

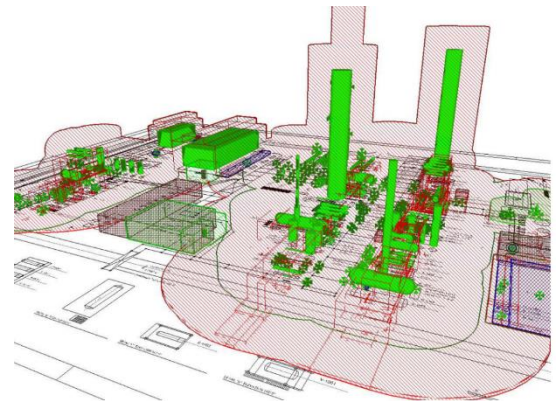
<https://hac-online.com>

Gases, vapours, mists and dusts can all form potentially explosive atmospheres with air. **Hazardous area Classification (HAC)** is used to identify places where, because of the potential for an explosive atmosphere, special precautions over sources of ignition are needed to prevent fires and explosions.

Hazardous area classification should be carried out to identify places (or areas) where controls over ignition sources are needed and those places where they are not. Hazardous areas are further classified into Zones / Class & Divisions / Classes & Zones, which distinguish between places that have a high chance of an explosive atmosphere occurring and those places where an explosive atmosphere may only occur occasionally or in abnormal circumstances.

METHODOLOGY:

- Hazardous Area Classification (HAC) is mandatory
- we do it according to IEC/EN 60079-10-1 (gas) and IEC/EN 60079-10-2 (dust),
- Model code of safe Practice Part 15 - IP15,
- IGEM/SR/25,
- API RP 505
- and many more industry specific standards...



Phase 1

- please fill out the input [checklist](#) and send it to hac@hac-online.com
- please send process description, and P&ID
- our pHAC expert will provide you a preliminary HAC (pHAC) for your convenience
- pHAC shall be a good basis for your project

Phase 2

- In case of project is finished you shall provide the final data of your project again like:
- please fill out the [questionnaire](#) and send it to hac@hac-online.com
- our HAC expert will provide you a final HAC (fHAC) for your convenience
- fHAC shall be kept for your files (Verification Dossier, EPD)
- All for your convenience. All terms and conditions will be sent in separate mail.



- HAC shall be a basis to ensure your Facility's safety.
- In case of further information requested, please contact us via hac@hac-online.com

A sample Table of Content for a proper HAC:

- Register
- Prelude
- General
- Legal background and applied standards
- Procedure of the classification of hazardous areas (basics)
- Statements
- Presentation of technology
- Determination of potentially explosive atmospheres
 - o Environmental data
 - o Release data
 - o Calculation of the rates of releases
 - o Evaluation of the effect of ventilation
 - o Characteristics of the releases
 - o Effects of releases
 - o Determination of the minimum requirements for applicable equipments
- Summary
- Annexes
 - o - Properties of Explosive substances
 - o - Zone maps of explosion hazardous areas



Statement:

5. Statement

This [REDACTED] Hazardous Area Classification document was made by the application of the standard IEC 60079-10-1:2015 Classification of areas – Explosive gas atmospheres (Edition 2.0 2015-09.) and based on the data provided by the Client (full list please ANNEX C).

The following technical literatures have been additionally used to determine the sizes of the explosive zones:

- „Classification of hazardous location” (ISBN 0 85295 258 9); published by „Institution of Chemical Engineers”;
- EI Model code of safe practice Part 15: Area classification code for installations handling flammable fluids;
- CEI 31-35 “Electrical apparatus for explosive atmospheres – Guide for classification of hazardous areas”.

Budapest, 12. March 2020.

Created by:

Approved by:

Presentation of the Technology, including:

- the amount of dangerous substances involved;
- the work processes, and their interactions, including any cleaning, repair or maintenance activities that will be carried out;
- the temperatures and pressures at which the dangerous substances will be handled;
- the containment system and controls provided to prevent liquids, gases, vapours or dusts escaping into the general atmosphere of the workplace;
- any explosive atmosphere formed within an enclosed plant or storage vessel; and,
- any measures provided to ensure that any explosive atmosphere does not persist for an extended time, e.g. ventilation.

