

IGEM/SR/23 Edition 2
Communication 1623

Venting of Natural Gas



1929

Patron: Her Majesty the Queen

*IGEM/SR/23 Edition 2
Communication 1623*

Venting of Natural Gas



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CONTENTS

SECTION	PAGE
1 Introduction	1
2 Scope	2
3 Legislation	3
4 Glossary	4
5 References	5
6 Vent design	6
7 Design of permanent vent systems	24
8 Designs of temporary vent systems	28
9 Major planned venting operations	30

APPENDIX

1 Details of the model used to predict the dispersion of an unignited vent	32
2 Mass flow rate from relief valves and pipeline vents	33
3 Details of the model used to predict thermal radiation levels downwind of an ignited vent	36
4 Methods of noise control	38
5 Prediction of noise from venting	40
6 Assessment and control of environmental noise levels	45
7 Sizing of orifice type flow restrictors for use on constant mass flow unsilenced vents	46

TABLE

1	Safe vertical separation distances for gas dispersion from vent stacks	8
2	Base noise levels dB(A), 100 m from vent stack	41
3	Correction for vent stack diameter	41
4	Correction for mass flow	42
5	Noise spectra	42
6	Environmental noise level limits for transient noise sources	43
7	Indicative background noise levels (dB(A))	44

FIGURE

1	Typical flows of air around buildings	7
2a	Safe horizontal distance for gas dispersion from vent stacks (stack diameters from 0.025 to 0.2 m).	9
2b	Safe horizontal distance for gas dispersion from vent stacks (stack diameters from 0.1 to 0.6 m).	10
3	Flammable gas discharge near a building, (a) flammable gas envelope does not reach building, and (b) flammable gas envelope clears building	12
4	Determination of stack heights in close proximity to buildings	13
5	Recommended design curves for vent stacks with exit velocities less than 60 m s ⁻¹	15
6a	Safe horizontal distance for ignited releases from vent stacks (stack diameter 0.1 m)	18
6b	Safe horizontal distance for ignited releases from vent stacks (stack diameter 0.2 m)	19
6c	Safe horizontal distance for ignited release from vent stacks (stack diameter 0.4 m)	20
6d	Safe horizontal distance for ignited releases from vent stacks (stack diameter 0.6 m)	21
7	Typical arrangement of permanent vent	26
8	Compressibility factor for natural gas over a range of temperatures	34
9	Mass flow rate variation with pressure for various vent diameters	35

SECTION 1 : INTRODUCTION

- 1.1 This Standard supersedes IGE/SR/23 Edition 1, Communication 1623, which is obsolete.
- 1.2 This Standard has been drafted by an Institution of Gas Engineers and Managers (IGEM) Panel, appointed by IGEM's Gas Transmission and Distribution Committee, and has been approved by IGEM's Technical Co-ordinating Committee on behalf of the Council of IGEM.
- 1.3 This Standard has been prepared to provide requirements for venting of natural gases.
- 1.4 This Standard has been prepared taking into consideration the guidance contained in the British Gas plc Engineering Standard BGC/PS/SGV2 on venting. They are based on up to date models and they include recognition of the fact that recent environmental legislation in the UK has placed constraints on venting operations. It is recommended therefore that using best available technology and knowledge not entailing excessive cost, safe systems are designed to minimise the venting of gases to the atmosphere.
- 1.5 This Standard makes use of the terms "must", "shall" and "should" when prescribing particular requirements. Notwithstanding Sub-Section 1.8:
- the term "must" identifies a requirement by law in Great Britain (GB) at the time of publication
 - the term "shall" prescribes a requirement which, it is intended, will be complied with in full and without deviation
 - the term "should" prescribes a requirement which, it is intended, will be complied with unless, after prior consideration, deviation is considered to be acceptable.
- Such terms may have different meanings when used in legislation, or Health and Safety Executive (HSE) Approved Codes of Practice (ACoPs) or guidance, and reference needs to be made to such statutory legislation or official guidance for information on legal obligations.
- 1.6 The primary responsibility for compliance with legal duties rests with the employer. The fact that certain employees, for example "responsible engineers", are allowed to exercise their professional judgement does not allow employers to abrogate their primary responsibilities. Employers must:
- have done everything to ensure, so far as it is reasonably practicable, that "responsible engineers" have the skills, training, experience and personal qualities necessary for the proper exercise of professional judgement
 - have systems and procedures in place to ensure that the exercise of professional judgement by "responsible engineers" is subject to appropriate monitoring and review
 - not require "responsible engineers" to undertake tasks which would necessitate the exercise of professional judgement that is not within their competence. There should be written procedures defining the extent to which "responsible engineers" can exercise their professional judgement. When "responsible engineers" are asked to undertake tasks which deviate from this, they should refer the matter for higher review.
- 1.7 It is now widely accepted that the majority of accidents in industry generally are in some measure attributable to human as well as technical factors, in the sense that actions by people initiated or contributed to the accidents, or people might have acted better to avert them.

