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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	**Relative vapour density (air = 1)**	2.70
Vapour pressure @ 20°C	10.00 kPa	**Liquid density @ 20°C**	880 kg/m3
LFL [vol/vol]	0.012 vol/vol	**Universal Gas Constant, R**	8314 (J/kmol/K)

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		

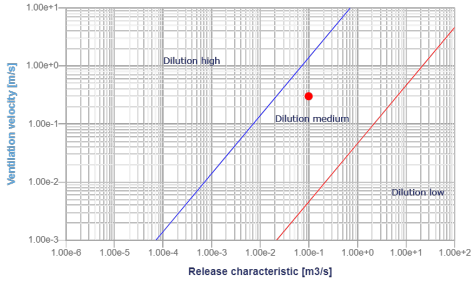
Ventilation assessment

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

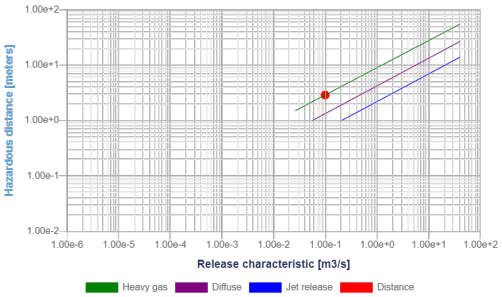
Classification of area

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

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



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



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.

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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 Example 1-2 Annex E.2 IEC 60079-10-1
Assessment	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) C6H6		
CAS-number	71-43-2		
Molmass	78.11 kg/kmol		
Flashpoint	-11 °C	**Relative vapour density (air = 1)**	2.70
Vapour pressure @ Tmedium	10000.00 Pa	**Liquid density @ 20°C**	880 kg/m3
LFL [vol/vol]	0.012 vol/vol	**Universal Gas Constant, R**	8314 (J/kmol/K)

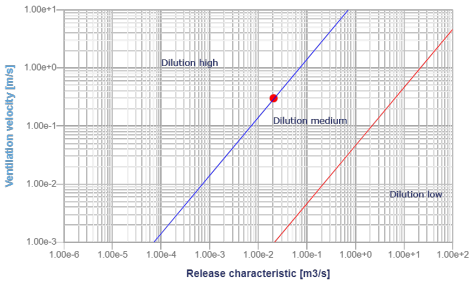
Release-assessment

Assessment according to	Edition 2020	**Release characteristic**	2.07e-2 m3/s
Type of release	Atmospheric	**Ambient temperature, Ta**	293 °K
Size of the liquid pool	1.5 m2	**Temperature medium, Tm**	293 °K
Estimated local air velocity over pool	3.00e-1 m/s	**Density of the gas, ρg**	3.25 kg/m3
Total airvelocity of fluid, Uw	3.00e-1 m/s	**Used formula**	B6 and B7
Mass release rate of the gas, Wg	8.06e-4 kg/s	**Safety factor**	No
Volumetric gas release rate, Qg	2.49e-4 m3/s		

Ventilation assessment

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

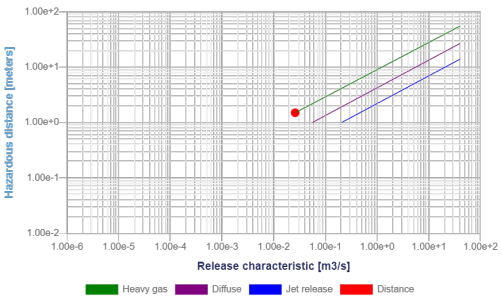
Graph assessment degree of dilution C.1 of EN 60079-10-1



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

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



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.

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

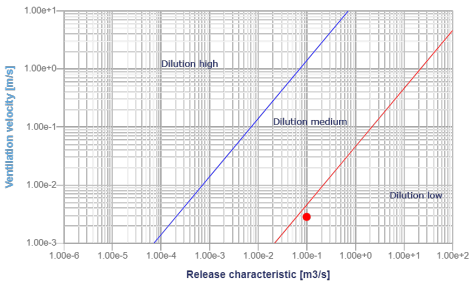
Release-assessment

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		

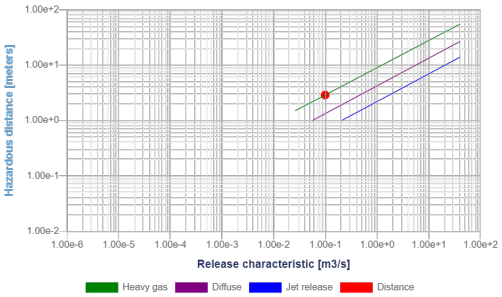
Ventilation assessment

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
Crtitical 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

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



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



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).

