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TECHNICAL MEMORANDUM NO.84

Inspection and Maintenance of LPG Pipework at Commercial and Industrial Premises

1. Introduction

LPG pipework may, under certain conditions, deteriorate and could eventually leak. Such a leak may result in a fire or explosion if the LPG accumulates and an ignition source is present. In order to ensure the continued safe operation of LPG pipework the owners of the pipework need to inspect and maintain the pipework. An "inspection strategy" for all pipework, based on a risk assessment of the system, should be drawn up to ensure the pipework is safe for continued use.

- This strategy should not be confused with the Statutory Written Scheme of Examination for a pressure system required under the Pressure Systems Safety Regulations (PSSR) which relates to risks associated with pressure.

This Technical Memorandum is aimed at those who are conducting the risk assessment and drawing up the inspection strategy for external pipework. It gives information on the factors to be considered in the risk assessment; the subsequent risk categories; and examples of inspection strategies which may be applied. It also gives specific guidance on an inspection strategy for internal pipework (see A.1).

This Technical Memorandum is intended for sites in single occupancy. For sites in multiple occupancy (such as metered estates) the LPG supplier should be consulted.

2. General

The Health and Safety at Work Act and legislation made under it, notably the Management of Health and Safety at Work Regulations (MHSAW), the Provision and Use of Work Equipment Regulations (PUWER) and the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) apply to all workplaces where there is gas pipework. These place a variety of duties on employers, the self employed and occupiers to ensure safety and:

- carry out a risk assessment of any work activities involving dangerous substances (which include substances such as LPG);
- provide measures to eliminate or reduce risks as far as is reasonably practicable;
- provide equipment and have procedures to deal with accidents and emergencies;
- provide information and training to employees;
- maintain and inspect work equipment;
- classify places where explosive atmospheres may occur during normal operations into zones and, where necessary, mark the zones.

The Gas Safety (Installation and Use) Regulations (GSIUR) require, in Regulation 35, that "it shall be the duty of every employer or self employed person to ensure that any gas appliance, installation pipework or flue installed at any place of work under his control is maintained in a safe condition so as to prevent injury to any person". These regulations apply to many applications in industrial and commercial premises where gas is used (for example: canteens, space heating…) but do not apply to the use of gas for industrial processes.

Employers need to draw up (or have drawn up) an "inspection strategy" for the periodic inspection and testing of all pipework to ensure the pipework is suitable for continued use. This should be based on a risk assessment of the system.

➢ Annex A gives examples of inspection strategies.

3. Risk Assessment

3.1 General

➢ Hazard means anything that can cause harm (e.g. chemicals, electricity, working from ladders, an open drawer, etc).

The principle hazard associated with LPG pipework is that, under certain conditions, the pipe may deteriorate and could eventually leak. Such a leak may result in a fire or explosion if the leaking LPG accumulates and an ignition source is present.

➢ Risk is the chance, high or low, that somebody could be harmed by these and other hazards together with an indication of how serious the harm could be.

To assess the risk it is necessary to consider the likelihood of a leak and the potential consequences of the leak and any subsequent ignition.

Note: *It may be necessary to carry out separate assessments of different sections of pipework where factors vary between them.*

3.2 Risk Category

3.2.1 General

Following identification of the hazards the overall Likelihood and Consequence factors need to be established so that the risk category, LOW, MEDIUM or HIGH may be assessed using a matrix as shown in 3.4.4.

Note: in this instance only one hazard, that of a potential leak of LPG, is being considered.

3.2.2 Likelihood Factors

Sum of the "counts" in 3.3.1 to 3.3.7

Sum of factors	**0**	**1**	**2**	**>2**
Overall Likelihood factor	Negligible	Remote	Possible	Probable
Examples	New, correctly installed pipework		Old buried metal pipe work, PE exposed to UV	Old buried metallic pipework in corrosive conditions, showing signs of deterioration

3.2.3 Consequence Factors

Sum of the "counts" in 3.4.1 to 3.4.5

Sum of factors	**0**	**1**	**2**	**>2**
Overall Consequence factor	Minor	Significant	Major	Catastrophic
Could result in	Minor injury	Major Injury	Single fatality	Multiple Fatalities

3.2.4 Risk Assessment Matrix

The overall Risk Assessment may be established from the overall Likelihood factor and the overall Consequence factor using the matrix shown in Table 1.

- By way of example a number of scenarios are included in the matrix.

