Hazard warning

Working with an energy source such as natural gas or LPG presents a potentially dangerous situation – not only to yourself but also to your customers and members of the public. If you work on gas systems in non-domestic situations, you will be affected by the requirements of The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR). Gas Safe Register's Technical Team look at the requirements of DSEAR and how they may affect you.

DSEAR does not only impact on gas work: it sets out the minimum requirements for the protection of pipework to protect workers from fire and explosion risks related to dangerous substances and potentially explosive atmospheres.

Risk assessment

Regulation 5 of DSEAR requires employers and self-employed people to assess all potential risks to employees and anyone who may be affected by the use or presence of a dangerous substance in the workplace.

Employers should check that suitable control measures are in place before starting any new work or process. These control measures should be checked periodically to assess suitability and whether further control measures are needed.

The Management of Health and Safety at Work Regulations 1999 also require that, if a business employs five or more people, the significant findings of the risk assessment should be recorded. They can be recorded as a separate record or as part of a company's management systems.

As the statutory minimum, the risk assessment should:

- Determine the hazardous properties of the dangerous substance(s)
- Identify who might be harmed and the likelihood and severity of the consequences
- Consider any employees who may be at increased risk because of lack of awareness, eg, inexperienced trainees and those under 18
- Consider others, including workers of another employer in the workplace or nearby, members of the public and other visitors, both on and off site
- Satisfy yourself that where a 'model' risk assessment is being used from sites elsewhere using similar processes, in each case, the model shall:
  - Reflect the core hazard
  - Be adapted to the detail of the particular situation
  - Be appropriate to the type of work.

> **Note**
>
> Gas systems within domestic premises are not within the scope of DSEAR, although gas systems serving some domestic premises are. Central gas systems serving a multi-occupancy dwelling would be an example of this.

Control measures

Employers and duty holders should put in place measures to eliminate the risk or reduce risk to the lowest practicable level.

In most cases, it may not be practicable for the gas engineer to remove the risk. From a gas engineer's point of view, unless they are purging the gas system to air – which requires precautions and risk assessment in its own right – it isn't possible to remove the gas. This means that using suitable control measures to lower the risk to the lowest practicable level is required.

Suitable control measures should:

- Reduce the quantity of the dangerous substance to a minimum
- Avoid or minimise releases
- Control releases at source
- Prevent the formation of a dangerous atmosphere – for example, by increasing ventilation
- Collect, contain and remove releases to a safe place. In the case of gases, this would mean venting directly to outside atmosphere
- Avoid ignition sources
- Avoid adverse conditions that might lead to danger, such as exceeding temperature or control limits
- Keep incompatible substances apart.

Zoning, or hazardous areas

IGEM/SR/25 – *Hazardous Area Classification of Natural Gas Installations*, IGEM/GM/7B – *Hazardous Area Classification for Gas Metering Equipment* and IGEM/UP/16 – *Design for Natural Gas Installations on Industrial and Commercial Premises* outline the process of identifying hazardous areas with respect to gas installations.

The room/area size, gas pressure, ventilation and grade of release will determine which hazardous area or 'zone' the space will fall into; these can be classified using **Table 1**.

Table 1: Classification of hazardous zones

Zone 0	An area in which an explosive atmosphere consisting of a mixture with air of gas, vapour or mist is present continuously, or for long periods, or frequently
Zone 1	An area in which an explosive atmosphere consisting of a mixture with air of gas, vapour or mist is likely to occur in normal operation occasionally
Zone 2	An area in which an explosive atmosphere consisting of a mixture with air of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will exist for a short period only
Zone 0 NE*	An area in which an explosive atmosphere consisting of a mixture with air of gas, vapour or mist is present continuously, or for long periods, or frequently, but would be of negligible extent
Zone 1 NE*	An area in which an explosive atmosphere consisting of a mixture with air of gas, vapour or mist is likely to occur in normal operation occasionally, but would be of negligible extent
Zone 2 NE*	An area in which an explosive atmosphere consisting of a mixture with air of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will exist for a short period only and would be of negligible extent
Safe Area	An area in which an explosive atmosphere consisting of a mixture with air of gas, vapour or dust is never present

**NE = negligible extent*

Definition

DSEAR defines a dangerous substance as a *"substance or preparation which meets the criteria in the approved classification and labelling guide for classification as a substance or preparation which is explosive, oxidizing, extremely flammable, highly flammable or flammable, whether or not that substance or preparation under the Chemicals (Hazard Information and Packaging for Supply) Regulations 2002"*. Both natural gas and LPG are considered to be a dangerous substance.

Where a zone is classified as NE, ie, where ventilation is sufficient and the leak rate small, no action is required to control sources of ignition within it. A zone of negligible extent is not the same as a safe area.

Considerations when classifying a hazardous area

Hazardous area classification should only be undertaken by someone with full knowledge and understanding of the gas systems and equipment concerned.

The following items should be considered when classifying a hazardous area:

- Grade of release
- Operating pressure
- Ventilation
- Adverse conditions such as corrosive atmospheres, coastal sites, etc
- Confinement and congestion which may obstruct airflow, such as large plant and equipment
- Construction methods and materials such as minimising joints, corrosion resistance, welding, etc
- Flammable dust content in gas
- Flammable liquid content within the gas and dew point. Some gases can contain a higher proportion of hydrocarbons than can condense at lower ambient temperatures or during venting
- Frequency of inspection
- Free cross-sectional area of openings
- Unobstructed ventilation.

Grades of release

Natural gas releases should be considered in three ways.

