

Hazardous Area Classification according to IEC 60079-10-1:2020: Example 1-1 Annex E.2

IEC 60079-10-1 Ed. 3.0 | Benzene - pump seal rupture - direct evaporation

Project IEC 60079-10-1 Ed. 3.0
Example 1-1 Annex E.2 IEC 60079-10-1

Assessment Ed. 3.0 | Benzene - pump seal rupture - direct evaporation

Location of release Outside

Area name Outdoor

Substance properties

Substance name Benzene (= Phenyl hydride) C₆H₆

CAS-number 71-43-2

Molmass 78.11 kg/kmol

Flashpoint -11 °C

Vapour pressure @ 20°C 10.00 kPa

LFL [vol/vol] 0.012 vol/vol

Relative vapour density (air = 1) 2.70

Liquid density @ 20°C 880 kg/m³

Universal Gas Constant, R 8314 (J/kmol/K)

Release-assessment

Assessment according to Edition 2020

Type of release Liquid

Atmospheric pressure, Pa 101325 Pa

Pressure in system, Pa 1601325 Pa

Cd 0.75

Density of the liquid, ρ_l 880 kg/m³

Release rate liquid, W 1.93e-1 kg/s

Percentage direct evaporation 2%

Evaporation rate of liquid, W_e 3.85e-3 kg/s

Volumetric evaporation rate, Q_g 1.19e-3 m³/s

Release characteristic 9.89e-2 m³/s

Ambient temperature, T_a 293 °K

Temperature medium, T_m 293 °K

Leak-opening, S 5.00e-6 m²

Density of the gas, ρ_g 3.25 kg/m³

Volumetric release rate liquid, W 219 ml/s

Time until leak of 200 ml (appr. 1 glass) 1 sec

Used formula B1

Safety factor No

Ventilation assessment

Air velocity for dilution 3.00e-1 m/s

Dilution class Medium dilution

Availability ventilation Good

Classification of area

Type of release source Secondary

Zone Zone 2

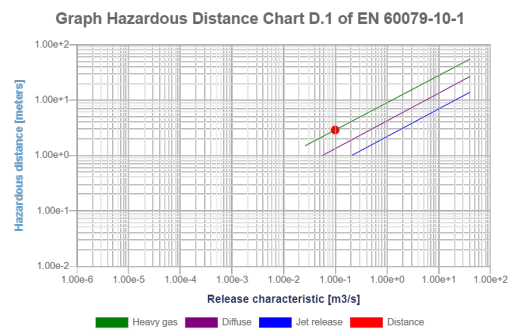
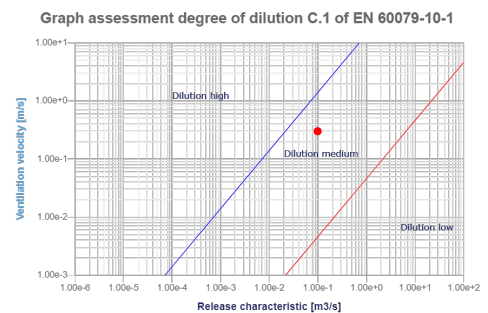
Density of gas relative to air vapour/gas is heavier than air

Type of release Heavy gas

Radius zone area 2.89 mtr

Temperature class T1

Gas group IIA



Comments

Example 1 : part 1 : direct evaporation from the source of release is calculated.

Advice

Zone 2 with an extent of 3 mtr from the source of release.

Hazardous Area Classification according to IEC 60079-10-1:2020: Example 1-2 Annex E.2 IEC 60079-10-1 Ed. 3.0 | Benzene - pump seal rupture - fluid flowing to sewer

Project	IEC 60079-10-1 Ed. 3.0
Assessment	Example 1-2 Annex E.2 IEC 60079-10-1 Ed. 3.0 Benzene - pump seal rupture - fluid flowing to sewer
Location of release	Outside
Area name	Outdoor

Substance properties

Substance name	Benzene (= Phenyl hydride) C ₆ H ₆
CAS-number	71-43-2
Molmass	78.11 kg/kmol
Flashpoint	-11 °C
Vapour pressure @ Tmedium	10000.00 Pa
LFL [vol/vol]	0.012 vol/vol

