

STACK HEIGHT CALCULATION using HMIP Guidance Note D1

Contract Blackwood Crematorium - Sirhowy Valley Crematorium
 Contract No Sales
 Comment Facultative Technologies Double Cremator Flue Gas Treatment System
 Operator Tony Readman
 Date 12-Feb-19

Building dimensions (m)	Height (m)	Width (m)	Dist (m)	Within 5Um
This is the building attached to the stack	7.99	35		
Other Buildings				

Summarised Calculation Result

Minimum height required 8.98 m For a single building wider than
 5Um 7.5 m it is high:

Area category used in this calculation (where applicable)

4 Partially developed area

Stack diameter or circular equivalent mm 350

	Flue 1	Flue 2	Flue 3	Flue 4	Flue 5
Gas volume (Am ³ /h)	3537				
Moisture content (% v/v)	18.60				
Gas temperature (°C)	159.44				
Oxygen content (% dry v/v)	9.60				
Efflux velocity (m/s)	10.21				
1)<3d, 2)<Um/2, 3)<5Um, 4)>5Um	1				

Pollutants	14				
(mg/m ³ @ 11% O ₂ dry)	PG5/2(12)				
Hydrogen chloride	30				
Sulphur dioxide					
Hydrogen Fluoride					
Nitrogen dioxide					
Nitric oxide					
Carbon monoxide	100				
Particulate matter	20				
Ozone					
Cadmium					
Mercury	0.05				
Metals					
Volatile Organic Compounds	20				

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Mae'r ddogfen hon ar gael yn Gymraeg, ac mewn ieithoedd a fformatau eraill ar gais.
 This document is available in Welsh, and in other languages and formats on request.

Background conc	User Defined			
Hydrogen chloride		0.0161	mg/m ³	from D1 tables for area 4
Sulphur dioxide		0.00425	mg/m ³	from DEFRA, 2019
Hydrogen Fluoride		0.0098	mg/m ³	from D1 tables for area 4
Nitrogen dioxide		0.0137	mg/m ³	from DEFRA, 2019
Nitric oxide		0.1000	mg/m ³	from D1 tables for area 4
Carbon monoxide		0.1234	mg/m ³	from DEFRA, 2019
Particulate matter		0.0130	mg/m ³	from DEFRA, 2019
Ozone		0.1300	mg/m ³	from D1 tables for area 4
Cadmium			mg/m ³	
Mercury		2.195E-06	mg/m ³	from CEH
Metals		1.91E-06	mg/m ³	from CEH
Volatile Organic Compounds		0.0003	mg/m ³	from DEFRA, 2019

Short term guideline (mg/m ³)	User Defined	1	2	3	4	5
Hydrogen chloride	0.750	0.101	0.101	0.101	0.101	0.101
Sulphur dioxide	0.350	0.440	0.440	0.440	0.440	0.440
Hydrogen Fluoride	0.160	0.063	0.063	0.063	0.063	0.063
Nitrogen dioxide	0.200	0.200	0.200	0.200	0.200	0.200
Nitric oxide	4.400	1.000	1.000	1.000	1.000	1.000
Carbon monoxide	14.286	57.000	57.000	57.000	57.000	57.000
Particulate matter	0.085	0.300	0.300	0.300	0.300	0.300
Ozone	0.171	0.180	0.180	0.180	0.180	0.180
Cadmium	0.003	0.001	0.001	0.001	0.001	0.001
Mercury	0.008	0.004	0.004	0.004	0.004	0.004
Metals	0.000					
Volatile Organic Compounds	0.353					

Discharge rate g/s	Flue 1	Flue 2	Flue 3	Flue 4	Flue 5
Gas volume (Nm ³ /s @11% O ₂)	0.576	0.000	0.000	0.000	0.000
Hydrogen chloride	0.017	0.000	0.000	0.000	0.000
Sulphur dioxide	0.000	0.000	0.000	0.000	0.000
Hydrogen Fluoride	0.000	0.000	0.000	0.000	0.000
Nitrogen dioxide	0.000	0.000	0.000	0.000	0.000
Nitric oxide	0.000	0.000	0.000	0.000	0.000
Carbon monoxide	0.058	0.000	0.000	0.000	0.000
Particulate matter	0.012	0.000	0.000	0.000	0.000
Ozone	0.000	0.000	0.000	0.000	0.000
Cadmium	0.000	0.000	0.000	0.000	0.000
Mercury	0.000	0.000	0.000	0.000	0.000
Metals	0.000	0.000	0.000	0.000	0.000
Volatile Organic Compounds	0.012	0.000	0.000	0.000	0.000

