



Exploration & Production

GENERAL SPECIFICATION

SAFETY

GS EP SAF 216

Area classification

Rev.	Date	Notes
05	01/2011	Extent of hazardous areas modified for pumps, compressors, pig traps, flanges and valves, as well as wellheads
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1. Scope

1.1 Purpose

This specification defines the method called **Area classification** used to classify the locations where a flammable atmosphere may occur in such frequencies as to require special precautions for the construction and use of electrical apparatus or other potential ignition sources.

Area classification consists in:

- The partition of a facility into hazardous and non hazardous areas,
- The sub-division of hazardous areas into hazardous zones,
- The sizing of the hazardous zones.

1.2 Applicability

This specification applies to:

- New or modified installations constructed by Company or affiliates both onshore and offshore including LNG and LPG plants
- All E&P operations: drilling, production, treatment, storage and bulk distribution operations.

The scope is limited only to **petroleum fluids** and all other flammable products that are present in the installations.

This specification does not apply to:

- Toxic gases (which on manned installations may lead to more stringent rules),
- Combustible dusts,
- Ignitable fibres,
- Marine facilities covered by the **IMO** code (International Maritime Organisation) e.g. tankers.

Particular case of F(P)SO's:

- This specification applies to the whole production deck facilities on **FPSO's** (Floating, Production, Storage and Offloading) and to utilities on **FSO's** (Floating, Storage and Offloading),
- For all spaces in the hull of a F(P)SO or concerning the cargo deck, **GS EP SAF 380** applies, which refers to **IEC 60092-502**,
- The battery limits between the process areas where **GS EP SAF 216** applies and marine areas where **GS EP SAF 380** / **IEC 60092-502** applies is defined hereafter:

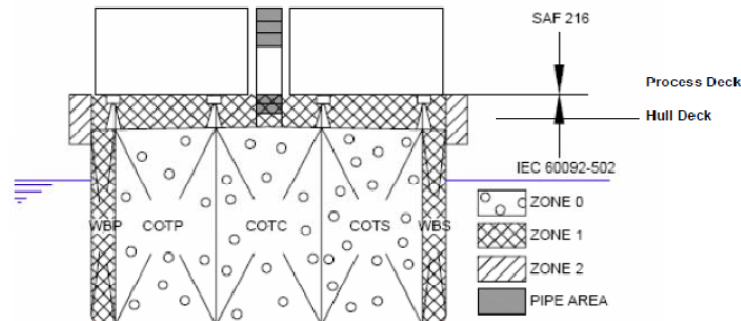


Figure 1 - Battery limits on FP(S)O's

The case of tankers at berth that generate a hazardous area on unit limits is covered in section 14.5 of this document.

This specification is not retroactive: its application to the facilities put in operation before the issue of this specification is not mandatory.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

For the classification of **hazardous areas** in Company petroleum installations, **GS EP SAF 216** can be used as a stand-alone document unless a relevant National Regulation is applicable.

It complies with **IEC 60079-10-1** "Classification of hazardous areas".

Since **IEC 60079-10-1** does not provide detailed recommendations regarding the extent of the hazardous areas in specific industries and applications and allows reference to other codes, **GS EP SAF 216** is mainly based on **IP Code, Part 15**.

The general philosophy of **IP Code, Part 15** and a lot of its detailed recommendations are adopted.

This specification and **IP Code, Part 15** differ mainly in areas not adequately covered by the code or where the code requires interpretation. Also, differences will be found regarding the area classification of some standard equipment/arrangements (namely pumps, compressors, pig traps, flanges and valves, as well as wellheads): for the sake of simplification and consistency between installations, Company purposely specifies hazardous area extent in line with former publications of the code and the GS so as to use well-established, widely accepted hazard radii.

In some cases reference is made to standards other than **IP Code, Part 15**, including **API RP 505**, although the latter shall not be used as a general reference.

The definitions of zones comply with the requirements of the **ATEX Directive 1999/92/EC**.

After the hazardous zones have been determined, the compatibility of all electrical equipment or any potential ignition sources with the zoning classification shall be ensured (see the relevant General Specifications of Company by discipline for the design, installation and use of equipment with potential ignition source).



Some of the specifications issued by the Company disciplines (instrumentation, electricity, mechanics, HVAC, etc.) require ATEX-certified equipment (in conformity with [ATEX Directive 1994/09/EC](#)).

