

## CRYOGENIC FLEXIBLE HOSES

**This Technical Bulletin is intended as guidance on the inspection requirements for EIGA Members who transfer cryogenic liquids either into or from cryogenic tankers**

Cryogenic hoses are a vital component in the transfer of cryogenic products either to, or from, cryogenic tankers.

The purpose of this Technical Bulletin is to provide guidance to members on how to maintain these hoses in a safe condition with additional specific requirements for liquid CO<sub>2</sub> cryogenic transfer hoses.

Cryogenic transfer hoses shall be designed and manufactured in compliance with recognised standards, e.g. *EN ISO 21012 “Cryogenic vessels — Hoses”* by suppliers who have been approved for the purpose.

The construction of cryogenic transfer hoses is typically a corrugated stainless steel inner hose with a stainless-steel braided overwrap. In order to protect the braiding from damage there is usually a stainless-steel spiral wire that stops the braid from touching the ground. The spiral should be welded to the hose end.

To prevent short angle bending of the hose near the connector, internal/external reinforcement should be considered e.g spiral with a small pitch on the first 30 cm or internal mesh.

The transfer of liquid CO<sub>2</sub> through cryogenic flexible hoses presents additional risks to be considered, such as:

- hose whipping caused by the failure of the hose, and hose connection;
- ice plugging and ice plug projection.

Examples of additional safety barriers for hose and/or hose connections:

- Flexible hose:
  - fitted with couplings with a design pressure of at least 1.25 times the hose’s design pressure;
  - flexible hoses of DN25 and above equipped with safety cables securely attached along of the hose itself between the spiral and the outer hose (with no possibility of sliding), with ends (e.g. carabiner) capable of being secured to solid fixtures on the road tanker and the static vessel; The safety cables and fixtures on tanks shall be designed to bear a tensile load defined in function of the MAWP and diameter of the cryogenic flexible hose (validated by a tensile test):

$$F = sf \cdot P \cdot \pi \cdot \frac{D^2}{4}$$

F tensile load (N), P pressure (Pa), D flex hose internal diameter (m), sf being a safety factor

The safety factor shall be determined in compliance with company and national standards, considering materials, expected slack margin (length of free cable/restraint for attachment to anchor points, allowing safe flexible hose connection/disconnection) ...

E.g.: Example given below pressure P:25 bar  $\Leftrightarrow$   $2.5 \times 10^6$  Pa

diameter D:50 mm  $\Leftrightarrow$  0.05 m

safety factor sf:3 (this is just an example and not to be considered as a binding value!)

$$F = 3 \cdot 2.5 \cdot 10^6 \cdot \pi \cdot \frac{0.05^2}{4} \approx 15\,000\text{N}$$

- internal braiding as reinforcement;
- non-metallic hose equipped with internal cable instead of an external one and shut-off valves (with loops at both ends of the hose to secure the connections), safety cable design to be based on previous calculation method;
- Hose-restraints (can be force rated steel cable, steel chain or fibre rope) on both ends of the hose attached to suitably designed anchor points on the transport bulk tank frame at one end of the hose, and to the static vessel at the other end of the hose

The recommendations of EIGA for the inspection of cryogenic transfer hoses are:

- Hoses should be visually inspected before each use for signs of damage to any of the components; this would include: the spiral wire and, in particular, for broken braiding and restraint system (if any). If a hose is found damaged, it shall not be used, but sent to an authorized inspection/repair facility;
- If a hose is found to leak in service, the transfer shall be stopped immediately; the hose depressurized and sent to an authorized inspection/repair facility for further action;
- Periodic inspection and testing shall be done in accordance with local regulations, considering the risk of introducing water into the hose for hydraulic pressure test could result in moisture being left in the hose and it being damaged when cooled to cryogenic temperatures;
- Periodic checking of the end connections for wear and their attachment to the hose (e.g threaded connection) is recommended to ensure that these are not out of specification;
- Periodic checking by a competent person or replacement based on an assessment of the duty and service of the hose and restraint system (if any).

#### DISCLAIMER

All technical publications of EIGA or under EIGA's name, including Codes of practice, Safety procedures and any other technical information contained in such publications were obtained from sources believed to be reliable and are based on technical information and experience currently available from members of EIGA and others at the date of their issuance.

While EIGA recommends reference to or use of its publications by its members, such reference to or use of EIGA's publications by its members or third parties are purely voluntary and not binding. Therefore, EIGA or its members make no guarantee of the results and assume no liability or responsibility in connection with the reference to or use of information or suggestions contained in EIGA's publications.

EIGA has no control whatsoever as regards, performance or non-performance, misinterpretation, proper or improper use of any information or suggestions contained in EIGA's publications by any person or entity (including EIGA members) and EIGA expressly disclaims any liability in connection thereto.

EIGA's publications are subject to periodic review and users are cautioned to obtain the latest edition.

© EIGA grants permission to reproduce this publication provided the Association is acknowledged as the source