It is therefore necessary to give proper consideration to the management of these human factors and the control of risk. To assist in this, it is recommended that due regard be paid to HSG48 and HSG65.

- 1.8 Notwithstanding Sub-Section 1.5, this Standard does not attempt to make use of any method or specification obligatory against the judgement of the responsible engineer. Where new and better techniques are developed and proved, they should be adopted without waiting for modification of this Standard. Amendments to this Standard will be issued when necessary and their publication will be announced in the Journal of the Institution.
- 1.9 Requests for interpretation of this Standard in relation to matters within their scope, but not precisely covered by the current text, should be addressed to Technical Services, IGEN, IGEN House, High Street, Kegworth, Derbyshire DE74 2DA and will be submitted to the relevant Committee for consideration and advice, but in the context that the final responsibility is that of the engineer concerned. If any advice is given by or on behalf of IGEN, this does not imply acceptance of any liability for the consequences and does not relieve the responsible engineer of any of his or her obligations.
- 1.10 This Standard was published in xx xxxxx 2012.

SECTION 2 : SCOPE

- 2.1 This Standard covers the conceptual design, operation and safety aspects of permanent, temporary and emergency venting of natural gas for the depressurisation of plant or equipment for onshore vertical vent systems.
- 2.2 This Standard is not intended to cover the detailed design, manufacture, installation, maintenance and inspection of the hardware for example valves, pipework etc.
- 2.3 This Standard is not intended to cover flare systems, although guidance is provided, particularly with respect to thermal radiation, in the event of vented gas being ignited.
- 2.4 This Standard covers releases of liquid free natural gas which have a combined proportion of methane plus inerts of greater than 89% by volume, with gross calorific values below 41 MJ m^{-3} , and at temperatures between -50°C and 50°C . The venting of gases other than the natural gases defined above are outside the scope of this Standard, and specialist advice should be sought on this topic.
- 2.5 This Standard covers releases from vent stacks with internal diameters equal to or greater than 25 mm. In order to promote rapid gas dispersion, it is recommended that the exit velocity of any release should be greater than 60 m s^{-1} , equivalent to a mass flow rate of 0.02 kg s^{-1} from a 25 mm diameter vent stack. However, consideration is given to those situations where this minimum exit velocity cannot be achieved.
- 2.6 This Standard applies for flow rates up to 40 kg s^{-1} . They do not apply to instrumentation vents, and purging and venting operations where small volumes of gas are released, that is small vents in distribution systems. Additionally, the isolation, purging and venting of watersealed and waterless gasholders should be carried out in accordance with IGE/UP/4.
- 2.7 This Standard does not apply to purging operations within the scope of IGE/UP/1.

SECTION 3 : LEGISLATION

This Standard is set out against a background of legislation in force in GB at the time of publication (see Appendix 2). The devolution of power to the Scottish, Welsh and Northern Ireland Assemblies means that there may be variations to the legislation described below for each of them and consideration of their particular requirements must be made. Similar considerations are likely to apply in other countries and reference to appropriate national legislation will be necessary.