Standards

Reference	Title
EN 1834-1	Reciprocating internal combustion engines - Safety requirements for design and construction of engines for use in potentially explosive atmospheres Part 1: Group II engines for use in flammable gas and vapour atmospheres
IEC 60079-10-1	Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres
IEC 60079-13	Electrical Apparatus for Explosive Gas Atmospheres Part 13: Construction and Use of Rooms or Buildings Protected by Pressurization
IEC 60079-16	Electrical Apparatus for Explosive Gas Atmospheres Part 16: Artificial Ventilation for the Protection of Analyzer(s) Houses
IEC 60079-20-1	Explosive atmospheres – Part 20-1: Material characteristics for gas and vapour classification – Test methods and data
IEC 60092-502	Electrical Installations in Ships – Part 502: Tankers - Special Features
IEC 61285	Industrial-Process Control - Safety of Analyser Houses
IEC 61892-6	Mobile and fixed offshore units – Electrical installations Part 6: Installation
IEC 61892-7	Mobile and fixed offshore units – Electrical installations Part 7: Hazardous areas
ISO 10418	Petroleum and natural gas industries - Offshore production installations - Analysis, design, installation and testing of basic surface process safety systems
ISO 23251 / API STD 521	Petroleum and natural gas industries—Pressure-relieving and depressuring systems

**Professional Documents**

Reference	Title
API Publ 4615	Emission Factors for Oil and Gas Production Operations
API RP 505	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2
API RP 2216	Ignition Risk of Hydrocarbon Liquids and Vapors by Hot Surfaces in the Open Air
NFPA 59A	Production, storage, and handling of Liquefied Natural Gas (LNG)

Regulations

Reference	Title
ATEX Directive 1994/09/EC	Directive 1994/09/EC of the European Parliament and of the Council of 23 March 1994 on the approximation of the laws of the member states concerning equipment and protective systems intended for use in potentially explosive atmospheres
ATEX Directive 1999/92/EC	Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres
Arrêté du 9 novembre 1972 modifié au 28 avril 2008	Aménagement et exploitation de dépôts d'hydrocarbures liquéfiés

Codes

Reference	Title
IP Code, Part 15	Area classification code for petroleum for installations, part 15 of the Institute of Petroleum Model Code of Safe practice

Other documents

Reference	Title
Not applicable	



Total General Specifications

Reference	Title
GS EP CIV 402	Design and construction of oil field laboratory on production installations
GS EP ELE 001	Electrical design criteria
GS EP ELE 021	Electrical design criteria for floating units
GS EP ELE 079	Electrical apparatus for potentially explosive gas atmospheres
GS EP HVA 100	HVAC Basis of design
GS EP SAF 021	Layout
GS EP SAF 221	Safety rules for buildings
GS EP SAF 222	"Safety rules for turbines, diesel engines, gas engines and process units in sheltered or enclosed areas"
GS EP SAF 227	Safety rules for fired heaters
GS EP SAF 228	Liquid drainage
GS EP SAF 253	Impacted area, restricted area and fire zones
GS EP SAF 262	Pressure protection relief and hydrocarbon disposal systems
GS EP SAF 312	Fire and gas detection systems
GS EP SAF 380	Safety engineering requirements for an F(P)SO

3. Terminology and definitions

There are three types of statements in this specification, the "shall", "should" and "may" statements. They are to be understood as follows:

Shall	Is to be understood as mandatory. Deviating from a "shall" statement requires derogation approved by Company.
Should	Is to be understood as strongly recommended to comply with the requirements of the specification. Alternatives shall provide a similar level of protection and this shall be documented.
May	Is to be understood as permission.
Can	Is to be understood as a physical possibility.
Must	Expresses a regulatory obligation

Note that "will" is not to be understood as a statement. Its use is to be avoided, unless it is necessary to describe a sequence of events.