Determination of potentially explosive atmospheres

Environment conditions

Environment

Name

Type

Ambient pressure p_a [Pa]

Free volume V_a [m³]

Type of ventilation

Ventilation (in)efficiency factor f_a

Ambient temperature T_a [°C]

Outdoor ventilation

Ventilation velocity u_w [m/s]

Ventilation availability

Main ventilation in close environment

Ventilation air flow rate Q_a [m³/s]

Ventilation velocity u_w [m/s]

Number of air changes C_a [1/s]

Type of ventilation

Availability of ventilation

Calculate Natural Ventilation

Residual ventilation in close environment

Ventilation air flow rate Q_a [m³/s]

Ventilation velocity u_w [m/s]

Number of air changes C_a [1/s]

Environment picture

Table C.1 – Indicative outdoor ventilation velocities

Table C.1 – Indicative outdoor ventilation velocities (u_w)

Type of outdoor locations	Unobstructed areas			Obstructed areas		
	≤ 2 m	> 2 m up to 5 m	> 5 m	≤ 2 m	> 2 m up to 5 m	> 5 m
Elevation from ground level						
Indicative ventilation velocities for estimating the dilution of lighter than air gas/vapour releases	0,5 m/s	1 m/s	2 m/s	0,5 m/s	0,5 m/s	1 m/s
Indicative ventilation velocities for estimating the dilution of heavier than air gas/vapour releases	0,3 m/s	0,6 m/s	1 m/s	0,15 m/s	0,3 m/s	1 m/s
Indicative ventilation velocities for estimating the liquid pool evaporation rate at any elevation	> 0,25 m/s			> 0,1 m/s		

Generally, values in the table may be considered with an availability of ventilation fair (see D.2).

For indoor areas, the evaluations should normally be based on an assumed minimum air speed of 0,05 m/s, which will be present virtually everywhere. Different values may be assumed in particular situations (e.g. close to the air inlet/outlet openings). Where ventilation arrangement can be controlled, minimum ventilation velocity may be calculated.

Outdoor ventilation

Outdoor situation

Elevation from ground level or surface below the release

Indicative ventilation velocities for

Ventilation velocity u_w [m/s]

ENVIRONMENTAL DATA

Environment name	
Environment type	Open
Type of ventilation	Natural
Ventilation (in)efficiency factor, f	2
Ambient temperature, T_a	35 °C
Ambient pressure, p_a	101300 Pa
Outdoor situation	Obstructed areas
Ventilation availability	Fair
Ventilation velocity, u_w	0,1 m/s

Release data

Emission type: Liquid jet Obstructed areas

Grade of release
Grade of release: Primary

The time te [s] of emission is known ?
Time of emission te [s]: 0

Number of releases:
Number of releases: 1

Pressure inside the containment system
☐ Absolute pressure [Pa]: 301300 ☒ Relative pressure [bar]: 2,15268

Rate of release

Discharge coefficient Cd	0,75	Ventilation (in)efficiency Main factor f	2
Temperature of the substance T [°C]	35	Ventilation (in)efficiency residual factor f	5
Ambient temperature Ta [°C]	35	Main rate of release in in the liquid phase W [kg/s]	0,00346
Safety factor attributed to LFL k	0,5	Main rate of release in in the gas phase Wg [kg/s]	0,00346
Hole cross section S [mm²]	0,25	Residual rate of release in in the liquid phase W [kg/s]	0,00346
Main air velocity u _w [m/s]	0,1	Residual rate of release in in the gas phase Wg [kg/s]	0,00346
Residual air velocity u _w [m/s]	0,1		
Type of release <input type="checkbox"/>	Heavy gas		
SR Representative of other <input checked="" type="checkbox"/>	?		

