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To
Agricultural, Factory and Quarries Inspectors
FCG Specialist Inspectors (Mech, Process Safety)
Railway Inspectors - for information
OSD Operations Branch Inspectors

PIPELINES FOR CONVEYING LPG LIQUID AND VAPOUR

DESIGN AND INSTALLATION

This OC, which is based on THSD Minute A3/T/2/95, gives general guidance on pipelines for LPG liquid and vapour within industrial buildings and premises, primarily: design; installation and testing. This guidance relates mainly to static installations but many of the recommendations can be applied also to pipework on mobile equipment.

1 All components should be suitable for the maximum and minimum pressures and temperatures expected to be found in service. In the case of any premises subject to The Gas Safety (Installation and Use) Regulations 1994 (due to be amended on 1 April 1996) installation should comply with the specific requirements of those regulations.

Location

2 Where practicable, the routing of pipework in the open air and above ground level is recommended. It is advisable to route the pipework away from, or protect it against, excessive heat or cold.

3 Pipework may be buried underground provided it is inherently resistant to or otherwise adequately protected against corrosion.

Mechanical protection

4 The possibility of physical damage, particularly from vehicles and mobile equipment needs to be minimised when considering the routing of a pipeline. Additional protection may be required, eg bollards or barriers etc.

Corrosion protection

5 Installations not inherently resistant to corrosion need to be suitably protected.

(1) Above ground - by galvanising, painting or wrapping.

(2) Below ground - by wrapping, sleeving and/or cathodic protection.

Earthing and bonding

6 All metallic pipework should be bonded to a common conductor and connected to the main earthing terminal which should be cross bonded to the electrical installation earthing system. All LPG pipework and storage vessels should be electrically continuous using bonds if necessary. To minimise the risk from static discharges, pipelines should have a resistance to earth not exceeding 1 megohm

Colour coding

7 It is recommended that pipelines containing vapour are colour coded "yellow ochre" to indicate a gas. Pipelines containing LPG need to be identified as such and readily distinguishable from other services.

Pipework materials and methods of construction

Liquid phase distribution

8 Only seamless carbon steel pipework can be recommended for liquid LPG duties.

9 Where liquid LPG may be trapped (eg between 2 shut-off valves or blank flanges) hydrostatic relief valves provide the most practical means to ensure the design pressure of the pipework and components are not exceeded.

Above ground

10 (1) For pipework up to 50 mm bore, welded joints are generally recommended. Threaded or flanged joints may also be used.

(2) For pipework over 50 mm bore, welded joints or welded flanges are recommended and have proved less likely to leak.

(3) For pipework up to a maximum of 75 mm bore, exceptions may need to be made for proprietary items such as valves, pumps and meters when compression fittings and threaded connections are used.

Below ground

11 Welded joints have many safety advantages unless other methods are shown to be essential for assembly/disassembly, in which case welded flanges and also threaded joints where the thread is seal welded can be used. Compression fittings are not acceptable.

Vapour phase distribution

12 It is recommended that distribution pressures be selected and controlled at levels below that at which LPG condensation may occur. At high pressures heat tracing the pipework system (for carbon steel and copper) or using an LPG-air mixture may be necessary.

Vapour pressure > 4.83 bar

13 For pressures at or above 4.83 bar, carbon steel (up to 150 mm nominal bore) and copper (up to 12 mm outside diameter) are acceptable for pipelines above and below ground. Copper is only acceptable as solid drawn tube.

Vapour pressure < 4.83 bar

14 For vapour pressures below 4.83 bar, carbon steel and copper (up to 35 mm maximum outside diameter) can be used for pipelines above and below ground, and medium-density polyethylene (PE) can be used for pipelines below ground.

Copper pipework

15 Copper should not be used where vibration may cause work hardening and possible failure. Copper fittings should be either brazed, soldered or have compression fittings to connect them to the pipe. Threaded fittings must have a transition fitting as copper pipe should not be threaded.

Polyethylene pipework

16 Polyethylene (PE) pipework is restricted to use below ground except at the termination of the underground section when it may be brought above ground to connect to metallic pipe.

17 Where PE pipe is brought above ground at the terminals it is usual to restrict the use to a length of 2m maximum. The above-ground length will need protection against ultra-violet light and mechanical damage by sleeving. The transition to metal pipework may be made below ground.

18 Polyethylene is not normally used for pressures above 2 bar because of the possibility of vapour condensation at low temperatures.

19 It is recommended that all PE joints are fusion welded, or compression fittings or other mechanical fittings.

Routeing

20 It is recommended that the pipework is routed and sized so as to restrict the contents of the pipe to a minimum, whilst taking into account maximum flow rates, acceptable pressure drops and mechanical strength.

21 Distribution systems within industrial buildings should be designed to operate at the lowest practical pressure consistent with the safe operation of appliances.

Joints

22 Joints should be kept to a minimum and made to the standards required by the materials being used. To limit potential leak sources the use of threaded joints, flanged joints and compression fittings need to be kept to a minimum. Multiple threaded reducers are not acceptable. Any elastomeric components need to be resistant to LPG.

23 Flexible connections in permanent pipework are to be avoided. Where they are necessary their lengths need to be kept as short as reasonably practicable and they need to maintain electrical continuity.

Supports and anchors

24 It is recommended that pipework supports and anchors be located, spaced and designed to ensure that pipework stresses and deflections due to predictable loads are within acceptable limits. Vibration, surge pressures, and valve-operating torque should be considered in the design of pipework and supports. Mobile installations (eg pipework on road tankers) need particular consideration.

25 Pipeline layout and supports require adequate allowance to accommodate any movement that may occur due to thermal expansion or contraction.

Underground pipeline

26 Any additional loading or constraint imposed by backfill or underground location needs to be taken into account in the design. It is recommended that pipelines are run, adequately supported and laid, in a shallow open-concrete or masonry-lined trench with open grid covers where necessary. The trench may be backfilled with an inert, non-corrosive material free from abrasive particles. Protection in the form of load bearing slabs for those sections over which traffic passes or where superimposed loads will occur is required.

27 Pipework conveying inert or flammable liquids may be laid in the same trench but piping containing corrosive or toxic materials or steam is not recommended.

28 It is also recommended that electric cables are not laid in the same trench unless protected by an outer pipe or sleeve.

Testing

29 After assembly and before the introduction of LPG, pipework systems are required to be proof tested and/or leak tested. The method of proof testing depends on nominal diameter and whether pipework is at vessel pressure. Normally pipework is tested in sections, generally between shut-off valves. Pressure and leak tests use manometers, dial gauges or other pressure and leak measuring devices. The pipework system cannot be commissioned unless it has passed a leak test for the entire system.

References

30 More detailed construction requirements can be found in:

- (1) LPGA (UK) Code of Practice No 22 - *LPG Piping System - Design and Installation, 1990* (NB: Sections 5-6, and Appendices 1-10.)
- (2) HS(G)34 *The Storage of LPG at Fixed Installations* HSE 1987.
- (3) Guidance Note CS11 *The Storage and Use of LPG at Metered Estates* HSE 1987.

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ASI headings

Design: installation: LPG: pipework: testing.