For the purpose of this specification, the following definitions shall apply:

Adequate ventilation	Natural, artificial , or a combination of both ventilations , sufficient enough to avoid persistence of flammable atmospheres within sheltered or enclosed areas but insufficient to avoid their initial formation and spread throughout the area. This will normally be achieved by a uniform ventilation rate of a minimum of twelve air changes per hour with no stagnant areas (IP Code, Part 15)
Air-lock	Two self-closing vapour-tight doors with a space in between (the “gap”) kept above the pressure prevailing in the adjacent hazardous area. The minimum pressure difference between the gap and the hazardous area shall be 25 Pa (0.25 mbar). A local alarm buzzer plus an alarm sounding and lighting in the main control room are to be provided to warn the operators and personnel if both doors are open simultaneously. Loss of differential pressure in the gap between the two doors shall also alarm in the main control room
Area	For the purpose of this specification, an area is a three-dimensional region or space (as per IEC 60079-10-1)
Area classification	Area classification is the assessed division of a facility into hazardous areas and non-hazardous (or not classified or safe) areas , and the sub-division of hazardous areas into zones (refer to section 5.3 of IP Code, Part 15).
Competent	Person who by combination of training, experience and supervision is able to make objective judgments
Dilution ventilation	Artificial ventilation sufficient to maintain generally as non-hazardous an enclosed area containing a source of release or an aperture into a hazardous area (IP Code, Part 15). In the case of a turbine enclosure, this will normally be achieved by a uniform ventilation rate of a minimum of ninety air changes per hour with no stagnant areas (Company definition from IP Code, Part 15)
Emergency Shutdown (ESD)	Control actions undertaken to shutdown equipment or process in response to a hazardous situation (ISO)
Emergency Shutdown System	System, activated by automatic or manual signals, which undertakes the control actions to shutdown equipment or processes in response to a hazardous situation (ISO 10418)
Enclosed area	Any building, room or enclosed space within which, in the absence or failure of artificial ventilation , the air movement will be limited and any flammable atmosphere will not be dispersed naturally (IP Code, Part 15)
ESD system	System of manual stations and automatic devices that, when activated, initiate a shutdown of the installation

Fire and Gas system (F&G)	The Safety System which monitors the temperature or the energy flux (fire), the concentration of flammable or toxic gases (gas), and initiates relevant actions (alarm, ESD, emergency depressurisation, active fire-fighting, electrical isolation) at pre-determined levels (Company)
Fired heater	A vessel in which the temperature of a fluid is increased by the addition of heat supplied by a flame within the vessel (Company from API). Fired heater is a generic term that covers all type of heaters including steam boilers, reboilers (flame tube or flue gas tube), indirect heaters (hot oil or hot water), incinerators, etc. For the purpose of this specification, fired heaters are sorted out into the following classes: • Class A: a heater that has heat utilisation equipment operating at approximately atmospheric pressure wherein there is a potential explosion or fire hazard that could be created by the presence of flammable volatile or combustible materials processed or heated in the heater • Class B: a heater that has heat utilisation equipment operating at approximately atmospheric pressure wherein there are no flammable volatile or combustible materials being heated
Flammable atmosphere	Mixture of flammable gases or vapours with air in such a proportion that, without any further admixture, it will burn when ignited. In the context of area classification the term "flammable" is preferable to "explosive" (IP Code, Part 15)
Flammable limits (upper, lower)	The limits of combustibility of flammable gases or vapours when mixed with air (IP Code, Part 15)
Flash-point	Lowest temperature to which a liquid must be heated to give off sufficient vapour to form a flammable mixture with air. Ignition does not occur at the flash point unless there is a source of ignition (IP Code, Part 15)
FPSO	Floating, Production, Storage and Offloading system includes, in addition to storage and offloading capability, facilities for receiving crude oil from producing wells and processing it for export by separating water and gas (OGP)
FSO	Floating, Storage and Offloading system consisting of a ship or barge-shaped floating hull incorporating tanks for storage of produced oil, and a method of loading the oil onto off take tankers (OGP)
Fuel source	Same as ISO definition of "source of release" (API)
Hazard radius	The hazard radius of a source of release is the largest horizontal extent of the hazardous area that is generated by the source when situated in an open area under unrestricted natural ventilation (IP Code, Part 15)