Table 1
Risk Assessment Matrix

		Consequence			
		Minor	Significant	Major	Catastrophic
Likelihood	Probable				Old, unprotected metallic, pipework entering into a basement below ground level
	Possible				
	Remote				
	Negligible	Recently installed, outdoor, above ground pipework not associated with a building			

Risk:	**Recommended Line of Action**
Low	A basic inspection plan should be drawn up that details relevant inspections and their frequencies. These frequencies are likely to be in line with the maxima given in Annex A.
Medium	A more detailed inspection strategy needs to be developed. The frequency of relevant inspections is likely to be increased in order to ensure confidence in the integrity of the pipe is maintained.
High	A very detailed inspection strategy needs to be developed with a high frequency of inspections in order to ensure the integrity of the pipe is maintained. ➢ This may prove more resource intensive than the alternative option of replacing the pipework.

3.2.4 Review and Recording of Risk Assessments

Initial risk assessments should be recorded. They should then be periodically reviewed (typically at intervals of 1 year), and appropriate actions implemented. The outcome of reviews should be recorded.

➢ It is particularly important that reviews of risk assessments which indicate low or medium risk are carried out ensure that the risk has not moved into a higher category.

3.3 Factors Affecting Likelihood of Leakage

Whilst the following highlight common factors it may not be a comprehensive list of all the factors that may affect likelihood of leak from LPG pipework in a specific location.

If, at a specific location, a factor which could significantly contribute to the likelihood of a leak of LPG is identified, then this should be included in the assessment. This can be

achieved by allocating a factor that increases the likelihood by a default factor of 1 and adding this to the other factors given below.

Note: *By adding a numerical value to the lower and higher factors this means that more weighting can be given to particular factors if these are seen as having a higher effect on the likelihood of a leak of LPG. Also if relevant to particular factors the number of divisions could be increased.*

3.3.1 The Location of the Pipework

Lower (Count = 0)	Higher (Count = 1)
Above ground (easily seen) and not liable to mechanical damage	• Below ground (out of sight, out of mind) • Above ground which may be susceptible to mechanical damage

3.3.2 The Operating Pressure of the Pipework

Lower (Count = 0)	Higher (Count = 1)
Low pressure (<75mbar) (most pipework will fall in this category)	Pressure above 75 mbar

3.3.3 How Long it has been in Service?

Lower (Count = 0)	Higher (Count = 1)
New <15 years	Old or Unknown >15 years

3.3.4 Materials of Construction

Lower (Count = 0)	Higher (Count = 1)
Corrosion resistant materials: **Above Ground:** Painted, Galvanised or Sheathed Steel, Copper, Stainless Steel, Proprietary Systems **Below Ground:** Polyethylene (PE), Sheathed Steel, Copper, Stainless Steel, Proprietary Systems, Cathodically protected Systems	Materials subject to corrosion (e.g. unprotected or incorrectly protected mild steel) Materials subject to environmental degradation (e.g. unsheathed Polyethylene)

3.3.5 Traffic Passing over the Pipe or Ground Liable to Movement

Lower (Count = 0)	Higher (Count = 1)
No traffic passing over pipework. Ground not liable to movement.	Pipework under roadway, unknown protection, ground liable to movement.

3.3.6 If there have been Excavations or Building near the Pipe

Lower (Count = 0)	Higher (Count = 1)
No recent excavations/building	Excavations/building within 3m of pipework without protection of the pipe.

3.4 Factors Affecting the Consequence of Leakage

Whilst the following highlight common factors it may not be a comprehensive list of all the factors that may affect consequence of leak from LPG pipework in a specific location.

If, at a specific location, a factor which could significantly contribute to the consequence of a leak of LPG is identified, then this should be included in the assessment. This can be achieved by allocating a factor that increases the likelihood by a default factor of 1 and adding this to the other factors given below.

3.4.1 The Phase of LPG in the Pipework (liquid or vapour)

Lower (Count = 0)	Higher (Count = 1)
Vapour	Liquid (1 volume of liquid will give 270 volumes of vapour)

3.4.2 The Location (outdoors or indoors)

Lower (Count = 0)	Higher (Count = 1)
Outdoors - but may be increased if there are large numbers of people in the vicinity	Indoors - injury, greater damage to facilities

3.4.3 Routing of Pipework to Entry Point

Lower (Count = 0)	Higher (Count = 1)
Pipework runs directly to external point of entry to building - less likelihood of gas entering the building	Pipework runs round buildings

3.4.4 Pipework Entry Point

Lower (Count = 0)	Higher (Count = 1)
Pipework enters building above ground level - less likelihood of gas entering the building	Pipework enters building below ground level

3.4.5 Internal Routing of Pipework

Lower (Count = 0)	Higher (Count = 1)
Building has no basement or other communicating service ducts. - less likelihood of gas building up unobserved	Building has a basement or communicating service ducts.