Appendix 2 lists legislation, guidance notes, standards etc. which are identified within this Standard as well as further items of legislation that may be applicable. Where standards are quoted, equivalent national or international standards etc. equally may be appropriate. Unless otherwise stated, the latest version of the referenced document should be used.

3.1 PRIMARY LEGISLATION

3.1.1 Control of Pollution Act (COPA)

3.1.1.1 A certain amount of noise is inherent in operation and maintenance activities. The best practicable methods should be employed to minimise noise emission, to protect site personnel and the public. Any relevant legal requirements must be applied.

3.1.1.2 Consideration should be given to the following:

- provision of suitable ear protection to site personnel
- siting and screening of plant
- the timing of all operations and maintenance activities, which should take into account the impact on the environment.

3.1.1.3 Noise is a major issue both for designers (who should endeavour to “design out” noisy processes, wherever possible) and managers of construction or demolition sites where the potential of nuisance should be recognised at the earliest possible stage.

3.1.1.4 Part III of COPA relates to construction site noise, which is subject to noise abatement zones and licensing enforcement by the local authorities. Local authorities have powers to control noise (and vibration) on or from building sites. This control is by the service of a notice placing obligations on the person responsible for the construction operations to observe specified controls to minimise noise. Such a notice can specify types of plant and machinery, permitted hours of operation, boundary noise levels, etc.

3.1.1.5 When drawing up such requirements, the local authority has regard to any code of practice approved or issued under COPA. It must also have regard to the concept of “best practicable means” and any alternative plant or machinery which may be used. BS 5228 has been adopted for this purpose. Although the standard has been adopted under COPA, it is not legally binding in itself. However, the content of each relevant part of the standard should be taken to represent current good practice.

3.1.1.6 Noise abatement zones are established essentially for the purposes of rationalising competing sources of noise, particularly where industrial premises and domestic premises are in proximity. Local authorities are required to keep registers of noise levels of specified premises within noise abatement zones.

3.1.2 Environmental Protection Act (EPA)

3.1.2.1 Waste

3.1.2.1.1 Waste is defined in Schedule 22 of the Environment Act as any substance or object which a holder discards or intends, or is required, to discard. This definition is based upon an EC Directive and is, therefore, known as "directive waste". "Controlled waste" is defined by EPA as "household, industrial and commercial waste". Controls under EPA, for example licensing requirements and the Duty of Care, apply only to "controlled waste" that is also "directive waste".

3.1.2.1.2 Section 34 of EPA introduced a duty of care for waste management. The duty of care applies to anyone who produces, imports, carries, keeps, treats or disposes of controlled waste. There are a number of objectives, outlined below, which duty holders should achieve, as is reasonable in the circumstances.

3.1.2.1.3 Every person who is subject to the duty of care must ensure not only that they do not commit an offence but that any other person does not similarly commit offence. In practice, this means that a waste holder is responsible for taking steps to prevent offences involving waste that they have controlled at some point. They must try to prevent other people from disposing of, treating or storing the waste:

- without a licence
- breaching the conditions of a licence
- in a manner likely to cause pollution or harm to health.

3.1.2.1.4 The producer or importer of waste must package it in such a way as to prevent escape of leakage while on site, in transit or in storage. The waste producer or holder must ensure that waste is only transferred to an authorised person. The categories of authorised persons are:

- a waste collection authority
- the holder of a waste management licence or someone who is exempt from holding a licence
- a registered carrier of controlled waste, or someone who is exempt from registration
- in Scotland, a waste disposal authority.

In addition, an accurate, written description of the waste must be provided by the producer or importer of the waste and transferred with the waste at each stage.

3.1.2.2 Noise

3.1.2.2.1 Part II of EPA relates to statutory nuisances, which include noise nuisances. Statutory nuisances are defined as including circumstances in which noise is emitting from premises so as to be prejudicial to health or a nuisance. The local authority can serve an abatement notice and enforce it in criminal proceedings before a magistrate's court in the event of non-compliance without reasonable excuse.