Relative vapour density (air = 1)	2.70
Liquid density @ 20°C	880 kg/m ³
Universal Gas Constant, R	8314 (J/kmol/K)

Release-assessment

Assessment according to	Edition 2020
Type of release	Atmospheric
Size of the liquid pool	1.5 m ²
Estimated local air velocity over pool	3.00e-1 m/s
Total airvelocity of fluid, U_w	3.00e-1 m/s
Mass release rate of the gas, W_g	8.06e-4 kg/s
Volumetric gas release rate, Q_g	2.49e-4 m ³ /s

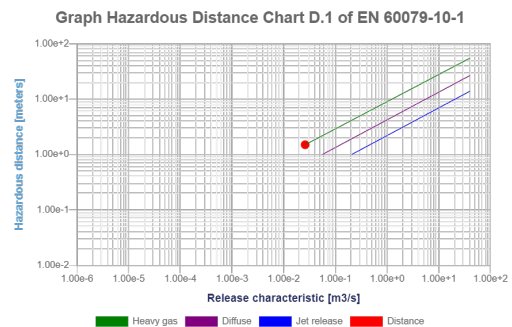
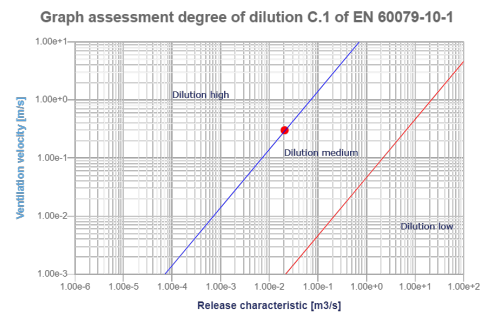
Release characteristic	2.07e-2 m ³ /s
Ambient temperature, T_a	293 °K
Temperature medium, T_m	293 °K
Density of the gas, ρ_g	3.25 kg/m ³
Used formula	B6 and B7
Safety factor	No

Ventilation assessment

Air velocity for dilution	3.00e-1 m/s
Dilution class	Medium dilution
Availability ventilation	Good

Classification of area

Type of release source	Secondary
Zone	Zone 2
Density of gas relative to air	vapour/gas is heavier than air
Type of release	Heavy gas
Radius zone area	1,5 mtr
Temperature class	T1
Gas group	IIA



Comments

Example 1 : part 2 : evaporation of the liquid that is drained to the sewer system. Based on an assumed liquid area of 1,5 m².

Advice

Zone 2 with an extent of 1,5 mtr above the floor or liquid spill area.

Hazardous Area Classification according to IEC 60079-10-1:2020: Example 2 Annex E.2

IEC 60079-10-1 Ed. 3.0 | Benzene - leaking of mechanical seal

Project	IEC 60079-10-1 Ed. 3.0
Assessment	Example 2 Annex E.2 IEC 60079-10-1 Ed. 3.0 Benzene - leaking of mechanical seal
Location of release	Inside
Area name	Example 2 - Building naturally ventilated (by wind)

Substance properties

Substance name	Benzene (= Phenyl hydride) C6H6	Relative vapour density (air = 1)	2.70
CAS-number	71-43-2	Liquid density @ 20°C	880 kg/m3
Molmass	78.11 kg/kmol	Universal Gas Constant, R	8314 (J/kmol/K)
Flashpoint	-11 °C		
Vapour pressure @ 20°C	10.00 kPa		
LFL [vol/vol]	0.012 vol/vol		

Release-assessment

Assessment according to	Edition 2020	Release characteristic	9.89e-2 m3/s
Type of release	Liquid	Ambient temperature, Ta	293 °K
Atmospheric pressure, Pa	101325 Pa	Temperature medium, Tm	293 °K
Pressure in system, Pa	1601325 Pa	Leak-opening, S	5.00e-6 m2
Cd	0.75	Density of the gas, ρg	3.25 kg/m3
Density of the liquid, ρl	880 kg/m3	Volumetric release rate liquid, W	219 ml/s
Release rate liquid, W	1.93e-1 kg/s	Time until leak of 200 ml (appr. 1 glass)	1 sec
Percentage direct evaporation	2%	Used formula	B1
Evaporation rate of liquid, We	3.85e-3 kg/s	Safety factor	No
Volumetric evaporation rate, Qg	1.19e-3 m3/s		