Pool generated by the liquid jet

Main concentration of the hazardous substance Xb
Continuous 0 Primary 0 Secondary 0

Residual concentration of the hazardous substance Xb
Continuous 0 Primary 0 Secondary 0

Calcola Close

RELEASE DATA	
Source of release name	
Source of release position	
Flammable substance	Methyl alcohol
Ambient pressure, pa	101300 Pa
Ambient temperature, Ta	35 °C
Number of release sources, n	1
Discharge coefficient, Cd	0,75
Hole cross section, S	0,25 mm²
Absolute pressure inside the container in the emission point, p	251 300 Pa (1,5 bar)
The Universal Gas constant, R	8314 J/kmol K
Temperature of the substance, T	308,15 K

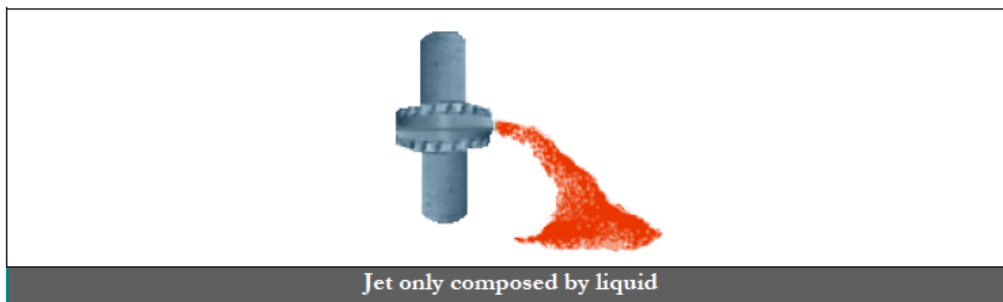
Calculations of the rates of release:

Type of Zone and Hazardous distance dz [m]			
Type of release	Heavy gas	dz Heavy gas [m]	2.96
Safety factor attributed to LFL	0.5	Type of Zone	Zone 1
Release characteristic Wg/(k.pg-LFL) [m³/s]	107E-3	Type of Equipment	2G Ex d, p, q, o, e, ib, m, s per Zone 1 - EPL
Ventilation velocity u _w [m/s]	0.1	u _w Low [m/s]	0.0049
Degree of dilution	Medium	u _w High [m/s]	1.4520
Grade of Release	Primary	pg [kg/m³]	1.076
Air flow rate availability	Fair	Release rate of liquid W [kg/s]	0.00346
		Evaporation rate: % W [kg/s]	100

Type of Zone and Hazardous distance dz [m]			
Safety factor attributed to Lel	0.5	dz Heavy gas [m]	2.96
Release characteristic Wg/(k.pg-LFL) [m³/s]	107E-3	Type of Zone	Zone 2
Ventilation velocity u _w [m/s]	0.1	Type of Equipment	3G Ex n, lc, s per Zone 2 - EPL Gc IIAT2

Close

Release rate of liquids



The rate of a liquid release is evaluated by means the follow equation:

$$W = C_d \cdot S \cdot 10^{-6} \cdot [2 \cdot \rho \cdot (\Delta P)]^{0.5} = 0,75 \cdot 0,25 \cdot 10^{-6} \cdot [2 \cdot 792 \cdot (150000)]^{0.5} = 0,00289 \text{ kg/s}$$

The rate of vaporization of a liquid release is then required to be determined. Liquid releases may take many forms. The nature of the release and how any vapor or gas is generated is also dependant on many variables.

Evaporation rate of liquid, W_e [m³/s]

To define the flow rate of gas emission shall be defined as the fraction of liquid that evaporates in the emission W_e (% W):