Note: *Additional factors for specific situations may be:*

- *tracking, via an identifiable route, to a sensitive area;*
- *the population that may be affected by an ignited release.*

3.5 Examples

3.5.1 Small Kitchen at a Pub (Outside Pipework)

Likelihood factors		
Factor:		**Count**
3.3.1 Location	Above ground, no likelihood of damage	**0**
3.3.2 Operating Pressure	37 mbar	**0**
3.3.3 Age	Unknown	**1**
3.3.4 Materials	Galvanised steel (no rust)	**0**
3.3.5 Traffic	None	**0**
3.3.6 Recent work near pipe	None	**0**
	Total	**1**
	Overall likelihood factor	**Remote**

Consequence factors		
Factor		**Count**
3.4.1 Phase	Vapour	**0**
3.4.2 Location	Outdoors	**0**
3.4.3 Routing	Pipework runs direct to building	**0**
3.4.4 Entry	Above ground level	**0**
3.4.5 Internal routing	Not near void or cellar	**0**
	Total	**0**
	Overall consequence factor	**Minor**

Overall Risk Assessment : **Low**

3.5.2 *Installation for Fork Lift Truck Refuelling with Underground Pipework*

Likelihood factors		
Factor:		**Count**
3.3.1 Location	Below ground	**1**
3.3.2 Operating Pressure	Vapour Pressure (>75 mbar)	**1**
3.3.3 Age	5 years	**0**
3.3.4 Materials	Proprietary system	**0**
3.3.5 Traffic	Passes over	**1**
3.3.6 Recent work near pipe	None	**0**
	Total	**3**
	Overall likelihood factor	**Probable**

Consequence factors		
Factor		**Count**
3.4.1 Phase	Liquid	**1**
3.4.2 Location	Outdoors	**0**
3.4.3 Routing	Pipework runs alongside building to remote filling point	**1**
3.4.4 Entry	N/A	**0**
3.4.5 Internal routing	N/A	**0**
	Total	**2**
	Overall consequence factor	**Major**

Overall Risk Assessment : **High**

3.5.3 *Installation for Fork Lift Truck Refuelling with Above Ground Pipework*

Likelihood factors		
Factor:		**Count**
3.3.1 Location	Above ground	**0**
3.3.2 Operating Pressure	Vapour Pressure (>75 mbar)	**1**
3.3.3 Age	10 years	**0**
3.3.4 Materials	Painted Steel (no rust)	**0**
3.3.5 Traffic	None	**0**
3.3.6 Recent work near pipe	None	**0**
	Total	**1**
	Overall likelihood factor	**Remote**

Consequence factors		
Factor		**Count**
3.4.1 Phase	Liquid	**1**
3.4.2 Location	Outdoors	**0**
3.4.3 Routing	Direct to dispenser	**0**
3.4.4 Entry	N/A	**0**
3.4.5 Internal routing	N/A	**0**
	Total	**1**
	Overall consequence factor	**Significant**

Overall Risk Assessment : **Low**

3.5.4 Vapour Installation at a Factory (1)

Likelihood factors		
Factor:		**Count**
3.3.1 Location	Below ground	**1**
3.3.2 Operating Pressure	37 mbar	**0**
3.3.3 Age	Unknown	**1**
3.3.4 Materials	Unprotected metallic	**1**
3.3.5 Traffic	Passes over	**1**
3.3.6 Recent work near pipe	None	**0**
	Total	**4**
	Overall likelihood factor	**Probable**

Consequence factors		
Factor		**Count**
3.4.1 Phase	Vapour	**0**
3.4.2 Location	Outdoors	**0**
3.4.3 Routing	Direct to building	**0**
3.4.4 Entry	Below ground level	**1**
3.4.5 Internal routing	Through basement	**1**
	Total	**2**
	Overall consequence factor	**Major**

Overall Risk Assessment : **High**

3.5.5 Vapour Installation at a Factory (2)

Likelihood factors		
Factor:		**Count**
3.3.1 Location	Below ground	**1**
3.3.2 Operating Pressure	37 mbar	**0**
3.3.3 Age	10 years	**0**
3.3.4 Materials	Polyethylene	**0**
3.3.5 Traffic	None	**0**
3.3.6 Recent work near pipe	None	**0**
	Total	**1**
	Overall likelihood factor	**Remote**

Consequence factors		
Factor		**Count**
3.4.1 Phase	Vapour	**0**
3.4.2 Location	Outdoors	**0**
3.4.3 Routing	Direct to building	**0**
3.4.4 Entry	Above ground level	**0**
3.4.5 Internal routing	No basement or void	**0**
	Total	**0**
	Overall consequence factor	**Minor**

Overall Risk Assessment : **Low**

4. Methods of Inspection and Test

Methods of inspection and test may include, as appropriate:

a) Visual inspection

Pipework, flanges and fittings should be inspected for corrosion and damage.