Ventilation assessment

Area length, width and height	6.00 x 5.00 x 5.00 mtr
Ventilation capacity	306 m3/h
Volume	150.00 m3
Ventilation rate	2.04 times/hr
Air velocity for dilution	2.83e-3 m/s
Dilution class	Low dilution
Availability ventilation	Fair
Efficiency ventilation	5
Critical concentration, Xcrit	3.00e-3 vol/vol
Background concentration, Xb	6.88e-2 vol/vol

Result background concentration > critical concentration, so **Not OK**

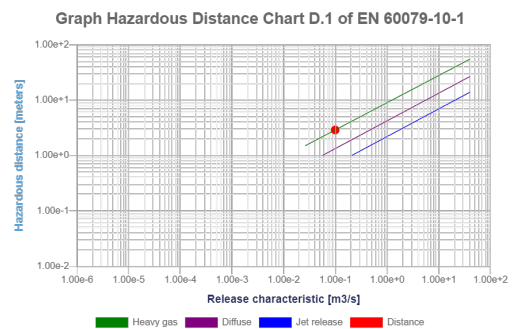
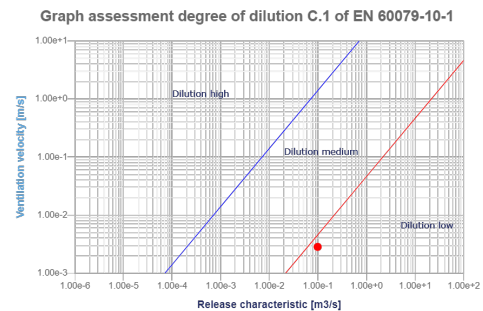
Resulting dilution class Low dilution

Classification of area

Type of release source	Secondary
Zone	Zone 1 and even Zone 0
Density of gas relative to air	vapour/gas is heavier than air
Type of release	Heavy gas
Radius zone area	2.89 mtr
Temperature class	T1
Gas group	IIA

Advice

Zone 1 with an extent of 3 mtr from the source of release, practically the whole room is zone 1 (see deminsions of the room).



Hazardous Area Classification according to IEC 60079-10-1:2020: Example 3 part 1 Annex E.2 IEC 60079-10-1 Ed. 3.0| Benzene - breather valve process vessel filling

Project IEC 60079-10-1 Ed. 3.0
Example 3 part 1 Annex E.2 IEC 60079-10-1 Ed. 3.0| Benzene - breather valve process vessel filling

Assessment

Location of release Outside

Area name Outdoor

Substance properties

Substance name Benzene (= Phenyl hydride) C₆H₆

CAS-number 71-43-2

Molmass 78.11 kg/kmol

Flashpoint -11 °C

Vapour pressure @ 20°C 10.00 kPa

LFL [vol/vol] 0.012 vol/vol

Relative vapour density (air = 1) 2.70

Liquid density @ 20°C 880 kg/m³

Universal Gas Constant, R 8314 (J/kmol/K)

