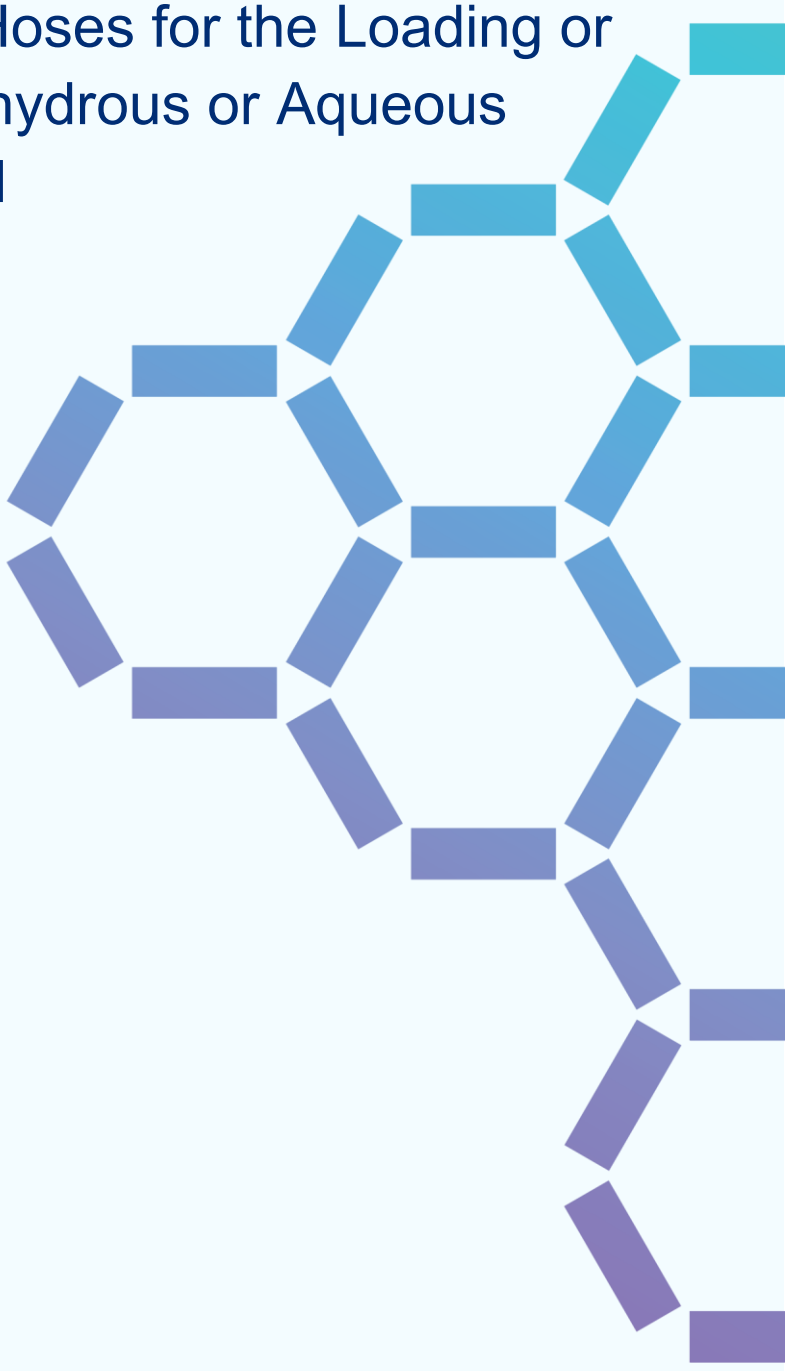
Hydrofluoric Acid Guidance – Section D
Use of Flexible Hoses for the Loading or Unloading of Anhydrous or Aqueous Hydrofluoric Acid



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Rev. 1 Reviewed by CIA HF Network Sector Group April 2025

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Chemical Industries Association

Introduction

The Hydrofluoric Acid Sector Network of the Chemical Industries Association (CIA) has developed this Guidance. It is intended to identify best practice in the use of flexible hoses for the loading and unloading of anhydrous or aqueous hydrogen fluoride only. The Guidance is based on many years of practical experience and draws on experience from within the CIA HF Sector Network. As such it reflects the current best practice (at the time of publication) and is recommended for use in conjunction with any additional Guidance from the supplier(s) of HF and from hose manufacturers.

