



COMPRESSED GAS ASSOCIATION, INC.

SAFETY BULLETIN

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PRODUCT MIGRATION IN MANIFOLDED CYLINDERS DUE TO TEMPERATURE VARIATIONS

Liquefied compressed gases are routinely filled into cylinders by the compressed gas industry. These are gases that generally become liquid in containers at ambient temperatures and at pressures from 25 psig to 1500 psig (172 kPa to 10 340 kPa).¹ Some examples include carbon dioxide, nitrous oxide, ammonia, propane, and chlorine. The amount of liquefied gas permitted in a cylinder is determined by transportation regulatory agencies. This maximum allowable fill weight is based on the fill density of the specific lading and the internal volume of the cylinder. This ensures that the cylinder does not become liquid full even at higher than normal room temperature. A vapor space shall be left in the container so when the cylinder encounters a warmer ambient condition, the liquid has room to expand. Even a small change in temperature of a liquid full cylinder can create excessive hydrostatic pressure that could cause the pressure relief device to activate and release the contents and/or cause the cylinder to rupture. See Table 7, [CGA G-6, Carbon Dioxide](#), Sixth Edition, for an example of the rapid increase in container pressure that can be caused by a slight temperature increase of an overfull container [2].

It is a common industry practice to manifold cylinders together to provide an increased gas flow rate. With liquefied compressed gases, this poses a potential risk if manifolded cylinders are not managed properly. Without proper controls in place, it is possible for product to migrate between manifolded cylinders due to temperature variations. With subsequent closure of the cylinder or manifold valve, an overfilled condition can occur.

A temperature differential between manifolded cylinders can cause product to flow from the warmer into the cooler cylinders. Conditions that can cause a temperature differential between cylinders follow:

- Temperature cycling over time. Temperatures can fluctuate in unheated rooms. This temperature change can cause cylinder pressures to vary;
- Uneven radiant heat exposure. Cylinders exposed to sunlight or other radiant heat source during some part of the day can cause this condition to occur;
- Uneven convective heating of cylinders. Small space heaters, electrical motors, or ventilation systems can result in uneven heating and subsequent temperature variations in cylinders;
- Uneven conductive heating of cylinders. Heating jackets, if used, may not operate at the same temperature; and
- Partial change-out of supply cylinders. If cylinders are brought from the outside and used to partially change out the manifold, a temperature differential between cylinders can occur.

The following can be used to prevent product migration in manifolded cylinders:

- Limit backup product supply to one cylinder;
- Check valves can be installed on the individual cylinder connections. However, due to the unreliability of check valves, it is not recommended as a primary means of preventing back flow;
- Use temperature controlled gas supply rooms and eliminate any external heat source that would cause uneven heating of the cylinders;

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

- Ensure that cylinders brought into a gas supply room have adequate time to equilibrate to the existing room temperature before connecting to the manifold;
- If heating jackets are used, test jackets periodically to ensure even heat distribution to the cylinders; and
- Use individual cylinder scales, which are alarm activated for weight increase.

Liquefied compressed gas cylinders removed from a manifold should be weighed immediately to determine the remaining contents.

Users of tube trailers, ISO modules, and bundled cylinders containing liquefied compressed gases should be aware that product migration can occur due to temperature variation if more than one tube or cylinder is open at the same time.

If it is suspected that product migration has occurred and an overfill condition exists, contact the gas supplier immediately.

References

Unless otherwise specified, the latest edition shall apply.

[1] [CGA P-11](#), *Metric Practice Guide for the Compressed Gas Industry*, Compressed Gas Association, Inc., 4221 Walney Rd., 5th Floor, Chantilly, VA 20151. www.cganet.com

[2] [CGA G-6](#), *Carbon Dioxide*, Compressed Gas Association, Inc., 4221 Walney Rd., 5th Floor, Chantilly, VA 20151. www.cganet.com

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