3.1.2.2.2 The Noise and Statutory Nuisance Act amends EPA to make noise from vehicles, machinery or equipment in the street a statutory nuisance. If the local authority is satisfied that noise from vehicles, machinery or equipment in the street is causing, or is likely to cause, a nuisance, it must serve an abatement notice on the person responsible.

- 3.1.2.2.3 The aim of the Control of Noise at Work Regulations (see Sub-Section 3.3.4) is to reduce the risks of occupational hearing damage to as low as reasonably practicable.

There are, among others, legal duties to:

- protect the hearing of those at work and of others
- carry out a noise assessment if employees are exposed to noise levels exceeding 85 dB(A)
- take measures to reduce noise levels to the lowest level reasonably practicable
- use warning signs to indicate where hearing protection must be worn
- inform workers about risks to hearing.

- 3.1.2.2.4 HSL108 is designed to give those with responsibilities for reducing noise exposure guidance and advice on legal duties on the introduction of control measures, the selection of ear protection and how to carry out a noise assessment by a competent person.

3.1.3 Health and Safety at Work etc. Act (HSWA)

- 3.1.3.1 HSWA applies to all persons involved with work activities, including employers, the self-employed, employees, designers, manufacturers, suppliers etc. as well as the owners of premises. It places general duties on such people to ensure, so far as is reasonably practicable, the health, safety and welfare of employees and the health and safety of other persons such as members of the public who may be affected by the work activity.

- 3.1.3.2 All persons engaged in the design, construction, commissioning, operation, maintenance and alteration of pipework must be competent to carry out such work. Competency is achieved by an appropriate combination of education, training and practical experience.

3.2 SECONDARY LEGISLATION

3.2.1 Construction, (Design and Management) Regulations (CDM)

These Regulations impose duties on designers, clients (and their agents), developers, planning supervisors and principal contractors. Not all the regulations apply to all construction projects. Further information is given in HSL144. For a notifiable project (as defined in CDM) the planning supervisor must notify HSE before construction work commences. Construction includes the alterations, repair redecoration, maintenance, decommissioning or demolition of a structure. It also covers installation, commissioning maintenance or removal of gas services.

3.2.2 Control of Substances Hazardous to Health Regulations (COSHH)

- 3.2.2.1 These Regulations, which reinforce existing statutory obligations under HSWA, impose a duty on employers to protect employees against risks to health, whether immediate or delayed, arising from exposure to substances hazardous to health, either used or encountered, as a result of a work activity. They also impose certain duties on employees.

- 3.2.2.2 Under COSHH, work must not be carried out which is liable to expose employees to hazardous substances unless the employer has made a suitable and sufficient assessment of the risk created by the work and the steps that need to be taken to comply with the Regulations. After assessing the risk, it is necessary to inform employees of the risks and to carry out the appropriate training and

instruction to ensure the risks are minimised. In certain cases, control measures such as ventilation or personal protective equipment may be necessary and, where provided, they must be used.

3.2.3 Pressure Systems Safety Regulations (PSSR)

3.2.3.1 These Regulations impose duties on designers, importers, suppliers, installers and user or owners to ensure that pressure systems do not give rise to danger. This is done by the correct design installation and maintenance, provision of information, operation within safe operating limits and, where applicable, examination in accordance with a written scheme of examination drawn up or approved by a competent person (as defined in PSSR).

3.2.3.2 Relevant fluids for the purposed of this document would be NG at a pressure greater than 0.5 barg that is, above atmospheric pressure, or LPG (which is a liquid with a vapour pressure greater than 0.5 barg at ambient temperature). A pressure system would include bulk storage tanks, pipelines and protective devices but not an LPG cylinder (transportable pressure receptacle). Once the pressure in the pipework drops below 0.5 barg, and the user/owner can show clear evidence that the system does not contain, and is not liable to contain, a relevant fluid under foreseeable operating conditions, then that part of the system is no longer covered by the Regulations. This is likely to be the case after the pressure relief valve associated with a pressure reducing valve which takes the pressure to below 0.5 barg, for example at the entry to a building but note the special requirements placed on protective devices in such systems (see para 110b of HSL122). The regulations also apply to pipelines and the protective devices in which the pressure exceeds 2 barg (see Sch 1 part 1 item 5 of HSL122).