Release-assessment

Assessment according to Edition 2020

Type of release Manual

Mass release rate of the gas, We 4.50e-3 kg/s

Volumetric gas release rate, Qg 1.39e-3 m³/s

Release characteristic 1.15e-1 m³/s

Ambient temperature, Ta 293 °K

Temperature medium, Tm 293 °K

Density of the gas, ρg 3.25 kg/m³

Used formula No formula, manual input

Safety factor No

Ventilation assessment

Air velocity for dilution 1.00e+0 m/s

Dilution class Medium dilution

Availability ventilation Good

Classification of area

Type of release source Primary

Zone Zone 1

Density of gas relative to air vapour/gas is heavier than air

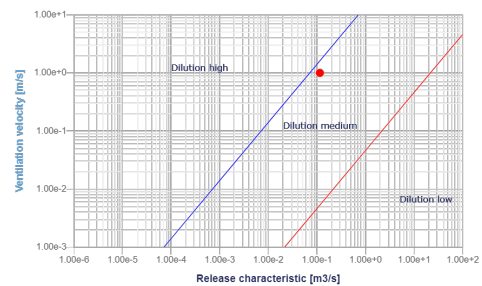
Type of release Diffuse

Radius zone area 1.44 mtr

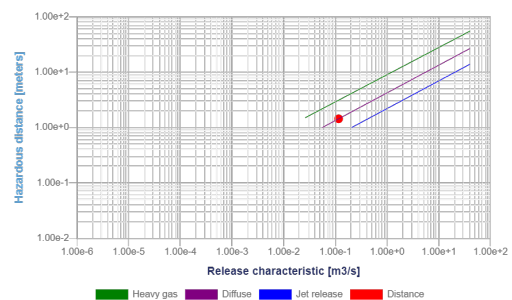
Temperature class T1

Gas group IIA

Graph assessment degree of dilution C.1 of EN 60079-10-1



Graph Hazardous Distance Chart D.1 of EN 60079-10-1



Comments

Part 1 of Example 3: primary release source

Advice

Zone 1 with an extent of 1,15 around the source of release.

Hazardous Area Classification according to IEC 60079-10-1:2020: Example 3 part 2 Annex E.2 IEC 60079-10-1 Ed. 3.0 | Benzene - breather valve sealing device rupture

Project IEC 60079-10-1 Ed. 3.0
Assessment Example 3 part 2 Annex E.2 IEC 60079-10-1 Ed. 3.0 | Benzene - breather valve sealing device rupture
Location of release Outside
Area name Outdoor

Substance properties

Substance name Benzene (= Phenyl hydride) C₆H₆
CAS-number 71-43-2
Molmass 78.11 kg/kmol
Flashpoint -11 °C
Vapour pressure @ 20°C 10.00 kPa
LFL [vol/vol] 0.012 vol/vol

Relative vapour density (air = 1) 2.70
Liquid density @ 20°C 880 kg/m³
Universal Gas Constant, R 8314 (J/kmol/K)

Release-assessment

Assessment according to Edition 2020
Type of release Manual
Mass release rate of the gas, We 4.95e-2 kg/s
Volumetric gas release rate, Qg 1.52e-2 m³/s

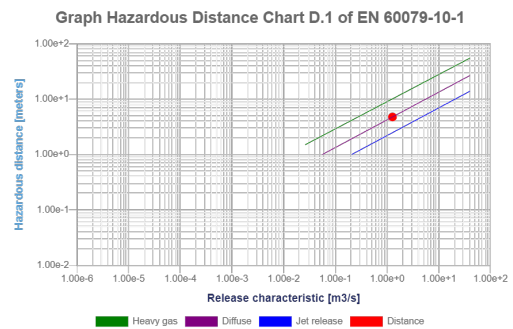
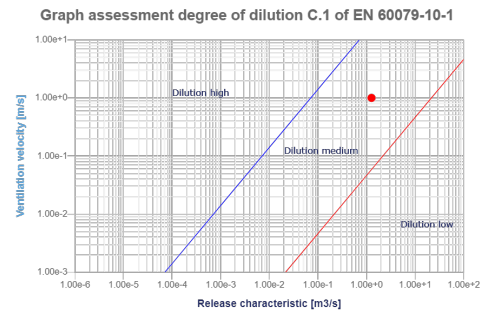
Release characteristic 1.27e+0 m³/s
Ambient temperature, Ta 293 °K
Temperature medium, Tm 293 °K
Density of the gas, ρg 3.25 kg/m³
Used formula No formula, manual input
Safety factor No

Ventilation assessment

Air velocity for dilution 1.00e+0 m/s
Dilution class Medium dilution
Availability ventilation Good

Classification of area

Type of release source Secondary
Zone Zone 2
Density of gas relative to air vapour/gas is heavier than air
Type of release Diffuse
Radius zone area 4.77 mtr
Temperature class T1
Gas group IIA



Comments

Part 2 of Example 3: secondary release source

Advice

Zone 2 with an extent of appr. 5 mtr around the source of release.