Hazardous area and zone	A hazardous area is defined as a three dimensional space in which a flammable atmosphere may be expected to be present at such frequencies as to require special precautions for the control of potential ignition sources (IP Code, Part 15). All other areas are referred to as non-hazardous areas in this context. In a hazardous area three types of zones (0, 1 and 2) are recognised (IP Code, Part 15)
HVAC	Abbreviation for Heating, Ventilating and Air Conditioning
Ignition source	Source of temperature and energy sufficient to initiate combustion (API)
Ignition temperature (synonymous with “auto”- and “self-ignition temperatures”)	The temperature at which a substance will begin to burn without application of any source of ignition (IP Code, Part 15). The test conditions shall be as per IEC 60079-20-1
Interceptor/coalescer	Vessel open or vented to atmosphere, used to separate petroleum liquids from other non-flammable liquids, typically water, and in which the petroleum liquids are present in smaller quantity. Typically they are found on the main oily water effluent treatment system of a facility (IP Code, Part 15)
Laboratory	A specific closed room or building where analyses are carried out by personnel
Normal operation	Operation within the plant design parameters, including start-ups, shutdowns, routine maintenance and any degraded modes of operations foreseen during design
Open area	An area that is outdoors without stagnant regions, where vapour is rapidly dispersed by wind and natural convection (IP Code, Part 15)
Over pressurisation	Artificial ventilation of an enclosed area to maintain the area at a controlled pressure above the ambient pressure (IP Code, Part 15) Over pressure obtained by artificial ventilation is referred to as simply over pressurisation in this specification
Safe area	Other term used for non hazardous or not classified area
Self-closing doors	Doors that are designed to close by themselves and to remain closed if not intentionally opened or kept opened
Sheltered/obstructed area	An area within or adjoining an open area (which may include a partially open building or structure) where, owing to obstruction, natural ventilation is restricted and less than in a true open area (IP Code, Part 15)
Source of release	Point from which a flammable gas, vapour or liquid may be released into the atmosphere (ISO)
Sump	A vessel, open or vented to atmosphere, used to collect petroleum liquids, usually as a result of deliberate draining. Other liquids, e.g. water, can enter the sump but the petroleum liquid is normally an appreciable part of the total liquid entering (IP Code, Part 15)

Under pressurisation	Artificial ventilation of an enclosed area to maintain the area at a controlled pressure below the ambient pressure (IP Code, Part 15) Under pressure obtained by artificial ventilation is referred to as simply under pressurisation in this specification
Units	Areas within the installation resulting from its partition into a reasonable number of geographical and functional groups of equipment having the same type (e.g. hydrocarbon, pressure, inventory or ignition) and levels (high, medium, low) of risks (Company)
Ventilation (natural, artificial)	Ventilation is a general term to indicate air movement and replacement by fresh air. Natural ventilation refers to ventilation caused by wind or convection effects. Artificial ventilation refers to ventilation caused by air purges or mechanical means (fans) (IP Code, Part 15).

4. Area classification procedure

The objective of the area classification is to reduce as much as possible the probability of coincidence of a flammable atmosphere and an ignition source.

The area classification shall be carried out before choosing appropriate electrical equipment or any equipment generating ignition sources.

The area classification process reduces the installation overall risk level through design improvements.

Additionally, the optimisation of the equipment layout shall be carried out to decrease the risk of ignition (e.g. pertinent grouping of equipment, optimisation of ventilation).

A flow diagram summarizing the basic steps of the procedure is included in Appendix 2.

4.1 Scenarios

The classification of hazardous areas takes into consideration events which are "liable to occur during normal or abnormal plant operating conditions" (IP Code, Part 15).

Events not considered for Area Classification:

- Large gas/vapour releases from process vents or flares. Such releases shall require appropriate dispersion calculations
- Failure scenarios which are very unlikely to occur, such as the rupture of a process vessel or pipe (IEC 60079-10-1). For these scenarios reliance is placed on the Emergency Shutdown System and safety distances resulting from consequence analysis calculations (refer to GS EP SAF 253) to mitigate the consequence of a failure in the installation.



4.2 Procedure

Area Classification shall be carried out by competent persons ¹.

Area classification shall be conducted in 5 steps (IP Code, Part 15):

- **Partition of the installation into hazardous and non hazardous areas** by identification of all the potential release sources of flammable products,
- **Sub-division of hazardous areas into hazardous zones** which shall be ranked according to the estimated probability of the presence of a flammable atmosphere,
- **Determination of the hazard radii** around each potential source of release,
- **Sizing of the hazardous Zone** around each potential source of release,
- **Prepare/modify** the hazardous area drawings; draw the envelopes of the zones.

4.3 Deliverables

The following results shall be delivered:

- The table of hazardous equipment as per Appendix 1,
- When relevant, the calculation notes necessary for the hazard radius determination
- The drawings of hazardous zones showing the Zone envelopes and their main dimensions, the rest of the installation being classified as non hazardous or safe ².