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

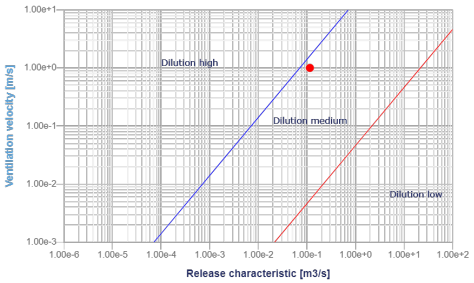
Release-assessment

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

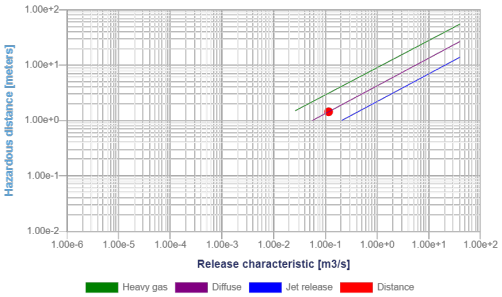
Graph assessment degree of dilution C.1 of EN 60079-10-1



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 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 aournd the source of release.

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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)

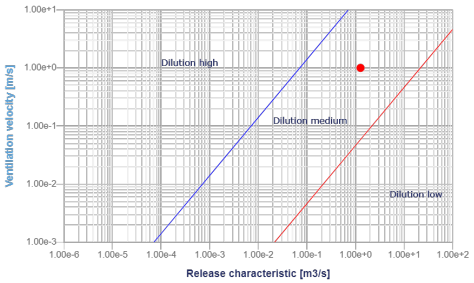
Release-assessment

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

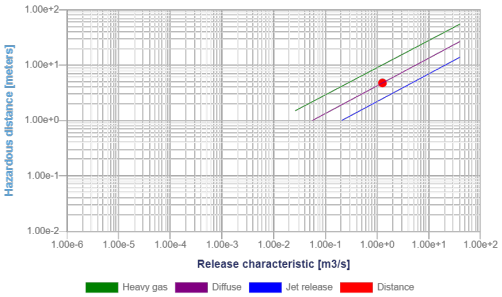
Graph assessment degree of dilution C.1 of EN 60079-10-1



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

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



Comments

Part 2 of Example 3: secondary release source

Advice

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

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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) (= Propyl hydride)
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	**Release characteristic**	1.60e-1 m3/s
Type of release	Pressurized	**Ambient temperature, Ta**	288 °K
Atmospheric pressure, Pa	101325 Pa	**Temperature medium, Tm**	293 °K
Pressure in system, Pa	1001325 Pa	**Leak-opening, S**	2.50e-6 m2
Cp	1530 J/kg/K	**Compressibility factor, Z**	1.00
γ	1.14	**Velocity of the released gas is**	sonic/choked release
Critical pressure, Pc	175819 Pa	**Density of the gas, ρg**	1.83e+0 kg/m3
Cd	0.75	**Used formula**	B4
Mass release rate of the gas, Wg	5.09e-3 kg/s	**Safety factor**	No
Volumetric gas release rate, Qg	2.73e-3 m3/s		

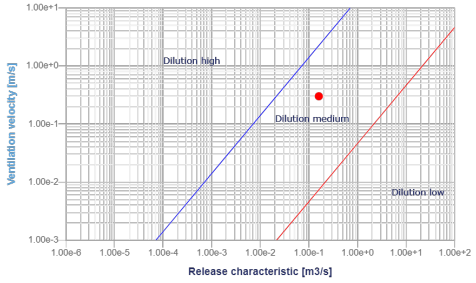
Ventilation assessment

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

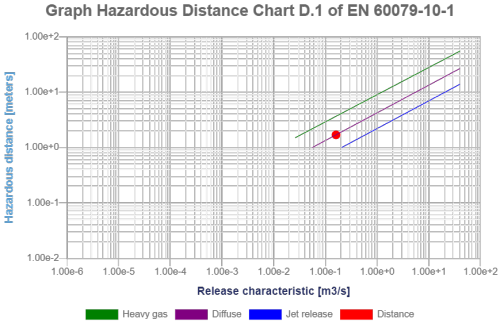
Classification of area

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

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



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



Advice

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

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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	**Relative vapour density (air = 1)**	
Vapour pressure @ 20°C	0.00 kPa	**Liquid density @ 20°C**	0 kg/m3
LFL [vol/vol]	0.040 vol/vol	**Universal Gas Constant, R**	(J/kmol/K)

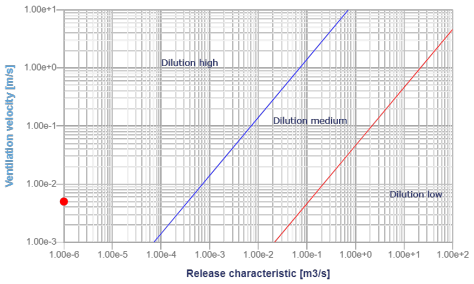
Release-assessment

Assessment according to	Edition 2020	**Release characteristic**	3.01e-7 m3/s
Type of release	Manual	**Ambient temperature, Ta**	293 °K
Mass release rate of the gas, We	1.00e-8 kg/s	**Temperature medium, Tm**	293 °K
Volumetric gas release rate, Qg	1.20e-8 m3/s	**Density of the gas, ρg**	0.83 kg/m3
		Used formula	No formula, manual input
		Safety factor	No

