GUIDANCE NOTE No. 60

SAFE USE AND HANDLING OF HOSES AND FLEXIBLE CONNECTIONS IN THE SOLVENTS INDUSTRY

1. Introduction

The Solvents Industry Association has issued this Guidance Note because of the specific risks when using connection hoses to transfer solvents and therefore covering the maintenance involved in the hoses and flexible connections. This Guidance Note is limited to scenarios associated with the maintenance of connection hoses used with solvents. It is widely recognised that connection hose assemblies should only be used in hazardous duties where permanent piped solutions are not suitable, or do not offer a safer alternative solution. However, connection hoses are used in a number of different operations within the solvent industry, most commonly in the transfer of solvent to or from bulk vehicles, transfer of solvents around storage tanks, closed loop systems for liquid or vapour, or transfer of solvents to or from packs (drums, IBCs, etc.). The major hazard involved with the transfer of solvents through a connection hose is the build up of static electricity due to a charge separation with potential of discharge resulting in fire and subsequent loss of containment. In addition to this Guidance Note, the SIA have produced the film, 'Solvents and Static Electricity' and the Guidance Note, 'Flammable Solvents and the Hazard of Static Electricity'. Both are available for download via the website www.solvents.org.uk.

There is no one specific regulation controlling maintenance of connection hoses, however a list of associated regulations, standards and guidance is given in the references. This Guidance Note does not replace these legal documents, but highlights the specific risks associated with solvents.

2. Selection of Connection Hose

The operating company has a requirement to ensure that the following factors are taken into account when selecting a connection hose;

- Compatibility of the inner liner material with the solvent to be conveyed
- Compatibility of the outer cover with working environment
- Flow requirements
- Pressure and temperature range
- The operational environment - length, flexibility and bend radius
- Weight, compactness and support requirements
- Volumetric expansion, movement under loading
- Compatibility of hose with end fittings, and fitting compatibility with media and operational environment
- The seals used in the end of the hoses should be suitable for the product being discharged (PTFE is a universally used seal, however may not be compatible with all solvents) Seals for Dry Discconnect Couplings are commonly Viton, EPDM or Kalrez.

All connection hoses used for solvents should have the following features;

- Where velocities exceed 1m/s, hoses should be made of conductive material or non-conductive material with embedded fine wire mesh (often referred to as an anti-static wire). If the hose material is non-conductive, the mesh should be bonded to the metal flanges or coupling of the hose.
- The bonding of the mesh is not a fail-safe method and regular inspection of the condition of the hose must be carried out, particularly if there is repetitive flexing during operation, as this can, in certain circumstances result in the mesh fracturing.
- With non-conductive hose materials, all end connections must be metallic and have electrical continuity bonding in the form of a continuous galvanised steel wire with an overall electrical resistance of <10 ohms
- If a metal hose with a liner is employed, the metal mantle and flanges or couplings must be bonded to each other
- The electrical resistance between the two couplings must not be higher than 10^6 ohms. This resistance is to be measured at regular intervals as part of the operators' hose management programme

TYPES OF HOSE

A wide range of transfer hoses are available, manufactured using different materials and processes. There is also a wide range of end connections and methods of end retention, however logistics providers in the solvent industry predominantly standardise on hoses that conform to BS5842:1980, BS3492:1987, BS EN13765:2018 Type 3. Hoses that conform to EN12115:2021 are also included in the list of acceptable hose types.

Composite hoses to BS13765:2018 standard are manufactured from multiple layers of polypropylene fabrics and films. The inner wire helix can be polypropylene coated carbon steel or stainless steel 316. The outer wire helix can be galvanised steel or stainless steel 316. The inner liner is made of solvent resistant material, such as PTFE or UPE.

Rubber hoses to BS3492: 1987 and EN12115:2021 standards are manufactured using a vulcanising process that bonds the tube, reinforcements and outer covers together. They also incorporate anti-static wires (mesh) or are manufactured using electrically conductive materials. In the case of EN12115 hose, they are also branded with the electrical continuity rating. This includes Ω or M, Ω/T and M/T types. Selection of the correct hose type is dependent upon the conductivity requirements of critical areas such as EX Zones.

Metal hose assemblies are less common and manufactured using a spiral or annular corrugated liner and stainless steel outer braid. The end fittings, the liner and cover are bonded together using a welding process to BSEN ISI 10380:2012

PTFE hose can be manufactured from virgin or black anti-static PTFE, steel spiral helical vac wire and stainless steel or polypropylene overbraid. PTFE hoses can also be produced with a rubber cover using the vulcanisation process.

PVC hose is manufactured using an extrusion method. They can also be manufactured to incorporate anti-static wires and plastic or steel helices.

END FITTINGS AND RETENTION

The common coupling used is the BSP fastening, and the size of the coupling ranges from 1.5” to 3”. Other methods of fastening are used, such as cam lock fittings, Tank Wagon (TW), Guillemin and Storz. API road tankers are fitted with a 6” API female.