5. Partition between hazardous and non hazardous areas

The main principles governing the partition between hazardous and non hazardous areas are as follows:

- All hydrocarbons handled at a temperature above their flash point, or whose flash point is below 21°C (69.8 °F), are liable to generate hazardous areas,
- A hazardous area is generated when a flammable mixture may be created further to an equipment release,
- All equipment containing flammable products (for the definition and characterisation of a flammable product, see section 8.1) shall be considered as potential release sources where the material quantities exceed the following thresholds:

¹ For new projects it is recommended that Area Classification is conducted by a senior safety engineer assisted by a process engineer. For the modifications of an existing installation the team should include a member of the operating crew. It should be noted that although the results of Area Classification have direct implications on the selection of the electrical apparatus, knowledge in electrical matters is not a must for conducting or participating to an Area Classification exercise.

² As a requirement regarding the number of hazardous area drawings to be provided: for onshore plant, plan view and cross sectional view; for offshore plant plan view of each deck level and at least two elevations.

Table 1 - Capacity thresholds above which hazardous area classification is required

	Gas: volume corrected to 1 bar (a) pressure	Liquefied flammable gas	Flammable liquid at a temperature above its flash point
Inside	50 litres	5 litres	25 litres
Outside	1000 litres	100 litres	200 litres

- All-welded piping, flexible hoses (without fittings such as valves, instruments and flanges) and instrument tubing designed and constructed according to Company specifications shall not generate hazardous areas.

6. Hazardous zones

The extent of the hazardous area depends on the rate of release, ventilation conditions, and fluid properties.

6.1 Sub division of hazardous areas into hazardous zones

GS EP SAF 216 shall be used for:

- Defining the Zones 0 and 1 inside units (see section 6.2.2),
- Defining the Zone 2 contour around the items of equipment located at the deck/unit surface limits.

The following documents shall be available for the determination of hazardous areas:

- Equipment list,
- A layout drawing showing the position of all equipment, air inlets/exhausts and main sources of ignition (e.g. furnaces, roadways, flares, etc.),
- The extent of confinement (open, sheltered or enclosed) and HVAC calculations,
- A process flow diagram,
- A piping & instrumentation diagram
- Material identification and process conditions (e.g. temperature and pressure).

The main following information shall be collected in the table included in Appendix 1:

- The equipment type and codification,
- The nature of the hazardous fluid,
- The main characteristics of the hazardous fluid.

6.2 Hazardous Zone ranking

The determination of the following parameters shall be made in order to evaluate the rank of the hazardous zone:

- The grade of release as per section 6.2.1,
- The type of area (open, sheltered or enclosed) as per sections 6.2.3 and 7,
- The type of ventilation as per section 6.2.4

All the above information shall be included in the table in Appendix 1.

6.2.1 Grades of release (or types of source)

Three grades of release ³ are defined in terms of their likely frequency and duration.

6.2.1.1 Continuous grade release

A release which is continuous or expected to occur for long periods: the cumulative duration of release exceeds 1000 hours per year.

Example: Gaseous atmosphere in a hydrocarbon storage tank.

6.2.1.2 Primary grade release

A release which can be expected to occur periodically or occasionally during normal operation: the cumulative duration of release is in the range of 10 to 1000 hours per year.

Examples: Sampling connection (for regular, open to atmosphere sampling), operating purge, drain.

6.2.1.3 Secondary grade release

A release which is not expected to occur in normal operation and, if it does, is likely to do so only infrequently and for short periods: the cumulative duration of release is less than 10 hours per year ⁴.

Examples: Flanges, pump seals.

6.2.2 Zones

Hazardous areas shall be identified and classified into **Zones 0, 1 or 2** based on the frequency of the occurrence and duration of a flammable atmosphere.

The classification in zones or “zoning” is the partition of the installation into volumes in which a flammable atmosphere may be present (see section 3).

The following definitions are from [IP Code, Part 15](#):

- **Zone 0**

That part of a hazardous area in which a flammable atmosphere is **continuously** present, or present for long periods.

³ For releases not considered for Area Classification see section 4.1.

⁴ Where releases are likely to be present for 1 to 10 hours per year but are anticipated in normal operation (e.g. routine sampling points) they should be regarded as primary grade releases unless carried out under permit-to-work circumstances ([IP Code, Part 15](#)).

- **Zone 1**

That part of a hazardous area in which a flammable atmosphere is **likely** to occur in normal operation.

