, shall be provided with a pressure relief device to limit its outlet pressure so that in the event of seat leakage or unintentional operation, the rated inlet pressure of the regulator on which it is installed is not exceeded.*¹

Background

Over the years, the Compressed Gas Association (CGA) has assigned cylinder valve connections to provide safety and standardization in the compressed gas industry. The foundation of safety has been established by making these connections *gas specific*, i.e., a particular gas or a group of gases has a unique connection that is not interchangeable with other gases. For example, a propane regulator with CGA 510 inlet connection cannot be used on an oxygen cylinder fitted with a CGA 540 valve.

In addition, these connections are *pressure specific*. For example, the CGA 540 connection is for oxygen up to 3000 psi (20 680 kPa) at 70 °F (21.1 °C), and the CGA 577 connection is for oxygen from 3001 psi to 3500 psi (20 690 kPa to 24 130 kPa) at 70 °F (21.1 °C). From time to time, CGA has revised, modified, and added connections to accommodate new technological developments in this industry, but always ensures safety by making the connections *gas specific* and *pressure specific*. The regulator manufacturers accept CGA connections as the basic criterion of regulator design and rate their regulators for use up to a specific limit of pressure, such as the CGA 540 connection up to a maximum oxygen pressure of 3000 psi (20 680 kPa) at 70 °F (21.1 °C). This pressure limit is a fundamental design consideration and is required to meet the excess pressure test stated in CGA E-4, *Standard for Gas Pressure Regulators*:

"The regulator shall be installed so the outlet is connected to a source of test gas at the maximum rated inlet pressure of the regulator. The inlet connection shall be blanked off, the delivery pressure

¹ kPa shall indicate gauge pressure unless otherwise noted as (kPa, abs) for absolute pressure and (kPa, differential) for differential pressure. All kPa values are rounded off per CGA P-11, *Metric Practice Guide for the Compressed Gas Industry* [2]

gauge and external pressure relief valve shall be removed and the ports plugged, and the regulator valve assembly(ies) shall be removed. The test gas is then suddenly admitted into the regulator outlet. The regulator shall safely contain the pressure or release it without the throwing of parts" [3].

The above test is based on the premise that regulator valves can leak, a safety valve can fail, there can be incorrect assembly of regulators, and regulators can be wrongly connected to the pressure source. (For example, high inlet pressure by mistake can be applied at the outlet, delivery pressure gauge, safety valve or flowmeter ports, etc., on a regulator body.) This critical test is conducted to build safety into the design of regulators. It has been proven by tests that there are many regulator models presently in use in the field that meet the excess pressure test requirements of 3000 psi (20 680 kPa) but fail at higher pressures. For example, an oxygen regulator fitted with a CGA 540 connection withstands 3000 psi (20 680 kPa) but fails at 5500 psi (37 900 kPa).

The requirement that cylinder connections shall be pressure specific was brought to a focus when developments in cylinder manufacturing technology enabled the industry to increase cylinder gas pressure substantially. CGA, anticipating that attempts could be made to use existing regulators on high pressure cylinders, established the following connections:

Gas	CGA connection	Pressure and temperature ranges
Compressed air	347	3001 psi (20 690 kPa) to 4700 psi (32 400 kPa) at 70 °F (21.1 °C)
Compressed air	702	4701 psi (32 410 kPa) to 6400 psi (44 100 kPa) at 70 °F (21.1 °C)
Flammable gases	695	3001 psi (20 690 kPa) to 4700 psi (32 400 kPa) at 70 °F (21.1 °C)
Flammable gases	703	4701 psi (32 410 kPa) to 6400 psi (44 100 kPa) at 70 °F (21.1 °C)
Inert gases	680	3001 psi (20 690 kPa) to 4700 psi (32 400 kPa) at 70 °F (21.1 °C)
Inert gases	677	4701 psi (32 410 kPa) to 6400 psi (44 100 kPa) at 70 °F (21.1 °C)
Oil-tolerant nitrogen	621	3001 psi (20 690 kPa) to 4700 psi (32 400 kPa) at 70 °F (21.1 °C)
Oxygen	577	3001 psi (20 690 kPa) to 3500 psi (24 130 kPa) at 70 °F (21.1 °C)
Oxygen	701	3501 psi (24 140 kPa) to 4700 psi (32 400 kPa) at 70 °F (21.1 °C)
SCUBA air	852	3001 psi (20 690 kPa) to 5500 psi (37 900 kPa) at 70 °F (21.1 °C)

To promote safety and standardization, it is essential to follow the basic rules of gas specificity and pressure specificity for regulators installed on compressed gas cylinders. Attempts to circumvent these basic rules by adapters or by other means can create serious hazards.

References

Unless otherwise specified, the latest edition shall apply.

[1] CGA V-1, *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections*, Compressed Gas Association, Inc., 14501 George Carter Way, Suite 103, Chantilly, VA 20151. www.cganet.com

[2] CGA P-11, *Metric Practice Guide for the Compressed Gas Industry*, Compressed Gas Association, Inc., 14501 George Carter Way, Suite 103, Chantilly, VA 20151. www.cganet.com

[3] CGA E-4, *Standard for Gas Pressure Regulators*, Compressed Gas Association, Inc., 14501 George Carter Way, Suite 103, Chantilly, VA 20151. www.cganet.com