Particular care should be paid to pipework where it passes through supports and walls.

Pipework supports should be checked to ensure that they are secure and in satisfactory condition.

Thermal insulation should be inspected for damage. Suspect areas should be removed to allow inspection of the pipe.

b) Gas detector test

Gas detector tests should be carried out in areas where gas can accumulate and linger, e.g. enclosed spaces, ducts and voids and around the pipework entry to buildings.

Gas detector tests may also be carried out on joints and over known routes of underground pipework.

Gas detection instruments having a scale that can detect to less than 10% of the lower explosive limit of the gas in air in the pipework should be used.

c) Leak detection fluid

Leak detection fluid may be used to check exposed joints for leakage.

d) Soundness and leakage tests

Soundness and leakage tests may be carried out as specified in BS 5482 part 1 or LPGA Code of Practice 1 part 1 or Code of Practice 22 as appropriate.

5. Recording of inspections and tests

Check lists should be used as an aid to ensuring that inspection and tests have been carried out in accordance with the strategy.

A competent person should review the outcome of the inspection and make recommendations for changes to the strategy as required

Annex A: Examples of Typical Inspection Strategies

➢ This Annex provides guidance to assist the occupier on what may be an appropriate inspection strategy for the gas pipework on a site. Such strategies will be dependent on the results of the associated risk assessment for the relevant pipework system.

The inspection strategy will need to incorporate a number of components dependent on the particular site. The frequency with which these components are carried out should be appropriate to the risk posed by the LPG installation on that particular site. As a general principle the higher the risk the greater the effort required will be.

A.1 Internal Pipework (Low Pressure)

If a leak is suspected (for example by smell) immediately :

- Open all doors and windows
- Do not operate electrical switches
- Shut off the gas supply at the LPG vessel
- Contact your gas supply company or consult a CORGI-registered installer to carry our appropriate tests and inspections and to make any necessary repairs.

As a minimum at intervals not exceeding 12 months and whenever any leak is suspected or any work (e.g. modifications or extensions) is carried out on pipework or on the gas circuit of appliances, internal pipework and fittings should:

- be visually checked for corrosion or damage;
- be tested for leakage;
- have their emergency control valves checked for accessibility and operation.

➢ Equipment should be serviced in accordance with the manufacturers' instructions to satisfy the provisions of PUWER. This may present a convenient opportunity to check pipework.

A.2 External Pipework

If a leak is suspected (for example by smell) immediately :

- Shut off the gas supply at the LPG vessel
- Contact your gas supply company or consult a CORGI-registered installer to carry our appropriate tests and inspections and to make any necessary repairs.

A.2.1 Above Ground Pipework

Irrespective of the result of the risk assessment, as a minimum**,** at intervals not exceeding 12 months, and whenever any leak is suspected or any work (e.g. modifications, replacements or extensions) is carried out on the pipework, external above ground pipework and fittings should:

- be visually checked for corrosion or damage - in particular protective finishes (e.g. paint, sleeving, galvanising) should be checked for effectiveness. The protective sleeving where underground (yellow) polyethylene gas pipes is joined to above ground systems (e.g. regulators or emergency control valves) should be checked to ensure that the pipework is protected from sunlight);

- have their emergency control valves checked for accessibility and operation.

Pipework should be tested for leakage at an interval dependent on the result of the associated risk assessment. For example,

- for high risk a leak test at an interval not exceeding 12 months;
- for medium risk a leak test at an interval not exceeding 10 years;
- for low risk breakdown maintenance only may be appropriate however risk assessments should be reviewed in accordance with 3.2.4 to ensure that the risk remains low.

Pipework should also be tested for leaks if any work is carried out in the intervening period (for example modifications or extensions)

- The Examination of bulk LPG vessels under the PSSR may present a convenient opportunity to check pipework.

A.2.2 Below Ground Pipework

- The LPG supply company or pipework owner should be consulted when any excavations, building work or road laying (including on adjacent premises) is carried out within 3 m of bulk LPG storage vessels or the pipeworks' route;

- HSE Guidance Note HS[G]47 *"Avoiding danger from underground services"* gives guidance on excavation;

- The Examination of bulk LPG vessels under the PSSR may present a convenient opportunity to check pipework.