- **Zone 2**

That part of a hazardous area in which a flammable atmosphere is **not likely** to occur in normal operation, and, if it occurs, will exist only for a short period.

For further guidelines refer to **IP Code, Part 15**.

"Type of sources" and "zones" are **not** synonymous as the type of a Zone depends on the level of ventilation in the considered area and for enclosed areas, the pressure relative to the surrounding areas and their Zone classification.

Throughout this specification, the zones are represented as follows:



Zone 0



Zone 1



Zone 2

6.2.3 Confinement (types of location)

An area can be classified in three categories with respect to confinement:

- An open area (basically no roof/ceiling, no walls and floor made of grating) or
- A sheltered, partially enclosed, partially confined area (various combinations of solid floor, ceiling and walls or equivalent obstructions to natural draft) or
- An enclosed area.

The extent of confinement governs the determination of the level of ventilation.

The level of ventilation achievable for the three categories is described below (section 6.2.4).

6.2.4 Ventilation and pressurisation

The openness of an area is an important factor in determining the effectiveness of ventilation and the extent and severity of a hazardous area.

- Two boundary cases (**open area, enclosed area**) and an intermediate case (**sheltered or obstructed area**) are defined in section 6.2.4.3
- The degree of ventilation (**unrestricted, restricted, adequate or inadequate**) is a key factor in determining the Zone classification of an area
- The level and extent of hazardous area classification depends on the ventilation of the zones where flammable vapours are likely to be present and to accumulate
- Conditions of ventilation and likelihood of detecting the leak may change the Zone definition for each grade of release.
- This specification defines only the functional requirements for ventilation or pressurisation systems to effectively dilute flammable gases or prevent the ingress of flammable gases in areas not suitable for the presence of a flammable atmosphere



- It is not a specification for the design and operation of ventilation and pressurisation systems. It does not cover in particular HVAC requirements for human comfort; temperature control and the extraction of smoke during/after a fire (refer to **GS EP SAF 221** for ventilation in buildings and to **GS EP HVA 100** for basis of HVAC design)
- Ventilation can either be natural when it is caused by wind or convection effects or artificial when it has to be provided to dilute and remove flammable gases or vapour released within a room or a building
- Pressure differential with respect to surrounding areas can only be achieved for enclosed areas and in conjunction with artificial ventilation
- For all artificial ventilation systems, the ventilation air shall be taken from a non-hazardous area and shall not, by virtue of any chemical products or impurities which it may contain produce harmful effects or introduce a reduction of the safety level.

6.2.4.1 Types of ventilation

The different types of ventilation are as follows:

6.2.4.1.1 Adequate/Inadequate ventilation

Adequate ventilation is defined as ventilation sufficient enough to prevent the accumulation of concentrations of flammable gas-air. This will normally be achieved by a uniform ventilation rate of at least 12 volumetric air changes per hour with no stagnant areas.

Open areas are considered as adequately ventilated and typically, air velocities will frequently be above 2 m/s and rarely less than 0.5 m/s.

By definition, any ventilation that does not match the above criteria will be considered as inadequate which normally results from natural draft less than 0.5 m/s or artificial ventilation rate less than 12 volumetric air changes per hour (sheltered areas or loss of ventilation of an enclosed area for example).

6.2.4.1.2 Dilution ventilation

Dilution ventilation shall be sufficient to immediately bring the flammable gas concentration below **20% of the Lower Flammability Limit (LFL)** and keep it so all the time.

Typical ventilation rates covering all scenarios for dilution ventilation cannot be proposed. A calculation shall be carried-out to estimate hydrocarbon leaks⁵. This can only be achieved by a very large number of air changes (well in excess of 12 per hour).

It shall be based on the largest secondary grade release.

Should simultaneous releases from more than one secondary grade releases be likely, then the cumulated release shall be considered.

Ventilation rates higher than those required for dilution ventilation may be required in case ventilation also serves other purpose than dilution to prevent flammability (e.g. in case toxic fluids are involved or in case high cooling requirements).

⁵ Methods to calculate minimum introduction rates to achieve adequate ventilation are proposed in **API RP 505** (Appendices B, first edition 11/1997, reaffirmed 11/2002). Unless otherwise specified, the default values for gas leaking rates should be those of **API Publ 4615**, assuming the equipment is in poor condition (leaking rates) but there is no failure (e.g. pipe rupture).