Hazardous Area Classification according to IEC 60079-10-1:2020: Example 4 Annex E.2

IEC 60079-10-1 Ed. 3.0 | Propane - control valve

Project	IEC 60079-10-1 Ed. 3.0
Assessment	Example 4 Annex E.2 IEC 60079-10-1 Ed. 3.0 Propane - control valve
Location of release	Outside
Area name	Outdoor

Substance properties

Substance name	Propane (= Dimethyl methane) (= Propylhydride)
CAS-number	74-98-6
Molmass	44.10 kg/kmol
Flashpoint	flammable gas
Vapour pressure @ Tmedium	flammable gas
LFL [vol/vol]	0.017 vol/vol

Relative vapour density (air = 1)	1.56
Universal Gas Constant, R	8314 (J/kmol/K)

Release-assessment

Assessment according to	Edition 2020
Type of release	Pressurized
Atmospheric pressure, Pa	101325 Pa
Pressure in system, Pa	1001325 Pa
Cp	1530 J/kg/K
γ	1.14
Critical pressure, Pc	175819 Pa
Cd	0.75
Mass release rate of the gas, Wg	5.09e-3 kg/s
Volumetric gas release rate, Qg	2.73e-3 m ³ /s

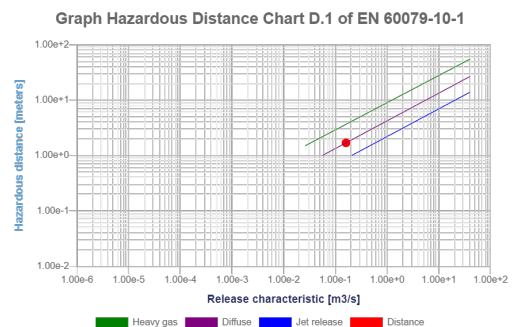
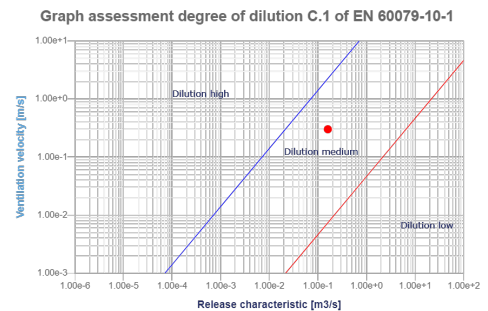
Release characteristic	1.60e-1 m ³ /s
Ambient temperature, Ta	288 °K
Temperature medium, Tm	293 °K
Leak-opening, S	2.50e-6 m ²
Compressibility factor, Z	1.00
Velocity of the released gas is	sonic/choked release
Density of the gas, ρg	1.83e+0 kg/m ³
Used formula	B4
Safety factor	No

Ventilation assessment

Air velocity for dilution	3.00e-1 m/s
Dilution class	Medium dilution
Availability ventilation	Good

Classification of area

Type of release source	Secondary
Zone	Zone 2
Density of gas relative to air	vapour/gas is heavier than air
Type of release	Diffuse
Radius zone area	1.69 mtr
Temperature class	T2
Gas group	IIA



Advice

Zone 2 with an extent of 2 mtr around the source of release (control valve).

Hazardous Area Classification according to IEC 60079-10-1:2020: Example 5 part 1 Annex E.2 IEC 60079-10-1 Ed. 3.0 | Natural gas oil well | pipe fittings

Project	IEC 60079-10-1 Ed. 3.0
Assessment	Example 5 part 1 Annex E.2 IEC 60079-10-1 Ed. 3.0 Natural gas oil well pipe fittings
Location of release	Inside
Area name	Example 5 - Building naturally ventilated (by wind)

Substance properties

Substance name	Wet. oil well natural gas
CAS-number	
Molmass	20.00 kg/kmol
Flashpoint	°C
Vapour pressure @ 20°C	0.00 kPa
LFL [vol/vol]	0.040 vol/vol

Relative vapour density (air = 1)

Liquid density @ 20°C	0 kg/m ³
Universal Gas Constant, R	(J/kmol/K)

Release-assessment

Assessment according to	Edition 2020
Type of release	Manual
Mass release rate of the gas, We	1.00e-8 kg/s
Volumetric gas release rate, Qg	1.20e-8 m ³ /s