3.2.3.3 More information is available in HSL122 and some information is presented in the HSE free leaflets INDG261 and INDG178.

3.2.4 Dangerous Substances and Explosive Atmospheres Regulations (DSEAR)

3.2.4.1 These Regulations are concerned with protection against risks from fire, explosion and similar events arising from dangerous substances used or present in the workplace. The regulations require that risks from dangerous substances are assessed, eliminated or reduced. They contain specific requirements to be applied where an explosive atmosphere may be present and require the provision of arrangements to deal with accidents, emergencies etc. and provision of information, training and use of dangerous substances. The regulations also require the identification of pipelines and containers containing hazardous substances.

The following publications contain details of the regulations and their application:

- INDG370
- HSL134
- HSL135
- HSL136
- HSL137
- HSL138.

3.2.4.2 All gas systems except those in domestic parts of buildings fall within the scope of DSEAR. This requires that a risk assessment be completed for each premise to determine if any hazardous area exists and its extent. Normally, systems of MOP not exceeding 0.5 bar do not require the use of certified electrical

components or restrictions on sources of ignition if correctly installed, tested and maintained.

3.2.5 Pressure Equipment Directive (PED)

3.2.5.1 PED applies to the design of pipework of MOP exceeding 0.5 bar which is designed and installed for a site user, for example a factory occupier. PED is implemented in the UK by the Pressure Equipment Regulations (PER) and PSSR. Compliance with PED can be demonstrated by the use of a harmonised standard. BS EN 15001-1 and -2 have been specially prepared for the gas industry and include a wide range of materials. Systems falling within the scope of PED must display a CE mark and this must be affixed by an approved person or body.

3.2.5.2 Systems in which the pressure (bar) times the volume (litre) is less than 250 are partially exempt from PED on the basis that they have a low contained energy. Pipework of diameter not greater than 25 mm nominal size is also partially exempt.

Note: Other pipework systems "designed and specified" by the customer which are thereafter installed and tested by a contractor will not normally fall within the scope of PED and sections of pipework designed and manufactured "off-site" will, generally, always fall outside the scope of PED if designed and specified by the contractor.

3.2.5.3 There is also a duty on the user of an installed system within the scope of PED not to allow the system to be used until they have a written scheme of examination covering protection devices, pressure vessels and parts, which if they fail, give rise to danger.

3.2.5.4 The scheme of examination must be drawn up by a "competent person" and the system must be examined in accordance with the written scheme of examination by a "competent person". The more complex a system is, the more qualifications, experience and training are needed to ensure competence.

3.2.5.5 Guidance on the selection of competent persons is given in HSL122. Users (or owners) of pressure systems are free to select any competent person they wish, but they have to take all reasonable steps to ensure that the competent person selected can actually demonstrate competence i.e. the necessary breadth of knowledge, experience and independence. In judging levels of competence, users or owners may wish to know that a national accreditation scheme has been developed by the United Kingdom Accreditation Service (UKAS) for bodies that provide services of this nature.

SECTION 4 : VENT DESIGN

4.1 GENERAL

Hydrocarbon gases produced from the depressurisation of pipelines, plant or equipment should, wherever practicable, be disposed of by re-injecting them into an adjacent system or alternatively by flaring. Where this is impractical, venting to atmosphere may be employed.

Lighter-than-air gases may be vented as long as the venting is infrequent, although for gases with a density close to that of air, further analysis may be necessary in order to ensure that venting does not constitute a hazard under certain atmospheric conditions such as temperature inversion.

Hydrocarbon gases that are denser than air, either due to their molecular weight or temperature, should generally be discharged to a properly designed flare system, unless it can be shown that venting of such gases would not constitute a hazard due to slumping. Alternatively, denser than air gases can be discharged to atmosphere through vents provided their density is decreased to less than that of air by mixing with hot gases.

Specialist advice should be sought with regard to any of the above requirements.