6.2.4.2 Loss of artificial ventilation in enclosed areas

Loss of artificial ventilation can cause the level of ventilation of the area to be less than dilution ventilation or even less than adequate. In such event:

- The Zone classification is temporarily down graded,
- All potential sources of ignition incompatible with the downgraded zoning shall be isolated (electrically or else, with or without delay).

6.2.4.3 Ventilation assessment

A method included in Appendix 3 of this specification will help to assess the type and level of ventilation for each type of area (open, sheltered or enclosed).

The level of ventilation available in a location shall be established in order to allow Zone classification:

- Open areas shall be deemed adequately ventilated (natural draft exceeding 2 m/s)
- For sheltered areas (or obstructed areas), the level of ventilation shall be established on the basis of [API RP 505](#) (see Appendix 4)
- For enclosed areas, ventilation is inadequate; it can be made adequate or better (e.g. dilution) by providing artificial ventilation to disperse any flammable atmosphere

6.2.4.4 Pressurisation

Pressurisation shall be provided to ensure the protection of a room or building ⁶:

- Containing electrical equipment or other potential sources of ignition and located in a hazardous area where flammable gases or vapours may enter (over pressurisation)
- Containing sources of release and surrounding by a safe area containing electrical equipment or other potential sources of ignition (under pressurisation)

The ingress of gases or vapours into a room is prevented by maintaining inside it a protective gas at a higher pressure than that of the outside atmosphere.

The egress of gases or vapours from a room is prevented by maintaining inside it a protective gas at lower pressure than that of the outside atmosphere.

This section does not deal with the electrical apparatus for which protection by pressurisation in hazardous areas follows the electrical codes (the protection of the electrical apparatus in hazardous areas shall comply with Company specification [GS EP ELE 079](#)).

The protection by pressurisation of rooms and buildings containing electrical equipment shall comply with [IEC 60079-13](#) and with this specification (some of the requirements of this section exceed the requirements of [IEC 60079-13](#)).

The types of pressurisation and associated construction requirements for buildings are addressed in [IEC 60079-13](#).

The pressurizing gas shall not, by virtue of any chemical products or impurities which it may contain, produce harmful effects or introduce a reduction of the safety level.

⁶ A room or building is an enclosure of sufficient size to permit the entry of a person.



6.2.4.4.1 Over pressurisation protection

Protection by over pressurisation is achieved when artificial ventilation or static pressurisation controls the pressure inside an enclosed area sufficiently above that of the surrounding hazardous area to prevent ingress of a flammable atmosphere from an outside fuel source.

The difference in pressure to be maintained shall be **greater or equal to 25 Pa (0.25 mbar)**.

Overpressure should be monitored or detected by a pressure switch as a minimum.

Loss of overpressure shall initiate an alarm.

Pressurised enclosed areas shall be provided with fixed gas detection as per **GS EP SAF 312** to immediately and automatically isolate all ignition sources not suitable for Zone 1⁷.

6.2.4.4.2 Under pressurisation protection

Protection by under pressurisation is achieved when artificial ventilation keeps the pressure inside an enclosed area sufficiently below that of the surrounding area to prevent possible egress of a flammable atmosphere to an outside less or non hazardous area.

The difference in pressure to be maintained shall be **greater or equal to 25 Pa (0.25 mbar)**.

Under pressure should be monitored or detected by a pressure switch as a minimum.

Loss of under pressure shall initiate an immediate alarm, and isolate all ignition sources located in the vicinity of the enclosed area and not suitable for Zone 1.

Isolation of these ignition sources on loss of under pressure may be delayed to allow the loss to be investigated.

7. Classification of open, sheltered and enclosed areas

7.1 Open areas

Where a facility is categorized as an open area (provided with adequate natural ventilation), the following classification applies:

- Zone 0 is generated by a continuous grade release
- Zone 1 is generated by a primary grade release
- Zone 2 is generated by a secondary grade release.

7.2 Sheltered areas

For a sheltered or obstructed area, the natural ventilation may be restricted. The level of ventilation may then be adequate or inadequate (see definitions in section 6.2.4).

When the level of ventilation of a sheltered/obstructed area is assessed as **adequate**, the classification rules for open areas shall apply (see section 7.1).

When the level of ventilation of a sheltered/obstructed area is assessed as **inadequate**, the area shall be classified as an enclosed area (see table in section 7.3 - "inadequate" column).