To avoid hazardous and environmentally damaging spillages the use of Dry Disconnect Couplings (Hose and Tank Units) to Stanag 3756 and Safety Breakaway Couplings (to prevent

damage and spillage should drive away occur whilst still connected.) should be considered, especially in Ex Zones and where contamination of drains or water courses could be an issue.

The common methods of end retention includes re-usable and non-re-usable options.

Non-reusable methods include: Swaging (also referred to as crimping), loose or preformed metal strapping and buckle.

Reusable methods include: Worm drive, single or double bolt clamps, and DIN safety clamps to BS EN 14420:2013.

Non-conducting tape should not be used on screw joints as it can break the continuity of the metal-to-metal connection in the pipework.

In all instances it remains the responsibility of the operator to ensure that the hose and fittings used are suitable for the application they are being used on. However, they must always refer to the hose manufacturers recommendation and not assume suitability, nor make use of non-approved hose end fittings.

3. Maintenance of Connection Hoses

In line with the EU Directive 2009/104/EU – The Use of Work Equipment, it is the responsibility of the operating company to ensure all connection hoses used in solvent service applications are examined on a regular basis to assess their suitability for continued service. Inspection frequency and criteria should be developed from site / company specific risk assessment. Some companies do not allow maintenance to be carried out on flexible connections and hoses as they do not have qualified personnel and therefore test certificates or insurance may be invalidated. In this instance it is recommended that a 3rd party specialist company, with trained personnel shall be employed to carry out this important function.
The competency of personnel carrying out maintenance should be considered as part of the risk assessment.

Prior to use, ideally on a daily basis, connection hoses and their fittings should be visually examined for physical damage such as:

- Blisters or bulges, dents
- Looseness of the outer cover

- Excessive softening or hardening of the hose (any of these three points may indicate fatigue, fractured or displaced reinforcement or a leaking liner)
- Kinks, twists (poor installation, hoses should always be fitted in their natural curvature to reduce unnecessary or excessive stress in service
- Abrasion, cuts, excessive elongation under load or test (the length of the hose should allow for any flexing during use)
- End coupling integrity (thread damage, distorted, oval, fractured, missing bolts or nuts etc.). Wherever possible caps and plugs should be used to protect the integrity of the end fittings. Annual servicing of Dry Disconnect Hose Units is recommended by all leading manuafactures. To be carried out by trained personel or authorised distributors.
- Corrosion of outer wires (reduced wire diameter by chemical attack, rusting, etc.)
- Scuffing of outer wires
- Serious displacement of outer wires
- Collapse of outer wire
- Collapse of inner wire
- Serious scuffing of outer cover (through to inner reinforcing fabrics)
- Severe impact damage to hose body
- Damage or deformity to the seal
- An in-date tag

Any hose exhibiting cover cracks, cuts or bulges should be removed from service, examined and re-tested as necessary. Any hose with reinforcement exposed should be removed from service and replaced if the extent of the damage exceeds manufacturer recommended limits. If in doubt, hoses displaying visible faults should be replaced.

An electrical continuity test should be performed periodically with the industry standard being every 12 months. This test is carried out by obtaining a circuit through an electrical resistance meter and observing the reading. In general, standard readings must be less than 10 Ohms per metre. However, much will depend on each manufacturers hose construction / material specification. It is recommended to take into account manufacturers' recommendations and the standard states it should be less than 100 Ohms per assembly. The test must be carried out on a dry non-conductive surface. The reading should take place from the hose tail at each end of the hose assembly, The multi-meter should be set to the 500V position. If the hose fails

the electrical resistance test then the pressure test cannot be carried out and the failure must then be repaired.

In addition to the electrical continuity test, pressure testing should be carried out in compliance with relevant vendor's procedure. It is recommended that all assemblies should be supplied hydrostatically tested and certified. Testing is generally carried out at 1.5 times the pressure of the hose rating before installation. Hoses that have been in service and are subject to a periodic re-test should be carried out at the working pressure of the hose assembly, not the operating pressure, in accordance with BS EN1402:2021. Records of visual examination must be kept, recording the condition of the hose on a particular date and the date of next inspection. The hose must be tagged with the latest inspection date and the date of next inspection.

Any connection hose failing the visual inspection, electrical continuity test or pressure test should be immediately removed from service and quarantined. If no repairs can be carried out the hose should be comdemned and ideally destroyed to prevent unintentional use, removing the ends is the recommended option to eliminate this risk.
They should also be disposed of responsibly and in line with any company or local authority environmental policies or requirements. Hoses fitted with reusable EN 14420 clamps and hose tails and other reusable methods can often be cut back, re-fitted and re-tested and returned to service.

4. Management Systems

Duty holders should ensure that the integrity of any connection hose used on solvent duty is addressed within their management system. Elements should include consideration of design, risk assessment, construction, installation, commissioning, operation, maintenance, testing, modification and decommissioning.

