



COMPRESSED GAS ASSOCIATION, INC.

TECHNICAL BULLETIN

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DESIGN CONSIDERATIONS FOR TUBE TRAILERS

This technical bulletin defines basic design considerations for new tube trailers (including tube modules) to maintain structural integrity during normal conditions of handling and transport. In addition, these design considerations should reduce the likelihood of separation of the tubes from the trailer or bundle and lessen the unintentional release of product when subjected to the multidirectional forces that can occur in a highway collision including a rollover accident. Tube modules shall meet the loading and accident protection standards that are applied to tube trailers.

Definitions

For the purpose of this technical bulletin, the following definitions apply:

- Endplug—fitting installed in the end of a tube that acts as an adapter between the tube and the pressure relief device (PRD), valve, or other fitting installed in the end of the tube.
NOTE—Also commonly known as a bullplug.
- Internal PRD—pressure- and/or temperature-activated device used to prevent the pressure in a tube from rising above a predetermined maximum that is installed within the tube and/or endplug to protect it from accidental damage that can cause the device to activate prematurely.
- Motor vehicle—vehicle, machine, tractor, trailer, semi-trailer, or any combination thereof propelled or drawn by mechanical power and used on the highways in the transportation of passengers or property.
- Tube—seamless compressed gas cylinder.

NOTE—A tube is authorized for transportation only when horizontally mounted on a motor vehicle or in an International Organization for Standardization (ISO) framework or other framework of equivalent structural integrity.

NOTE—Also defined by Transport Canada's (TC) *Transportation of Dangerous Goods Regulations* as a large means of containment that is cylindrical in shape and capable of withstanding an internal absolute pressure of 12.4 MPa [1].

- Tube bundle—group of tubes and their related attachments such as bulkheads or saddles.
NOTE—This grouping of tubes and related attachments and framework cannot be used independently of the tube trailer or tube module.
- Tube module—assembly, comprised of a tube bundle mounted within a structural frame that is designed to be temporarily mounted on a motor vehicle for transportation.
NOTE—This group of tubes and related attachments and framework forms a stand-alone unit attached to the trailer chassis as a whole, separate and distinct unit. Tube modules are also known as skid containers, ISO skids, ISO containers, or multiple-element gas containers (MEGCs).
- Tube trailer—trailer or semi-trailer motor vehicle designed specifically for the transportation of horizontally mounted tube bundles.

Basic design considerations

In addition to current U.S. Department of Transportation (DOT) and Transport Canada (TC) regulations, tube trailers shall be designed to withstand the static, dynamic, and thermal loads found during normal conditions of handling and transport without loss of contents. The design shall demonstrate consideration of the effects of fatigue caused by repeated application of these loads through the expected life of the tube trailer. The design shall address the following key areas:

- mounting of individual tubes in the tube bundle;

- attachment of the tube bundle to the motor vehicle chassis or attachment of a tube bundle to a tube module structural frame; and
- accident damage protection for pressure-retaining equipment.

For tube trailers, verifiable performance testing, analytical methods, or a combination thereof, shall be used to prove the adequacy of the design. For tube modules, analytical methods may be used in addition to, or in combination with, performance testing. Changes to a design are permitted in accordance with UN *Manual of Tests and Criteria* [2]. For all new tube trailer designs and modifications thereof verifiable performance testing may be used to validate analysis.

For each of the loading conditions described in this bulletin, the safety factor for the materials used in the construction of the framework and fastenings shall be as follows:

- for steels having a clearly defined yield point, a safety factor of 1.5 in relation to the guaranteed yield strength;
- for steels with no clearly defined yield point, a safety factor of 1.5 in relation to the guaranteed 0.2% proof strength, and for austenitic steels, the 1% proof strength; or
- for materials other than steel, design practices shall ensure a level of safety equivalent to those established for steel.

Mounting of tubes in the tube bundle

The tubes shall be mounted to lessen frictional wear under normal operating conditions.

The mounting apparatus for the individual tubes should be capable of withstanding the following separately applied static forces:

- in the direction of travel (fore and aft), a force equivalent to two times the weight of the individual tube plus the maximum weight of the contents;
- horizontally at right angles to the direction of travel, two times the weight of the individual tube plus the maximum weight of the contents;
- vertically upwards, the weight of the individual tube plus the maximum weight of the contents; and
- vertically downwards, two times the weight of the individual tube plus the maximum weight of the contents.

Attachment of the tube bundle to either the motor vehicle chassis or to the tube module structural frame

The tube bundle and method of attachment should be capable of withstanding the following separately applied static forces:

- in the direction of travel (fore and aft), a force equivalent to two times the total weight of the tube bundle including the maximum weight of the contents;
- horizontally at right angles to the direction of travel, two times the total weight of the tubes including the maximum weight of the contents plus the weight of the associated framework that forms the tube bundle;
- vertically upwards, the total weight of the tubes including the maximum weight of the contents plus the weight of the associated framework that forms the tube bundle; and
- vertically downwards, twice the total weight of the tubes including the maximum weight of the contents plus the weight of the associated framework that forms the tube bundle.

If the tube bundle is left unrestrained in the direction along the axis of the tubes to accommodate thermal expansion, any of the previously listed forces that are applied along the axis of the tube shall be evaluated at the fixed end of the bundle only.