This Guidance should be considered alongside **CIA HF Sector Network Guidance Section C – 'Best practice for loading/ unloading anhydrous HF tankers'** which also covers loading/unloading facilities.

The Guidance is a recommendation and not a mandatory standard to which all users of HF must adhere. It should not be used as a substitute for any applicable specific legislative requirement. Whilst all reasonable efforts have been made to ensure the accuracy of the contents and correspondence to legislative requirements at the time of publication, readers must refer to these themselves to ensure their compliance with current legal duties.

Acronyms

ANSI	American National Standards Institute, see also ASA
ASA	American Standards Association
Bara	Bar Absolute
Barg	Bar Gauge
ISO	International Organization for Standardization
HF	Hydrogen Fluoride, Hydrofluoric Acid
PPE	Personal Protective Equipment
PTFE	Polytetrafluoroethylene

D1. General

Anhydrous or aqueous HF may be delivered either packaged in small containers (i.e. holding one tonne or less) or in bulk containers, i.e. vehicles incorporating a tank containing usually between 14 and 22 tonnes. This Guidance deals with **bulk deliveries only** and is concerned specifically with the method for transferring HF into or from the transport tank.

Two methods of loading or unloading HF are in common practice in the UK, 'fixed' or 'flexible' pipework. Fixed pipework is defined as mild steel (or more exotic materials) pipes which are designed to connect to the valves on a delivery vehicle. They are normally designed to the same specification as the HF feed pipework and are stored local to the load station. Fixed pipes have a number of disadvantages in that they are normally quite heavy and difficult to manipulate and therefore require the delivery vehicle to be located very accurately for loading/offloading. Also, depending upon the use pattern, fixed pipes can be more susceptible to corrosion, stress related issues or leakage if 'forced' to fit a vehicle slightly misaligned. Additionally, as HF acid is transferred from/ to the transport tank the change in the weight of the tank can also subject the fixed piping to stresses as the tank rises or falls from its original transfer position.

Fixed pipe offloading is nevertheless in safe use at a number of facilities. However, one way in which these disadvantages can be eliminated is through the use of 'flexible hose' pipes. Flexible pipes are generally easier to use since the delivery tank does not need to match exact points and they are generally lighter than fixed pipework and are therefore easier to manipulate, which can reduce the possibility for error. However, the flexible hose must be adequately designed, tested and maintained to ensure integrity. This Guidance summarises the current specifications for flexible PTFE hoses recommended for loading and unloading HF. It also advises the minimum scope of inspection to be applied during operations, the basic training requirements for personnel involved in flexible hose tasks and suggests the auditing requirements pertinent to this aspect of HF handling.

D2. Flexible Hose Specification

D 2.1 Hose Materials of Construction

Flexible hoses should be fabricated from a HF-resistant material, e.g. virgin PTFE. Ideally, the PTFE inner lining should be smooth bore rather than convoluted. This reduces the potential for product to be retained within the hose once transfer is completed. A suitable thickness of PTFE liner should be specified to prevent porosity for the expected service life.

The inner PTFE hose should be protected by either a metallic, e.g. stainless steel or Monel outer wire braid, or alternatively two layers

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of polypropylene braid. Damage to metal braided hoses can introduce the potential for operators PPE to suffer puncture and pinhole leaks. To negate this possibility the polypropylene covered hose, or metallic braided hose with a rubberized outer covering, can be specified dependent upon duty.

A working pressure far in excess of that possible during normal operations should be specified, e.g. 20 bara. Minimum burst test pressures should be established (see **D3 – 'Manufacturer's Testing'**).

D 2.2 Hose Fittings

Two types of fitting are used within the UK industry.

- Hose that is flanged at both ends.
- Hose that is flanged at one end only with a screwed coupling on the other.

Hoses should be equipped with ASA300 flanged fittings to ensure leak free connections

Image 1: Example of Hoses

D3 Manufacturer's Testing

Hoses should be manufactured to a recognised standard, e.g. British Standard or ISO. The manufacturer should test each hose to a minimum pressure of 30 barg. An independent inspection facility should witness and approve the test procedure. Manufacturers should provide data showing the burst pressure of hoses, a minimum of 80 barg is recommended. This is far in excess of any pressure likely to be experienced on a loading station. The manufacturer should mark the following information on each hose:

- Applicable standard
- Manufacturer's mark or name
- Unique serial number
- Month and year of manufacture
- Nominal bore
- Design and test pressure.