4.2 CHOICE OF PERMANENT OR TEMPORARY VENTS

4.2.1 When designing a vent system, consideration should be given to whether a permanent or temporary vent stack is required.

4.2.2 When permanent vent systems cannot be justified or are not practicable, temporary vent stacks should be used. Provision should be made for temporary vents in the pipework at the design stage. Such situations cover maintenance or commissioning operations to depressurize items of plant or equipment.

4.3 STACK EXIT VELOCITY

4.3.1 To promote rapid dispersion, vent stacks should be designed to discharge at the maximum velocity having regard to the safety of persons or plant, and local circumstances and consistent with permitted noise levels.

4.3.2 It is recommended that the minimum design stack exit velocity should be 60 m s^{-1} . However, it should be recognised that the velocity may decay at the end of a release. There are a limited number of situations where velocities of 60 m s^{-1} cannot be achieved or are not acceptable for noise reasons.

4.4 FLOW CONTROL

4.4.1 Facilities should be provided to vent gas at constant mass flow rate from the various items of plant through a remotely sited vent stack situated in a sterile or controlled area. Control of the mass flow rate provides a near constant exit velocity flow from the vent stack over the duration of the release, and thereby avoids high initial mass flows that can occur in some vent systems with their potential for high thermal radiation levels should the release be accidentally ignited. Constant mass flow venting therefore assists in keeping the size of any sterile or controlled area within reasonable limits.

Note: Some vents need not employ constant mass flow. These include, for example, temporary venting, venting of relief valves and venting where small quantities of gas are involved. In such cases, manually operated flow control is normally used, with the flow to, and out of, the vent stack first increasing as the control valve is opened until a reasonably constant flow rate is reached. The majority of the gas to be vented will then be released at this

steady flow rate, until at the end of the release period when the flow rate will decay to zero as the control valve is shut.

4.4.2 In the requirements below, it is the flow rate which gives the maximum safe distance that should be used in any assessment of safe separation distances between the vent stack and surrounding plant or personnel.

4.5 GAS DISPERSION

4.5.1 General

4.5.1.1 Gas dispersion is influenced by:

- Gas exit velocity, flow rate, density, temperature and pressure
- Stack diameter and height
- Atmospheric conditions
- Local topography.

4.5.1.2 Vent stacks should discharge vertically upwards wherever practicable. The information given in clause 4.5.1.3 to 4.5.1.4 regarding safe separation distances applies to vertical discharges only. Where the discharge is not vertical, further specialist advice should be sought.

4.5.1.3 The vent tip should be at least 3 m above the ground or platform level.

4.5.1.4 Vent stacks should not be located near to natural topographical features such as cliffs, etc.

Note: When a stack is sited near a building(s), it is possible for complex aerodynamic forces to influence the gas dispersion processes. Figure 1 gives a schematic representation of the air flow with the wind blowing from left to right. If the vent stack is not correctly sized or situated, gas concentrations may build up in the recirculation zones at the front, rear, and top of the building(s). This problem may be avoided using the guidance given in clauses 4.5.1.7, 4.5.2, and 4.5.3.

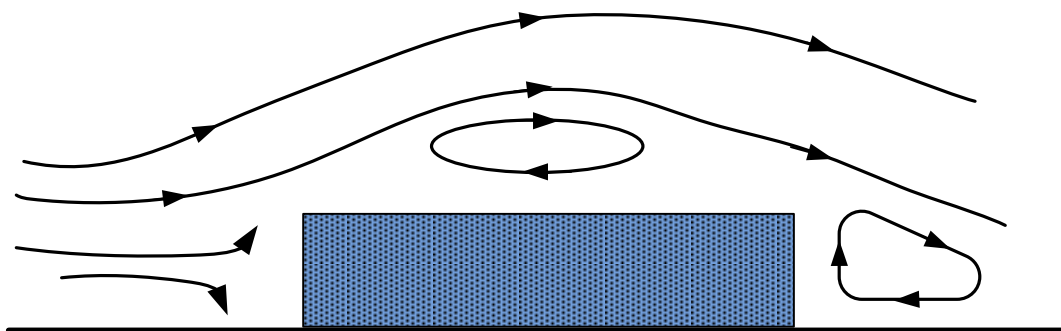


FIGURE 1 - TYPICAL FLOWS OF AIR AROUND BUILDINGS

4.5.1.5 Vent stacks should not be sited near furnaces, engine inlets, gas pre-heating equipment, etc., where dangers might arise from the ingestion of gaseous mixtures, even if the gas mixture is below the flammable limit.