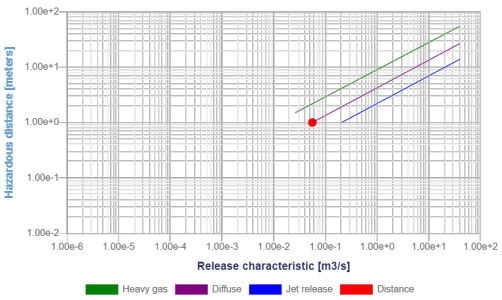
Ventilation assessment

Area length, width and height	3.00 x 3.00 x 3.50 mtr
Ventilation capacity	189 m3/h
Volume	31.50 m3
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
Crtitical 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

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



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



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 continiuous 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.

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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	**Relative vapour density (air = 1)**	
Vapour pressure @ 20°C	0.00 kPa	**Liquid density @ 20°C**	0 kg/m3
LFL [vol/vol]	0.040 vol/vol	**Universal Gas Constant, R**	(J/kmol/K)

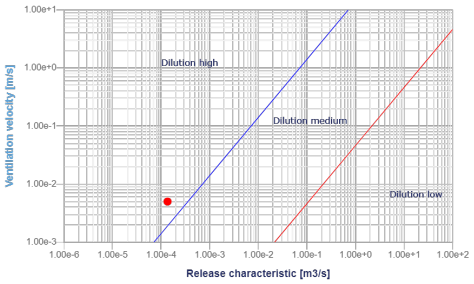
Release-assessment

Assessment according to	Edition 2020	**Release characteristic**	1.36e-4 m3/s
Type of release	Manual	**Ambient temperature, Ta**	293 °K
Mass release rate of the gas, We	4.51e-6 kg/s	**Temperature medium, Tm**	293 °K
Volumetric gas release rate, Qg	5.42e-6 m3/s	**Density of the gas, ρg**	0.83 kg/m3
		Used formula	No formula, manual input
		Safety factor	No

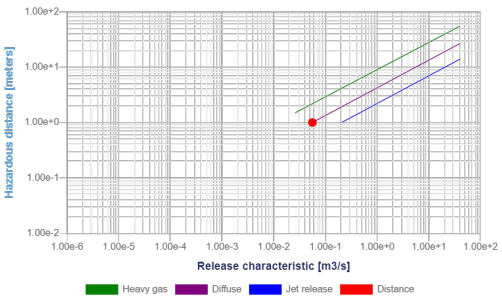
Ventilation assessment

Area length, width and height	3.00 x 3.00 x 3.50 mtr
Ventilation capacity	189 m3/h
Volume	31.50 m3
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
Crtitical 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

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



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



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 continiuous 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.

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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	**Relative vapour density (air = 1)**	
Vapour pressure @ 20°C	0.00 kPa	**Liquid density @ 20°C**	0 kg/m3
LFL [vol/vol]	0.040 vol/vol	**Universal Gas Constant, R**	(J/kmol/K)

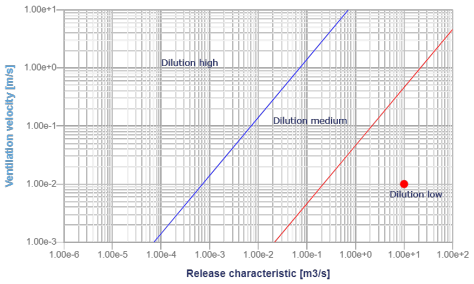
Release-assessment

Assessment according to	Edition 2020	**Release characteristic**	5.11e-2 m3/s
Type of release	Manual	**Ambient temperature, Ta**	293 °K
Mass release rate of the gas, We	1.70e-3 kg/s	**Temperature medium, Tm**	293 °K
Volumetric gas release rate, Qg	2.04e-3 m3/s	**Density of the gas, ρg**	0.83 kg/m3
		Used formula	No formula, manual input
		Safety factor	No

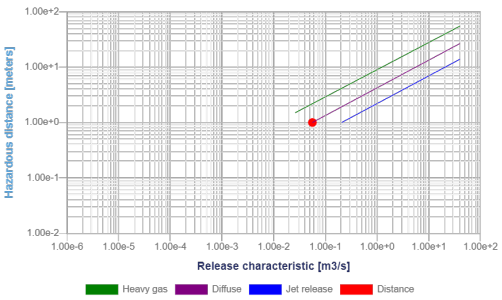
Ventilation assessment

Area length, width and height	3.00 x 3.00 x 3.50 mtr
Ventilation capacity	189 m3/h
Volume	31.50 m3
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
Crtitical 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

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



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



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 continiuous 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.