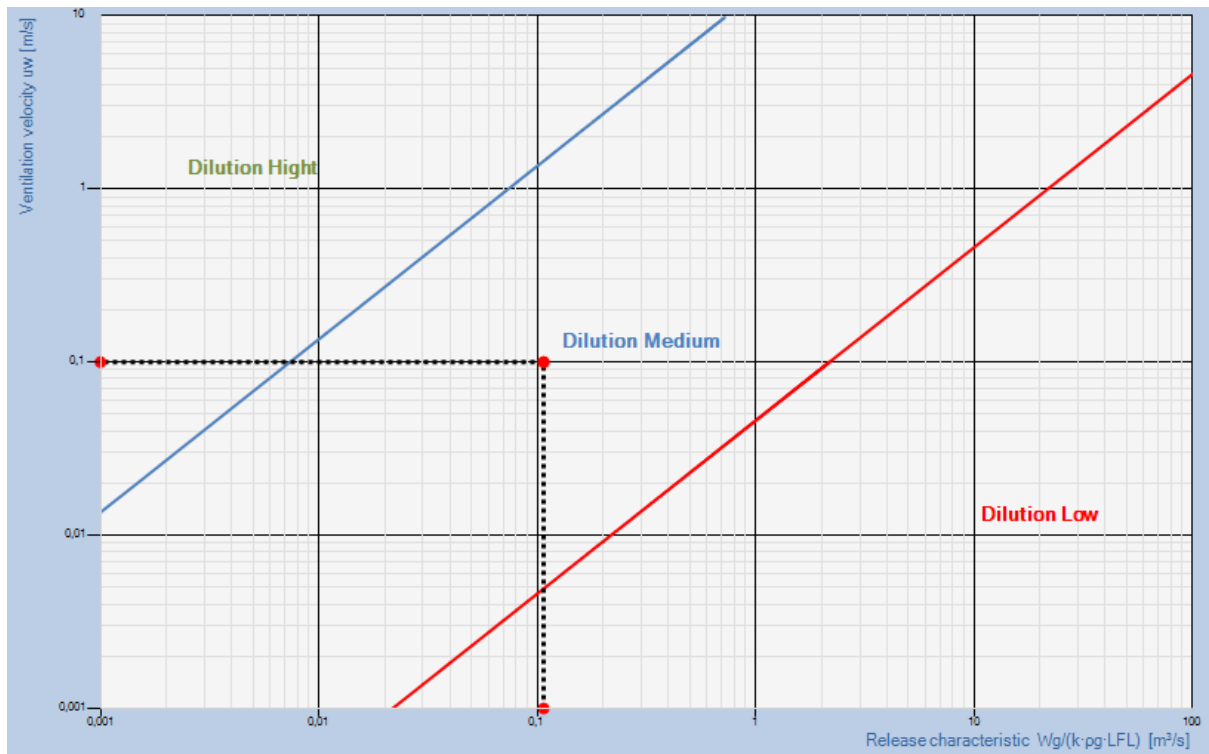
The evaporation rate of liquid W_e = % W = 100% · W = 0,00289 kg/s

Where W is release rate of liquid (mass per time, kg/s);

The volumetric flow rate of gas in (m³/s) is equal to:

$$Q_g = \frac{W_e}{\rho_g} = 0,00342 \text{ m}^3/\text{s} - [\text{B.5 IEC 60079-10-1}]$$