Release characteristic	3.01e-7 m ³ /s
Ambient temperature, Ta	293 °K
Temperature medium, Tm	293 °K
Density of the gas, ρg	0.83 kg/m ³
Used formula	No formula, manual input
Safety factor	No

Ventilation assessment

Area length, width and height	3.00 x 3.00 x 3.50 mtr
Ventilation capacity	189 m ³ /h
Volume	31.50 m ³
Ventilation rate	6.00 times/hr
Air velocity for dilution	5.00e-3 m/s
Dilution class	High dilution
Availability ventilation	Fair
Efficiency ventilation	3
Critical concentration, Xcrit	1.00e-2 vol/vol
Background concentration, Xb	6.87e-7 vol/vol
Result	background concentration < critical concentration, so OK
Resulting dilution class	High dilution

Classification of area

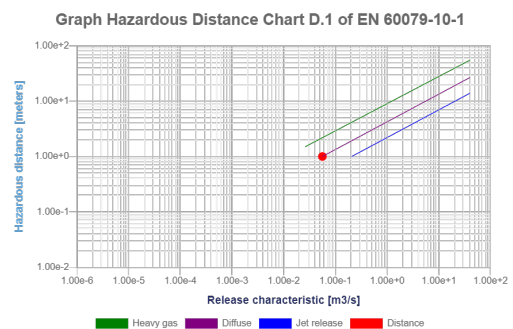
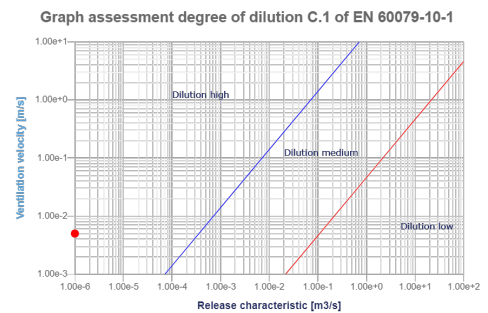
Type of release source	Continuous
Zone	Zone 2 (Zone 0 NE)
Density of gas relative to air	vapour/gas is lighter than air
Type of release	Diffuse
Radius zone area	1,0 mtr
Temperature class	
Gas group	

Comments

Example 5 part 1 : all 10 continuous sources of release are summed for the input of the release rate.

Advice

Zone 2 (zone 0 NE) with an extent of 1 mtr around the source of release. Summation of all release sources lead to a background concentration which is far beneath the critical concentration of 25%LEL.



Hazardous Area Classification according to IEC 60079-10-1:2020: Example 5 part 2 Annex E.2 IEC 60079-10-1 Ed. 3.0 | Natural gas oil well | pipe fittings

Project	IEC 60079-10-1 Ed. 3.0
Assessment	Example 5 part 2 Annex E.2 IEC 60079-10-1 Ed. 3.0 Natural gas oil well pipe fittings
Location of release	Inside
Area name	Example 5 - Building naturally ventilated (by wind)

Substance properties

Substance name	Wet. oil well natural gas
CAS-number	
Molmass	20.00 kg/kmol
Flashpoint	°C
Vapour pressure @ 20°C	0.00 kPa
LFL [vol/vol]	0.040 vol/vol

Relative vapour density (air = 1)

Liquid density @ 20°C	0 kg/m ³
Universal Gas Constant, R	(J/kmol/K)

Release-assessment

Assessment according to	Edition 2020
Type of release	Manual
Mass release rate of the gas, We	4.51e-6 kg/s
Volumetric gas release rate, Qg	5.42e-6 m ³ /s

Release characteristic	1.36e-4 m ³ /s
Ambient temperature, Ta	293 °K
Temperature medium, Tm	293 °K
Density of the gas, ρg	0.83 kg/m ³
Used formula	No formula, manual input
Safety factor	No

Ventilation assessment

Area length, width and height	3.00 x 3.00 x 3.50 mtr
Ventilation capacity	189 m ³ /h
Volume	31.50 m ³
Ventilation rate	6.00 times/hr
Air velocity for dilution	5.00e-3 m/s
Dilution class	High dilution
Availability ventilation	Fair
Efficiency ventilation	3
Critical concentration, Xcrit	1.00e-2 vol/vol
Background concentration, Xb	3.10e-4 vol/vol
Result	background concentration < critical concentration, so OK
Resulting dilution class	High dilution