A secondary release of natural gas is defined as a release which is not expected during normal operation and which, if it does occur, is likely to do so only infrequently and for short periods.

The following are secondary grades of release with a nominal hole size of 0.25mm^2:

- Pairs of flanges
- Screwed fittings
- Joints
- Distribution regulator diaphragms
- Valve glands.

The following can also be considered as secondary grades of release. Theses releases are specific to the type of equipment and, in general, are significantly larger than 0.25mm^2:

- Small holes in the shell/crown of a water-sealed gasholder
- The outer seal on water-sealed gasholders where prevention of overfilling cannot be ensured
- The piston seal within a water-sealed gasholder
- Purge vents, drains and sample points if operating infrequently
- Relief valve vents when operating
- Process machinery and instrument vents if operating infrequently
- Shaft seals on compressors and boosters.

A primary grade of release can be defined as a release which can be expected to occur periodically or occasionally during normal operation.

The following can be considered as primary grades of release:

- Purge vent terminations, drains and sample points if operating frequently
- The valve seating of close purge vent pipes, drains and sample points if they haven't been capped when they're not in use
- The valve seating of relief valves that are not operating
- Process, machinery and instrument vents, if in frequent operation.

A release can also be continuous or expected to occur frequently or for long periods. Certain types of valve actuator, analyser, instrument vent pipe termination and gas-powered controller can be considered a source of a continuous grade of releases.

Ventilation

Elimination or minimisation of the release of the 'dangerous substance' (gas) should always be the first control measure used.

Ventilation can be used and should be designed to dilute any dangerous concentrations to a safe level, below that which could form an explosive atmosphere. It should provide air movement in all positions where a joint or leakage source has been identified, to provide adequate dispersion of any escaping flammable gas.

Because natural gas is lighter than air, it will rise to the high point in any space. Any space above the highest ventilator will not be as well diluted and so additional control measures may be required if there are joints or leakage sources above the ventilator.

As far as reasonably practicable, natural ventilation grills for internal spaces should be positioned on all four walls and be located at both high and low levels.

Where it is not possible to create good internal air movement, it can be enhanced by the use of an interlocked mechanical ventilation system.

Maintenance of gas pipework

IGEM/UP/2 – *Edition 3 Installation Pipework in Industrial and Commercial Premises* provides guidance on the maintenance of pipework.

Once gas pipework installation has been completed, a plan should be drawn up for the inspection, maintenance and testing of all gas pipework to ensure its continued integrity. The plan should include inspection and testing of all pipework, AECVs, valves, regulators, boosters, etc. Reference should also be made to manufacturer's literature for any manufacturer's requirements.

The maintenance plan should also include access >

Table 2: Minimum ventilation requirements for joined pipework to provide a Zone 2 NE classification

Pressure (mbar)	Notional leak size							
	0.025mm²		0.25mm²			2.5mm²		
	1	2	3	4	5	6	7	8
	More than one wall. High/low level vent free area in each wall (cm²)	One wall. High/low level vent free area in wall (cm²)	More than one wall. High/low level vent free area in each wall (cm²)	One wall. High/low level vent free area in wall (cm²)	Airflow for 10% LEL (m^3h^{-1})	More than one wall. High/low level vent free area in each wall (cm²)	One wall. High/low level vent free area in wall (cm²)	Airflow for 10% LEL (m^3h^{-1})
Up to 50	30	42	290	400	11.4			
Exceeding 50 up to 100	47	65	445	620	18.2			
Exceeding 100 up to 150			630	880	25.0	15500	21700	250
Exceeding 150 up to 200			770	1075	31.8	17900	25100	318
Exceeding 200 up to 300			885	1240	36.3	21900	30700	363
Exceeding 300 up to 400			1090	1520	45.4	25300	35400	454
Exceeding 400 up to 500			1250	1760	52.2	28300	39600	522
Exceeding 500 up to 1000			1400	1970	56.8	58100	81300	568
Exceeding 1000 up to 2000			1860	2610	77.2	77000	107800	772

arrangements for inspection.

Consideration should be given to implementing the following maintenance of gas pipework, depending on the associated risk:

- A tightness test in accordance with IGEM/UP/1, 1A, 1B or 1C
- AECV and other types of valves should be checked periodically for correct and effective operation
- Visual inspection, usually annually. A checklist completed during a visual inspection can help to ensure that the pipework is being adequately maintained
- Gas detection in hazardous areas. A gas detection instrument can be used in areas where small amounts of gas can accumulate and linger
- Gas detection in building entries. Using a gas detection system at building entries can detect gas tracking into the building from outside
- Leak detection fluid and gas detector checks may be used to check joints for gas escapes. ■

Table 2 *(above) shows the minimum ventilation requirements for jointed pipework to provide a Zone 2 NE classification. The notional leakage sizes are:*

- *0.025mm² for normal pipework with an operating pressure (OP) not exceeding 100mbar*
- *0.25mm² for normal pipework with OP exceeding 100mbar and not exceeding 2bar in ventilated locations. It also applies to pipework with OP not exceeding 100mbar that is subject to vibration that might lead to failure, or is within 1m of three significant surfaces. Vibration might be generated from a reciprocating compressor, booster or engine. Using flexible connections that are able to withstand the vibration levels may overcome the risk of failure*
- *2.5mm² is for pipework with OP exceeding 100mbar that is subject to vibration and might lead to failure. This could be overcome by using flexible connections that are able to withstand the vibration levels. It also applies to areas where ventilation is less than 0.5 air changes per hour.*