Space should also be available for users to add information, e.g. inspection dates.*

***Note: See Appendix 1 for Manufacturing notes/tests for screwed coupling hoses.**

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D4 Operational Testing and Handling Practices

The operations team should always ensure that the flexible hose is within test date prior to use. Prior to each use the flexible hoses should be leak-tested to a pressure greater than operating pressure. Furthermore, prior to each use the hose should be visually inspected for signs of mechanical damage to:

- Outer protective covering (where applicable)
- Stainless steel braiding (if applicable)
- PTFE lining/joint face – cuts/abrasion
- Hose kinks

Hoses should not be dropped or dragged on the ground as damage to the protective braid and the PTFE lining, particularly the tafted end on the flange, can result. This may lead to an increased potential for leakage. Should damage be found, the hose must be removed from service for repair or replacement. If there is any doubt, the advice of the responsible engineer should be sought. Tests/failures should be recorded according to the particular site procedures.

Following use, the flexible hoses should be carefully stored so that damage from vehicle movements cannot occur. The hose should also be capped, blanked, or adequately stored to prevent damage to the tafted ends or ingress of moisture. Hoses should be of a sufficient length to reach the delivery vehicle without difficulty. However, the length should not be excessive as this could lead to 'kinking' in the hose creating a crease/weak spot and could also lead to difficulties with the transfer and decontamination.

Note: It should be remembered that the actual transfer of HF to or from a transport vehicle is a potentially hazardous operation and that the appropriate safety, health and environmental standards must be followed. HF transfer should be regarded as a safety critical task, and the necessary procedures, human factors analysis, training and equipment should be in place.

D5 Maintenance and Decommissioning

All maintenance work should only be carried out by personnel trained and approved by the manufacturer or responsible engineer. Flexible hose maintenance within the UK is rare. Due to the relatively modest costs involved companies often adopt a hose replacement policy. The frequency of change should be based upon usage but should not be a greater period of time than that specified by the hose manufacturer.

Note: Should flexible hose maintenance be undertaken it should be remembered that HF will diffuse through the PTFE pipe and therefore the hose cannot be fully decontaminated.

D5.1 Decommissioning Hoses

To prevent inadvertent use of decommissioned hoses after they come to the end of their safe life or when damage is found on inspection, it is recommended that hoses permanently removed from service are prevented from unintentionally being re-used by cutting in half.

D6 Training

Operating teams should be trained to handle, connect, and disconnect flexible hoses, relevant to their particular equipment. For those companies where the operations team connect and disconnect hoses, the training and validation package should include basic fitting skills and standards. This will negate the possibility of damage to the hose or leakage due to misalignment or poor jointing technique.

Operations teams should be trained and validated to carry out visual inspections of the flexible hose and understand the defect reporting procedures of their company. If the facility operates a hose repair/maintenance policy rather than replacement, then engineering personnel should be trained and validated to carry out the inspection, maintenance and testing of equipment to the required standard.
Note: All training should be recorded.

D7 Auditing

In order to ensure that relevant procedures and standards are maintained, regular auditing of the hose management systems is imperative. Periodic auditing will confirm that the systems are working correctly as intended and are being followed, or otherwise will identify issues that need attention. Auditing should be considered at several differing levels of independence, e.g. frequent audits from within the work group and less frequent, external auditing by non-facility personnel.

Note: All audits and actions arising should be fully documented, with individual actions and responsibilities clearly identified and followed up.

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Appendix 1

Appendix 1.1 Manufacturing Notes/Tests for the Screwed Coupling Hose:

- All threads checked with a thread gauge to ensure correct fit is achieved.
- Gasket contact surface finish to be serrated concentric finish only (serrated spiral is not to be used).
- Pipework and hose assembly to be subjected to a hydro test at 35barg with pressure held for 10 minutes. Test witnessed by an independent inspection company.
- Pipework and hose assembly to be subjected to a 5barg submerged helium leak test with pressure held for 5 minutes. Test to be witnessed by an independent inspection company.
- Assemblies to be thoroughly dried after successful pressure test and ends sealed to prevent moisture ingress.
- All butt welds to be subject to 100% radiography. Other welds including lugs to be subjected to dye penetrant test.
- Test certificates are required for all materials, pressure and non-destructive testing