Classification of area

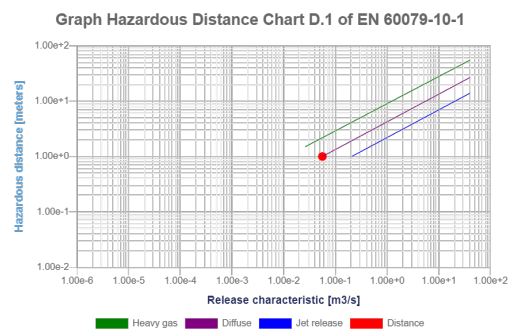
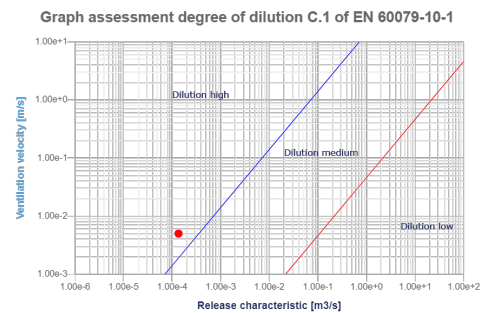
Type of release source	Primary
Zone	Zone 2 (Zone 1 NE)
Density of gas relative to air	vapour/gas is lighter than air
Type of release	Diffuse
Radius zone area	1,0 mtr
Temperature class	
Gas group	

Comments

Example 5 part 2 : all 10 continuous sources of release + primary release source are summed for the input of the release rate.

Advice

Zone 2 (zone 1 NE) with an extent of 1 mtr around the source of release. Summation of all release sources lead to a background concentration which is far beneath the critical concentration of 25%LEL.



Hazardous Area Classification according to IEC 60079-10-1:2020: Example 5 part 3 Annex E.2 IEC 60079-10-1 Ed. 3.0 | Natural gas oil well | pipe fittings

Project	IEC 60079-10-1 Ed. 3.0
Assessment	Example 5 part 3 Annex E.2 IEC 60079-10-1 Ed. 3.0 Natural gas oil well pipe fittings
Location of release	Inside
Area name	Example 5 - Building naturally ventilated (by wind)

Substance properties

Substance name	Wet. oil well natural gas
CAS-number	
Molmass	20.00 kg/kmol
Flashpoint	°C
Vapour pressure @ 20°C	0.00 kPa
LFL [vol/vol]	0.040 vol/vol

Relative vapour density (air = 1)

Liquid density @ 20°C	0 kg/m ³
Universal Gas Constant, R	(J/kmol/K)

Release-assessment

Assessment according to	Edition 2020
Type of release	Manual
Mass release rate of the gas, We	1.70e-3 kg/s
Volumetric gas release rate, Qg	2.04e-3 m ³ /s

Release characteristic	5.11e-2 m ³ /s
Ambient temperature, Ta	293 °K
Temperature medium, Tm	293 °K
Density of the gas, ρg	0.83 kg/m ³
Used formula	No formula, manual input
Safety factor	No

Ventilation assessment

Area length, width and height	3.00 x 3.00 x 3.50 mtr
Ventilation capacity	189 m ³ /h
Volume	31.50 m ³
Ventilation rate	6.00 times/hr
Air velocity for dilution	5.00e-3 m/s
Dilution class	Medium dilution
Availability ventilation	Fair
Efficiency ventilation	3
Critical concentration, Xcrit	1.00e-2 vol/vol
Background concentration, Xb	1.12e-1 vol/vol
Result	background concentration > critical concentration, so Not OK
Resulting dilution class	Low dilution

Classification of area

Type of release source	Secondary
Zone	Zone 1 and even Zone 0
Density of gas relative to air	vapour/gas is lighter than air
Type of release	Diffuse
Radius zone area	1,0 mtr
Temperature class	
Gas group	

Comments

Example 5 part 2 : all 10 continuous sources of release + primary release source are summed for the input of the release rate.

Advice

Zone 1 (zone 1 NE). Due to area dimension apply zone 1 to the whole room. Summation of all release sources lead to a background concentration which is higher than the critical concentration of 25%LEL.