4.5.1.6 Vent stacks should not discharge inside buildings. It is good practice to avoid siting vent stack exits close to air conditioning intakes to buildings and air intakes for pressurisation within buildings.

4.5.1.7 Each vent stack should be of constant diameter and vertical for at least four stack diameters from the exit. This is to make some allowance for the pipe flow to recover following bends and diameter changes.

4.5.1.8 To ensure good gas dispersion and jet rise, the vent stack diameter should be sized to discharge at the maximum practicable exit velocity which should not be less than 60 m s^{-1} . If this is achieved, the considerations in clause 4.5.2 apply. Where an exit velocity of 60 m s^{-1} cannot be achieved, the considerations in clause 4.5.3 will apply.

4.5.1.9 In some situations it may be necessary to assess safe gas dispersion distances for discharges from multiple vent stacks. In such cases, the total gas flow rate which is to be vented should be determined by addition of the individual flow rates through each of the vent stacks being used. An equivalent diameter of a single vent stack should be determined by equating the cross-sectional area of that stack to the sum of the cross-sectional areas of the vent stacks being used. Values for the total gas flow rate and equivalent stack diameter determined in this way should be used in conjunction with the recommendations in clauses 4.5.2 and 4.5.3 and will result in a conservatively safe horizontal distance.

Note: Reference may be made to IGEN/SR/25 or specialist advice sought.

4.5.2 Recommended safe dispersion distances for stack exit velocities of 60 m s^{-1} or greater

It should be noted that the safe distances obtained from this section may differ from those derived from more general codes of practice for Hazardous Area Classification. However, for venting operations within the scope of this Standard, the safe distances given will always be conservative.

4.5.2.1 Figures 2(a) and 2(b) show how safe horizontal gas dispersion distances can be estimated for given flow rates and diameters of stack. They show the safe horizontal distance from the vent stack plotted against the flow rate and stack diameter, calculated using the mathematical model of gas dispersion described in Appendix 1 for a fixed minimum stack height of 3 m.

Table 1 gives equivalent safe vertical distances in terms of height in metres above the tip of the vent stack. These distances can be used to define a cylindrical hazardous zone centred on the vent stack. This zone has a radius obtained from Figure 2, and extends to a height above the vent stack tip given in Table 1; it extends below the vent stack tip by a distance D. The distance D is given by:

$$D = L + (3 \times \text{vent stack diameter})$$

where $L = 1 \text{ m}$ or $(0.4 \times \text{height of stack above ground level})$, whichever is the greater.

Stack tip diameter (m)									
Mass flow (kg s ⁻¹)	0.025	0.05	0.10	0.15	0.20	0.30	0.40	0.50	0.60
> 0.5	15	20	35	NA	NA	NA	NA	NA	NA
> 0.5 to 1.0	20	20	35	45	NA	NA	NA	NA	NA
> 1.0 to 2.0	25	30	40	50	60	NA	NA	NA	NA
> 2.0 to 5.0	40	40	45	60	70	90	NA	NA	NA
> 5.0 to 10.0	60	60	60	70	80	100	115	130	NA
> 10.0 to 20.0	80	80	80	80	80	110	130	150	160
> 20.0 to 40.0	120	120	120	130	130	140	160	180	200

TABLE 1 - SAFE VERTICAL SEPARATION DISTANCES FOR GAS DISPERSION FROM VENT STACKS (HEIGHT IS IN METRES ABOVE VENT TIP)