RISK ASSESSMENT

A risk assessment should consider:

- Hazards & hazard effects associated with hose failure, e.g. catastrophic failure, chemically-induced degradation, corrosion, small unintended releases
- Foreseeable failure modes
- Specific requirements for risk management, for example COMAH

- Temperature range (typical and worst case)
- Pressure range rating (typical and worst case)
- Material of construction compatibility (including connections)
- Length and weight of hose including bend radius
- Intended service and duration of service – note that expected service life may be reduced as a consequence of the severity of the hazard
- Lifting, handling and carrying activities
- Appropriate fittings, for example: couplings and clamps, protective sleeves, scuff rings
- Flushing / draining and decontamination and cleaning requirements
- Accessories, for example lifting buns, hose straps
- Use of hose whip checks/restraining wires or permanent fixtures in instances where hose whip could result from high pressure and failure of fittings
- Likely external environmental exposures, for example: corrosion, adverse weather, physical abrasion

COMPETENCE

Persons responsible for hose selection should be suitably competent and aware of safety critical factors affecting connection hose integrity through an understanding of hose constructional elements and their function in maintaining integrity, failure modes, failure criteria, etc. Such personnel should undergo relevant training to familiarise themselves with any existing procedures or products currently in use. This should be included in the duty holders written procedures.

Persons responsible for management and/or maintenance of flexible hose assessmblies should, in addition to the above, have a thorough understanding of the risk assessment, relevant standards and internal procedures.

Users of flexible hose assemblies should have sufficient training to be able to:

- Understand hazards and typical failure modes
- Requirements for pre-use visiual inspection
- Correct techniques for hose connection / disconnection
- Flushing, cleaning & storage requirements
- Handling techniques and accessories
- Spill or hose failure response
- Fault / defect reporting procedure

MAINTENANCE

Employers should maintain a hose register, which is kept on site and is available for inspection and records information, such as:

- Hose type and date of production
- Date of installation and expected service life
- Manufacturer's design specifications, for example: temperature and pressure ratings
- Inspection and maintenance requirements
- Location of hose
- Process/lines where hoses are compatible for use
- Compatible fittings
- Duty of hose

Employers should also ensure:

- Hoses are identified with a consistent labelling and tagging system
- Hose assemblies, including all fittings, are inspected regularly and maintained in accordance with relevant standards or manufacturer's specifications

Inspection and maintenance activities should be documented in a procedure and may include:

- Appropriate storage, for example clear identification/segregation of hose assemblies tagged out or retired
- Visual inspection immediately prior to use
- Decontamination and cleaning requirements
- Defects investigation, reporting and tag out process
- Tracking remediation actions
- Retiring/disposal process
- Pneumatic or hydraulic leak testing

When connection hoses are used for bulk transfer of solvents, the Duty holder shall employ a bulk loading and offloading procedure. This should include written instruction that state when offloading flammable liquids, the driver must first connect the tanker to the earthing connection at the off-loading point. The electrically conducting discharge hose can then be connected to the liquid intake point on the storage. The electrical resistance between the two couplings on a flexible hose must not be higher than 10^6 ohms. Particular importance should be given for hoses being used in EX Zones where the most volatile and high explosion risk solvents are being used. In this instance EN12115 type Ω/T hoses offer the highest level of safety with regards to their ability to discharge electrostatic energy when used in high-risk applications.

All records associated with maintenance and testing of connection hoses should be held for at least the life span of the hose.

5. References

Management of Health and Safety at Work Regulations 1999

Dangerous Substances and Explosive Atmospheres Regulations 2002

Provision and Use of Work Equipment Regulations 1998

Guidance Note 47 Flammable Solvents and the Hazard of Static Electricity, SIA

Institute of Petroleum / Oil and Gas UK 'Guidelines for the Management, Design, Installation and Maintenance of Small Bore Tubing Systems' (ISBN 0 85293 275 8)

Guidelines for the management of flexible hose assemblies – The Energy Institute 2nd Edition 2011

HS(G)176 The storage of flammable liquids in tanks, HSE, 2015

HS(G)140 Safe use and handling of flammable liquids, HSE, 2015

BS 3492:1987 Specification for electrically bonded road and rail tanker hose and hose assemblies for petroleum products, including aviation fuels, British Standards Institution.

BS 5842:1980 Specification for thermoplastic hose assemblies for dock, road and tanker use

BS 3492:1987 Specification for road and rail tanker hoses and hose assemblies for petroleum products, including aviation fuels

BS EN 13765:2018 Thermoplastic multi-layer (non-vulcanized) hoses and hose assemblies for the transfer of hydrocarbons, solvents and chemicals. Specification

BS EN ISO 15465:2004 Pipework. Stripwound metal hoses and hose assemblies

BS EN 14420 (various parts) Hose fittings with clamp units: Various parts (eg flange, threaded, cam-lock etc)

EN12115: 2021 Rubber and thermoplastics hoses and hose assemblies for liquid or gaseous chemicals — Specification

BS EN1402:2021 Rubber and plastic hoses and hose assemblies. Hydrostatic testing

STANAG 3756 – Dry Disconnect Couplings

EN 13760 / EN13175 Selflocking quick connect / disconnect couplings for the loading and unloading of LPG and various other media.

CLC/TR 60079-32-1:2018 - Explosive atmospheres - Part 32-1: Electrostatic hazards, guidance

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