⁷ If gas detection is not provided or if a source of primary grade of release is installed in the building (each of them requiring derogation to this specification approved by Company), loss of overpressure shall automatically and immediately isolate all ignition sources not suitable for Zone 1.



7.3 Enclosed areas

An enclosed area is any building, room or enclosed space within which, in the absence or breakdown of artificial ventilation, the ventilation will be regarded as inadequate (refer to section 6.2.4).

The Zone classification of the outside areas shall be taken into account when classifying the enclosed areas in contact (via an aperture) with them unless the enclosed walls, ceilings, floors and any ducting are vapour-tight by construction.

A vapour-tight door or hatch, locked in normal operation and opened only under a permit to work procedure, and **air-locks** should not be considered as apertures. One ordinary door or one door of a vapour-tight design (**self-closing** or not) shall be considered as an aperture.

The outside areas in contact through an aperture with the enclosed area shall be considered for classification.

Areas having a direct opening onto another area:

- Shall take the Zone classification of adjacent areas if they are more stringent
- Shall extend their own classification to adjacent areas of openings if they would otherwise be less stringent.



Exploration & Production

General Specification

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Zone classification of enclosed areas

Grade of internal release	Internal ignition sources	Type of ventilation						
		Inadequate	Adequate	Dilution ⁽²⁾	Dilution + overpressure	Dilution + under pressure	Overpressure ⁽⁴⁾	Under pressure ⁽⁴⁾
Continuous ⁽¹⁾⁽³⁾	yes	Not allowed	Not allowed	Not allowed	Not allowed	Not allowed	Not allowed	Not allowed
Continuous ⁽¹⁾⁽³⁾	no	Not allowed	Not allowed	Not allowed	Not allowed	Not allowed	Not allowed	Not allowed
Primary ⁽¹⁾⁽³⁾	yes	Not allowed	Not allowed	Not allowed	Not allowed	Not allowed	Not allowed	Not allowed
Primary ⁽¹⁾⁽³⁾	no	Not allowed	Not allowed	Not allowed	Not allowed	Not allowed	Not allowed	Not allowed
Secondary ⁽³⁾	yes	Zone 1 if surrounded by a safe zone	Zone 2	Not classified if surrounded by a safe zone	Not classified if surrounded by a Zone 0, 1 or 2.	Not classified if surrounded by a safe Zone containing an ignition source	Zone 1 or 2 depending on the ventilation rate, if surrounded by a safe zone	Zone 1 or 2 depending on the ventilation rate, if surrounded by a safe zone
Secondary ⁽³⁾	no	Zone 1 if surrounded by a safe Zone or a Zone 1 or 2.	Zone 2	Not classified if surrounded by a safe zone	Not classified if surrounded by a Zone 0, 1 or 2.	Not classified if surrounded by a safe Zone containing an ignition source	Zone 1 or 2 depending on the ventilation rate, if surrounded by a safe zone	Zone 1 or 2 depending on the ventilation rate, if surrounded by a safe zone
No source	yes	Zone 0 if surrounded by a Zone 0 or 1 Zone 1 if surrounded by a Zone 2	Zone 0 if surrounded by a Zone 0 Zone 1 if surrounded by a Zone 1 Zone 2 if surrounded by a Zone 2	Not classified if surrounded by a safe zone	Not classified	Not classified if surrounded by a safe zone	Not classified	Not classified if surrounded by a safe zone
No source	no	Zone 0 if surrounded by a Zone 0 or 1 Zone 1 if surrounded by a Zone 2	Zone 0 if surrounded by a Zone 0 Zone 1 if surrounded by a Zone 1 Zone 2 if surrounded by a Zone 2	Not classified	Not classified	Not classified	Not classified	Not classified

- (1) With the exception of accumulator batteries (see section 12.1), continuous or primary grade sources shall not be located within an enclosed area. Such design shall require formal derogation to this specification.
- (2) An area within a larger enclosure subject to local artificial ventilation, i.e. by extractor fan, shall be classified according to the local ventilation rate in that local area, i.e. either dilution or adequate ventilation depending on which is met.
- (3) With a source of small hazard radius, e.g. a sample point, the local ventilation may be high enough to prevent the source from influencing the classification of the whole enclosure. There should still be a local Zone 1 or 2 around the source and the extent of this Zone should be greater than in the open air, typically about twice the extent.
- (4) Typical case of living quarters where ventilation rate is low.

General Note: In the above table, 'if' to be taken as a restrictive condition