Appendix 1.2 Screwed Coupling Hose and Connection Specification

- Screwed connection is made from Hastelloy C276
- Flanges are swivel type made from Stainless steel. (1” and 1.5” nb ASA 300)
- Hose is in three parts.
- 1.5 mm Internal virgin PTFE Fluon grade CD086 or equivalent lining with tafted end – externally convoluted to provide flexibility but with smooth bore.
- Double Monel helix braid (To provide earth continuity).
- Protective covering of two polymer (polypropylene) braids (inner braid coloured orange, outer braid black – to indicate when damage has occurred)

Note: The above specification indicates stainless steel swivel flanges. This is the preferred specification of some companies, but it should be noted that other member companies have adopted carbon steel flanges due to issues experienced with stainless steel.

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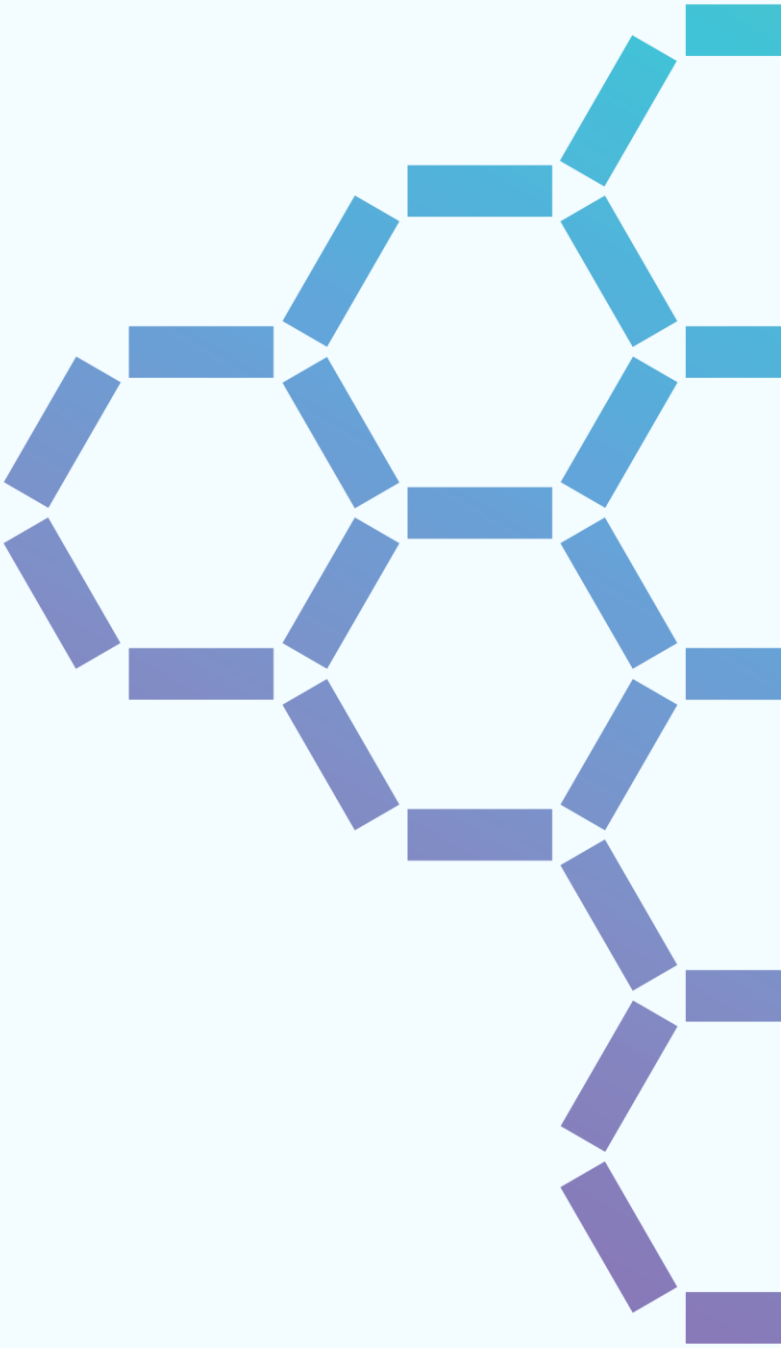

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