A.2.2.1 Polyethylene Pipework

Irrespective of the result of the risk assessment, as a minimum**,** whenever any leak is suspected or any work (e.g. modifications, replacements or extensions) is carried out on the pipework or when any excavations, building work or road laying has been carried out within 3 m of the pipeworks' route, it should be tested for leakage.

Pipework should be tested for leakage at an interval dependent on the result of the associated risk assessment. For example:

- for high risk a leak test at an interval not exceeding 12 months;

- for medium risk a leak test at an interval not exceeding 20 years;
- for low risk breakdown maintenance only may be appropriate however risk assessments should be reviewed in accordance with 3.2.4 to ensure that the risk remains low.

The transition from underground to above ground pipework should be assessed as in A.1.1 above.

A.2.2.2 Metallic Pipework

- The inspection strategy for underground metallic pipework will depend on the results of the associated risk assessment which will, in turn, be strongly influenced by the degree of protection against corrosion or damage afforded.

A.2.2.2.1 Unprotected Metallic below Ground Pipework

Unless the location and condition of the pipework can be positively established as satisfactory, for example by excavation, high risk metallic below ground pipework should be replaced as soon as practicable.

Where the condition can be established as satisfactory or where the pipework is low risk or medium risk a programme should be put in place to either replace it or to ensure its continued satisfactory condition.

A.2.2.2.2 Cathodically Protected below Ground Pipework

- Cathodic protection systems should be designed and installed by, or in conjunction with, specialist cathodic protection engineers or consultants.

At intervals not exceeding 12 months the effectiveness of the cathodic protection should be checked in accordance with the suppliers or specialist cathodic protection engineers or consultants' instructions and the results recorded. If the effectiveness of the cathodic protection cannot be established then the pipework should be treated as 'high risk', as in A.2.2.2.1.

Irrespective of the result of the risk assessment, as a minimum**,** whenever any leak is suspected or any work (e.g. modifications or extensions) is carried out on the pipework or when any excavations, building work or road laying has been carried out within 3 m of the pipeworks' route, and at intervals not exceeding twenty years, it should be tested for leakage.

A.2.2.2.3 Wrapped Metallic below Ground Pipework

Unless the location and condition of the pipework and its wrapping can be positively established as satisfactory, for example by excavation of the riser(s) and the pipework adjacent to them, it should considered as unprotected metallic pipework and replaced as soon as practicable.

Where the location and condition of the pipework and its wrapping can be positively established as satisfactory it should be re-inspected and tested for leakage at intervals depending on the risk associated with its duty.

Irrespective of the result of the risk assessment, as a minimum**,** whenever any leak is suspected or any work (e.g. modifications or extensions) is carried out on the pipework or when any excavations, building work or road laying has been carried out within 3 m of the pipeworks' route, it should be tested for leakage.

Pipework should be tested for leakage at an interval dependent on the result of the associated risk assessment. For example:

- for medium risk a leak test at an interval not exceeding 5 years;
- for low risk a leak test at an interval not exceeding 10 years.

A.2.2.2.4 Plastic Coated Metallic below Ground Pipework

Irrespective of the result of the risk assessment, as a minimum**,** whenever any leak is suspected or any work (e.g. modifications or extensions) is carried out on the pipework or when any excavations, building work or road laying has been carried out within 3 m of the pipeworks' route, it should be tested for leakage.

Any below ground couplings, joints or connections should be visually examined at intervals depending on the risk assessment.

- for high risk an inspection at an interval not exceeding 12 months;
- for medium risk an inspection at an interval not exceeding 10 years;
- for low risk an inspection at an interval not exceeding 20 years.

Pipework should be tested for leakage at an interval dependent on the result of the associated risk assessment. For example:

- for high risk a leak test at an interval not exceeding 12 months;
- for medium risk a leak test at an interval not exceeding 10 years;
- for low risk breakdown maintenance only may be appropriate however risk assessments should be reviewed in accordance with 3.2.4 to ensure that the risk remains low.

A.2.2.2.5 Proprietary below Ground Pipework

Proprietary below ground pipework should be inspected in accordance with the suppliers instructions and replaced at the end of its declared life.

- HSE PETEL 65/54a: "Petrol filling stations & autogas installations - Precautions to minimise below ground release and migration of liquid or vapour phase volatile organic compounds (VOCs)" gives specific guidance for autogas stations and can be accessed from **http://www.hse.gov.uk/lau/lacs/65-54a.htm**.