



FLEXIBLE CONNECTIONS IN HIGH PRESSURE GAS SYSTEMS

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Prepared by EIGA WG-2 Cylinders

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Amendments from 42/16

Section	Change
general	Update of references to standards
6.4	More clear explanation on what this document recommends

1 Introduction

Since the publication of the original document in 1986, IGC 42, *Prevention of Hose Failures in High Pressure Gas Systems* [1]¹, there has been progress in the development of International Standards, such as EN ISO 14113, *Gas welding equipment - Rubber and plastics hose and hose assemblies for use with industrial gases up to 450 bar (45 MPa)* [2] relating to hoses for high-pressure gas systems. In addition to this, EIGA member companies have reported a significant improvement in hose performance, and this has been reflected in EIGA safety statistics.

The intention of updating the original document in 2004 was to extend the scope to include other types of flexible connections, for example joints and to include the operational experience gained since publication of the original document.

The scope of ISO standard ISO 16964:2019, *Gas cylinders - Flexible hose assemblies - Specification and testing* [3], covers hose assemblies intended to be connected to gas cylinders, bundles of cylinders or trailers (battery vehicles), and MEGCs for use when filling and emptying gas at production sides and also for customer use. This standard applies to flexible hose assemblies with rated pressures up to 1 000 bar for use in the temperature range of -40° C to +65° C.

This publication has been revised to reflect current standards.

2 Scope and purpose

2.1 Scope

This publication includes flexible connections for charging and discharging, compressed, liquefied and dissolved gases in the temperature range -40 °C to + 65 °C. There are no upper or lower pressure limits.

Flexible connections for cryogenic fluids which are covered by EN ISO 21012, *Cryogenic vessels - Hoses* [4] and flexible hoses for dispensing high pressure hydrogen from refuelling dispensers to hydrogen vehicles which are covered by ISO 19880-5, *Gaseous hydrogen — Fuelling stations — Part 5: Dispenser hoses and hose assemblies* [5] are excluded.

2.2 Purpose

This publication provides guidance on the design of systems that use flexible connections for high-pressure gas, such that the integrity of systems using these components is further improved.

3 Definitions

3.1 Publication terminology

3.1.1 Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 Should

Indicates that a procedure is recommended.

3.1.3 May

Indicates that the procedure is optional.

¹References are shown by bracketed numbers and are listed in order of appearance in the reference section.

3.1.4 Will

Used only to indicate the future, not a degree of requirement.

3.1.5 Can

Indicates a possibility or ability.

4 Flexible connections

4.1 General

Flexible connections are used extensively in the industrial gases industry for a variety of applications for the transmission of gases. They can be classified into the following types:

- Flexible hoses;
- Pigtails; and
- Articulated joints.

For the purpose of this publication, a flexible connection is the generic term covering any of the above connection types.

4.2 Flexible hoses

Flexible hoses are the most widely used type of flexible connections, and these can be divided into two groups:

- Hoses incorporating a plastic liner with metal or filament over braiding, see Figure 1; and
- Hoses incorporating a corrugated metallic liner with over braiding.

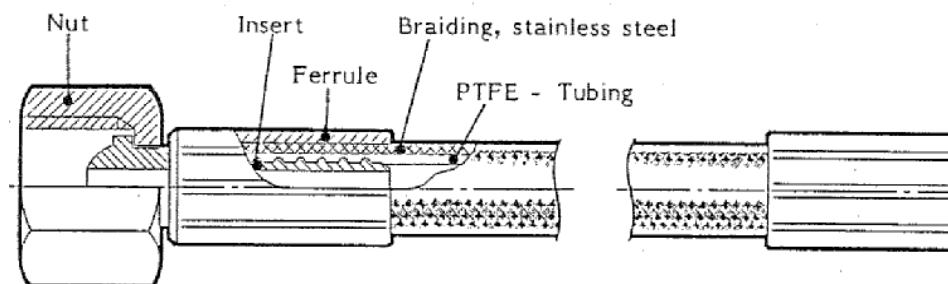


Figure 1 Construction of a typical hose with a PTFE (polytetrafluorethylene) liner

PTFE lined hoses have been used successfully in high-pressure gas systems for many years. However, hose failures, in particular ignition of the hose liner when used in oxygen service, have been reported from time to time.

Although most of the reported failures are associated with distribution manifold systems, typically at customer installations, failures have also been reported at cylinder filling stations.

4.3 Pigtails

Pigtails are usually manufactured from solid tube with a mechanical connection at each end, that connects two high-pressure systems. Pigtails are semi flexible and usually form part of a fixed installation. Pigtails are also used in applications where a flexible hose is unsuitable, for example in applications using corrosive gases, or the permanent installation of gas cylinders, for example, bundles of cylinders.



Figure 2 Pigtails used for an installation of bundles of cylinders

4.4 Articulated / swivel joints

Articulated joints are where a length of pipe is articulated about a union and the pipe takes the place of the flexible hose. These types of connections are used where frequent “making and breaking” of the connection takes place and when a flexible hose is not suitable. Swivel joints are also used to avoid torsion.



Figure 3 Swivel joint

5 Failures of flexible connections

Before designing any high pressure flexible connection, it is important to consider the various modes of failure that can affect a flexible connection as by designing out any weaknesses, it will inevitably lead to better in-service performance of the connection.

The flexible connection has in many cases been the weak link of a pressure system, and it is important to consider this at the design stage. The integrity of the connection is not the only cause for failures that can also be attributed to a design fault in the distribution system or in the use of the flexible connection.

Flexible connection failures can be grouped into two types:

- Mechanical failures (e.g. due to a leak being the consequence of crimping of the hose ends on plastic tube); and
- Hose ignitions.

Linked to this the following have been identified as significant factors in connection failures;