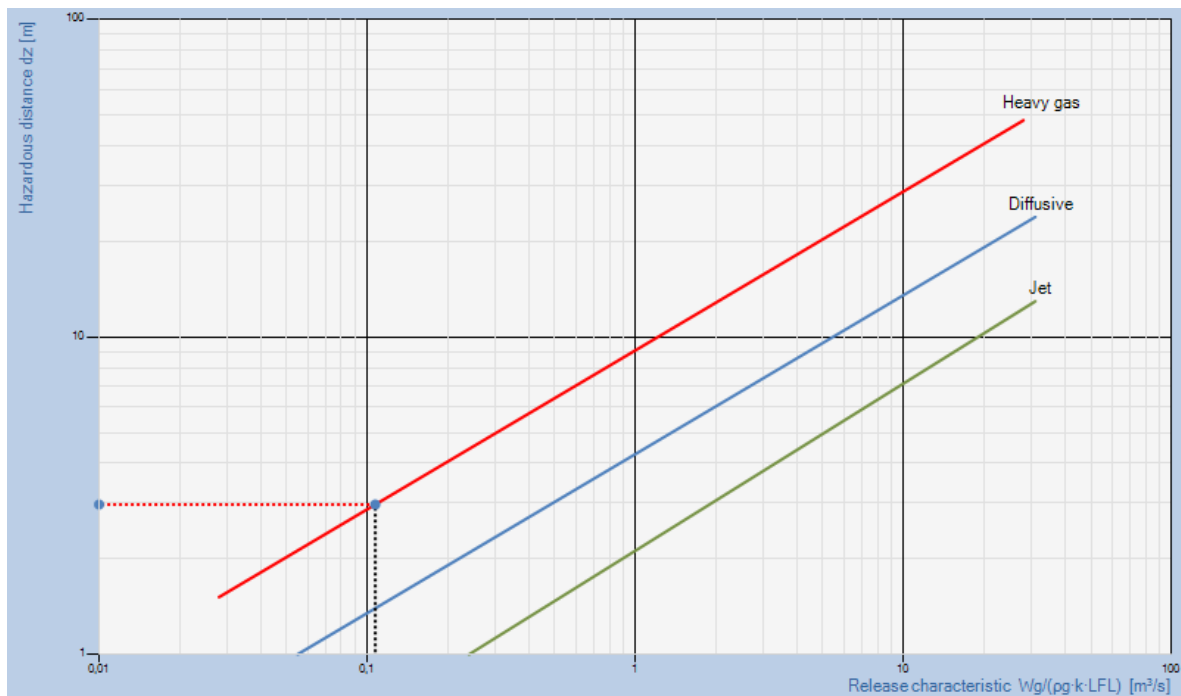
Evaluation of the effect of ventilation



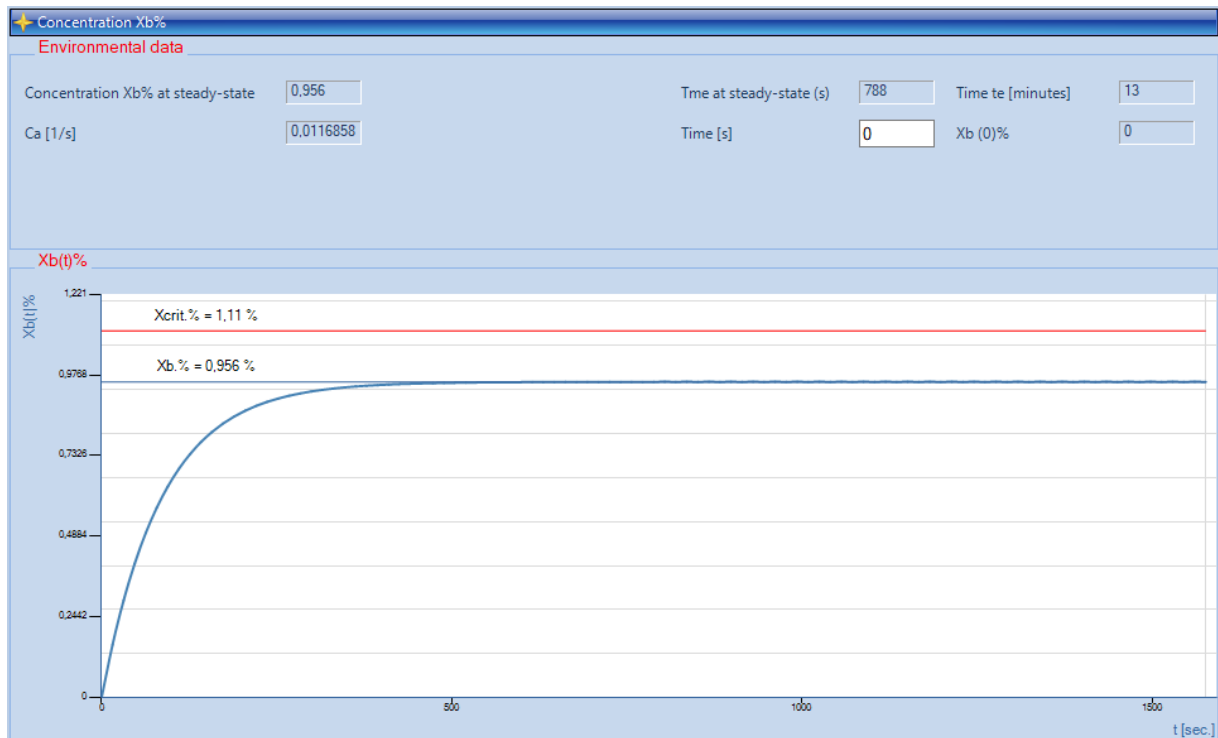
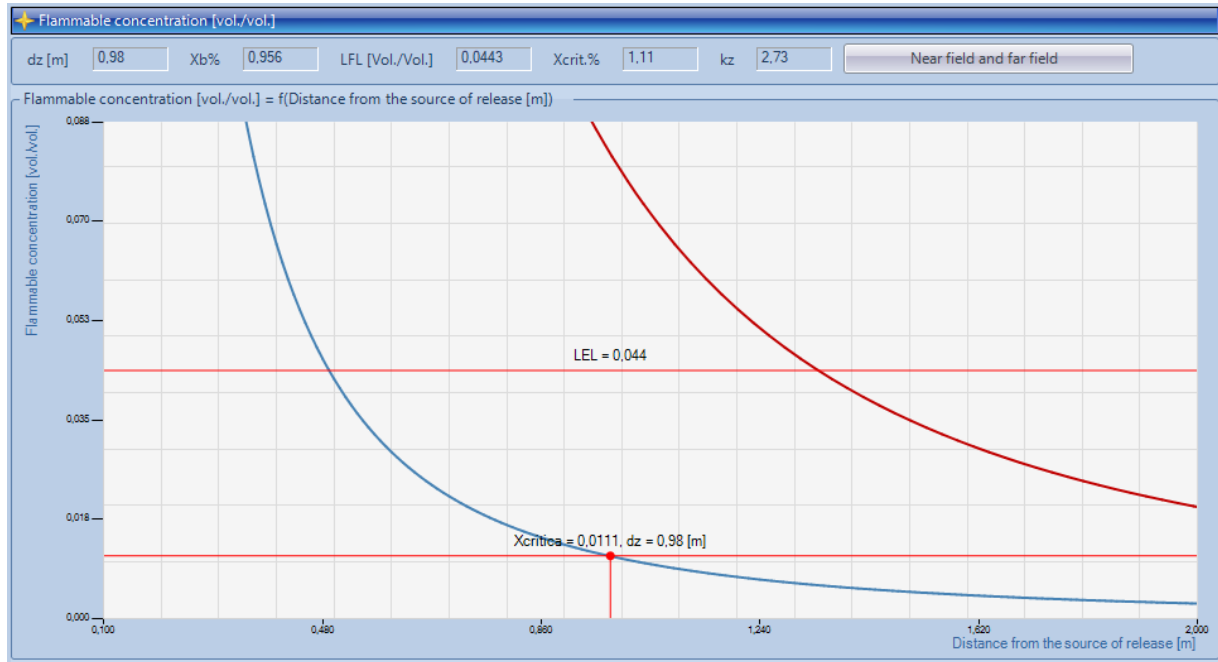
EFFECTIVENESS OF VENTILATION							
Grade of release	High Dilution			Medium Dilution			Low Dilution
	DISPONIBILITÀ DELLA VENTILAZIONE						
	Good	Fair	Poor	Good	Fair	Poor	Good, fair or poor
Continuous	Non hazardous (Zone 0 NE)	Zone 2 (Zone 0 NE)	Zone 1 (Zone 0 NE)	Zone 0	Zone 0 + Zone 2	Zone 0 + Zone 1	Zone 0
Primary	Non hazardous (Zone 1 NE)	Zone 2 (Zone 1 NE)	Zone 2 (Zone 1 NE)	Zone 1	Zone 1 + Zone 2	Zone 1 + Zone 2	Zone 1 o Zone 0
Secondary	Non hazardous (Zone 2 NE)	Non hazardous (Zone 2 NE)	Zone 2	Zone 2	Zone 2	Zone 2	Zone 1 o Zone 0