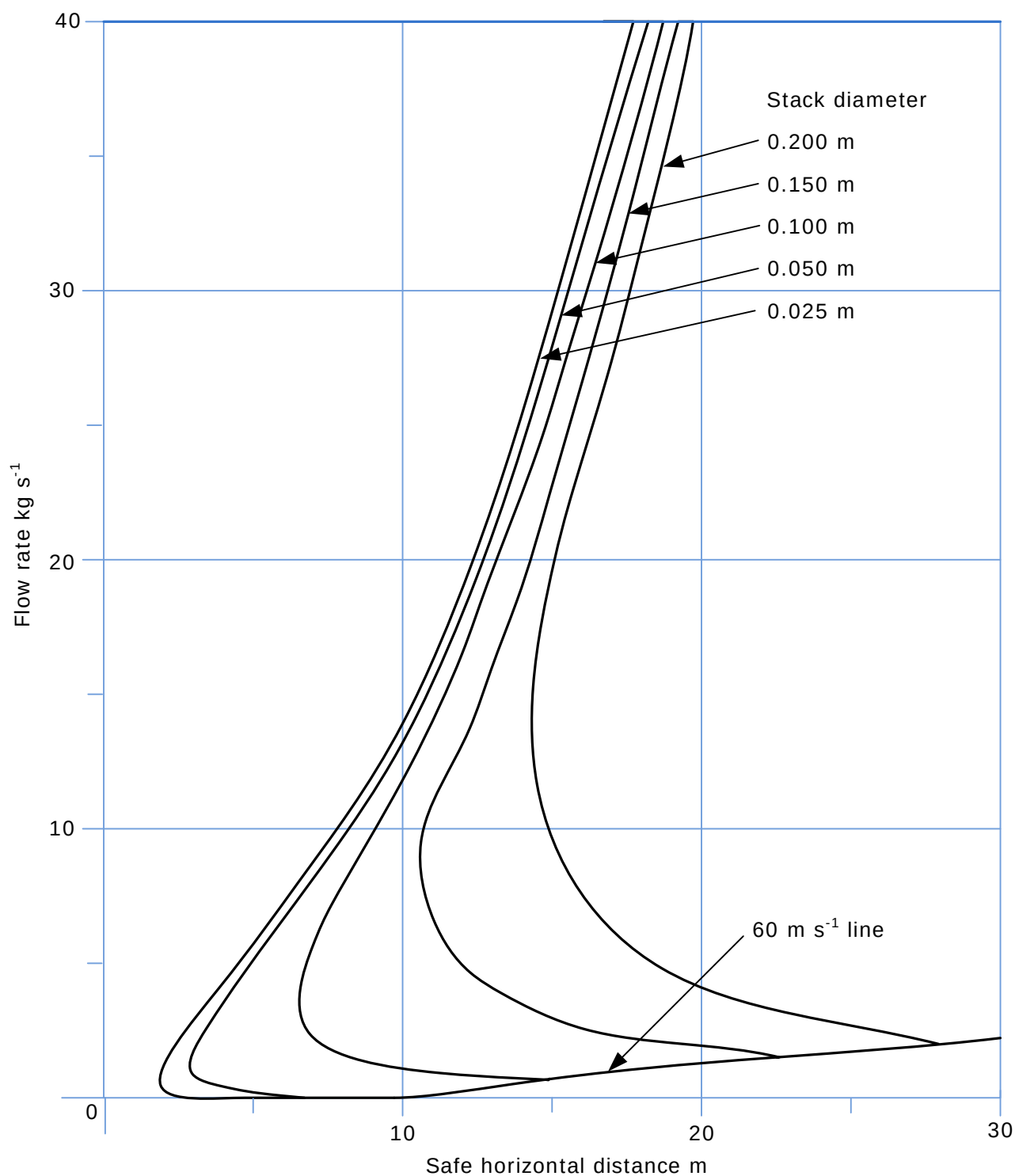


FIGURE 2(a) - SAFE HORIZONTAL SEPARATION DISTANCE FOR GAS DISPERSION FROM VENT STACKS, (STACK DIAMETERS FROM 0.25 TO 0.2 m)