Characteristics of the releases

CHARACTERISTICS OF RELEASE:	
Flammable substance	Methyl alcohol
Physical state of the substance	Liquid
Molar mass, M	32,04 kg/kmol
Lower flammable limit, LFL	6 %vol.
Auto-ignition temperature, AIT	440 °C
Relative density of a gas or a vapour to air	1,11
Fugitive emissions	0 kg/s
Source of release, SR	Pump seals and pipe fittings/connections
Grade of release	Primary / Secondary
Safety factor, k	0,5
Main rate of release, Wg	0,00289 kg/s
Release characteristic, Wg/(k·ρg·LFL)	0,076 m³/s



Dispersion and background concentration



Effects of releases and Determination of the minimum requirements for applicable equipments

Hazardous area suggested shapes

Hazardous area suggested shapes: $a=dz$

SE

Shape and size of the Hazardous Area

Geometric figure Zone

Form of hazardous area: Liquid

Ventilation velocity u_w [m/s]: 13927.2 Formulas used: $b = a/p$

First type of zone

a [m]: 2,96 b [m]: 2,67 c [m]: 0

Second type of zone

a [m]: 2,96 b [m]: 2,67 c [m]: 0

✓ Close

EFFECTS OF RELEASE	
Type of release	Heavy gas
Critical concentration, X_{crit} .	0,015 vol./vol. equal to 25 % of LFL
Background concentration, X_b .	0 vol./vol.
Time to X_{crit} , t_d	Not applicable
Relationship of concentrations, $X_b < X_{crit}$	Verified
Degree of delution	Medium
Type of zone	Zone 1 and Zone 2 Hazardous Area
Applicable equipment (minimum):	Zone 1 - IIA T2 Gb Zone 2 - IIA T2 Gc

Minimum requirements for applicable products used in Zone 1:

IIA T2 Gb

Minimum requirements for applicable products used in Zone 2:

IIA T2 Gc

Properties of Explosive substances

Characteristic of flammable substance

Flammable Substance and characteristics

Name

Metyl alcohol (Methanol)

Liquid volume mass pliq [kg/m³]

792

Composition

CH3OH

Latent heat of vaporization at Tb, Clv [J/kg]

1100000

Relative density of gas or vapour to air

1,11

Average specific heat of liquid Csl [J/(kg K)]

2500

Flash point FP [°C]

9

Auto-ignition temperature AIT [°C]

440

Gas diffusion coefficient cd [m²/h]

0,057

?

Polytropic index of adiabatic expansion γ (cp/cv)

1,2

Molar mass M [kg/kmol]

32,04

?

Equipment Group

?

IIA

Index K_G

401

?

Temperature class

?

T2

Volatility

Vapour pressure at 20 °C pv [Pa]

12900

Vapour pressure at 40 °C pv [Pa]

35200

Boiling point Tb [°C]

65

Flammability limits in air

Lower flammable limit LFL [% vol.]

6

Lower flammable limit LFL [kg/m³]

0,0679

Close

Cancel

ANNEX A - Physical and chemical properties of the explosive materials

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Flammable substance				Volatility ^a				LFL		Ex characteristics		
	Name	CAS No.	Molar mass [kg/kmol]	Relative density gas/air	Polytropic index of adiabatic expansion γ	Flash point [°C]	Ignition temp. [°C]	Boiling point [°C]	Vapor pressure at 20°C [Pa]	Vol (%)	kg/m³	Equipment group	Temp. Class [°C]
1	Methyl alcohol (Methanol)	67-56-1	32,04	1,11	1,2	9	440	65	12900	6	0,185	IIA	T2
2	Xylene	1330-20-7	106,17	3,67	1,21	25	465	137	800	0,7	0,0408	IIA	T1
3	Acrylonitrile	107-13-1	53,06	1,83	1,15	0	481	77	11800	2,8	0,0618	IIB	T1