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Pollution index	Flue 1	Flue 2	Flue 3	Flue 4	Flue 5
Hydrogen chloride	23.555	0.000	0.000	0.000	0.000
Sulphur dioxide	0.000	0.000	0.000	0.000	0.000
Hydrogen Fluoride	0.000	0.000	0.000	0.000	0.000
Nitrogen dioxide	0.000	0.000	0.000	0.000	0.000
Nitric oxide	0.000	0.000	0.000	0.000	0.000
Carbon monoxide	4.069	0.000	0.000	0.000	0.000
Particulate matter	160.571	0.000	0.000	0.000	0.000
Ozone	0.000	0.000	0.000	0.000	0.000
Cadmium	0.000	0.000	0.000	0.000	0.000
Mercury	3.843	0.000	0.000	0.000	0.000
Metals	0.000	0.000	0.000	0.000	0.000
Volatile Organic Compounds	32.721	0.000	0.000	0.000	0.000

	Flue 1	Flue 2	Flue 3	Flue 4	Flue 5
Total acid indices	23.555	0.000	0.000	0.000	0.000
Overall index per flue (m ³ /s)	160.571	0.000	0.000	0.000	0.000
Heat released (MW) {0.03-100}	0.117	0.000	0.000	0.000	0.000
Factor a	-0.933				
Factor b	0.485				
Momentum (m ⁴ /s ²) {1-20000}	6.568	0.000	0.000	0.000	0.000
Factor x	-2.866				
Factor y	5.390				
Factor z	-2.745				

Calc.buoyancy height 1.37 m

Minimum buoyancy height 1.30 m

Uncorr.buoyancy height $U_b =$ 1.37 m

Calc.momentum height 1.44 m

Minimum momentum height 1.50 m

Uncorr.momentum height $U_m =$ 1.50 m

Min(U_b, U_m) 1.37 m

U_m/U_b 1.09 m

Calculated height 8.98 m

Corrected height (m) 8.98 m

Minimum stack height required is 8.98 m

"5 U_m " (m) 7.49 m

Efflux Velocity (ref D1 - 6.1.1)	Flue 1 m/s	Flue 2 m/s	Flue 3 m/s	Flue 4 m/s	Flue 5 m/s
Discharge Heat release	10.1	0.0	0.0	0.0	0.0
Discharge Momentum	9.8	0.0	0.0	0.0	0.0
Minimum Efflux Velocity Required	10.1	0.0	0.0	0.0	0.0

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Comment	Facultatieve Technologies Double Cremator Flue Gas Treatment System
Operator	Tony Readman
Date	12-Feb-19

Data sources used in the calculation**Crematorium dimensions, drawings and geographic location**

Building dimensions were taken from clients architect drawings and/or actual measurement

Geographic location is from clients data and, internet based, Ordnance Survey published maps

The crematorium location is taken as:	X	318786 (standard 6 figure OS reference)
	Y	196403 (standard 6 figure OS reference)

Flue Gas Volume and conditions

Flue gas volume, temperature, oxygen content, moisture content and efflux velocity are derived from in house heat and mass balance calculations.

Gas flows are based on maximum cremation rate without burner input

Pollutant emission levels

Emission concentrations are assumed to be at the maximum allowed, for regulated substances, under the relevant legislation or guidance.

Cremation equipment is covered by Process Guidance Note 5/2(12)

Area Category

D1 include five area types for estimation of background pollutant levels.

These are generally used for pollutant species where no other information is available

The D1 category used is area 4, Partially developed area



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Background concentrations

Background concentration data is available, from DEFRA, for the following species:

Sulphur dioxide	2001 data
Nitrogen dioxide	2019 data
Carbon monoxide	2001 data
Particulate matter	2019 data
Mercury	CEH Annual Mean, Cwmystwyth
Metals	CEH Annual Mean, Cwmystwyth
Volatile Organic Compounds	2001 data

The remaining species use the relevant data from D1, using the area category

Sulphur dioxide, Nitrogen dioxide, carbon monoxide, particulate matter and volatile organic compounds

Data source: UK Air Quality Archive

<https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2013>

Caerphilly 393

Local_Auth_Code 393

Grid Reference X 318500 (standard 6 figure OS reference)

(1km square centre) Y 196500 (standard 6 figure OS reference)

geo_area 2

EU_zone_agglom_01 41

Distance from subject site 302 m

Sulphur dioxide

Nitrogen dioxide

Carbon monoxide

Adjusted to 2019 levels

Particulate matter

Volatile Organic Compounds

Assumed as Benzene

Adjusted to 2019 levels

Mercury and other metals

Data source: UK Pollutant Deposition portal <http://www.uk-pollutantdeposition.ceh.ac.uk/>

Cwmystwyth

Grid Reference X 277150 (standard 6 figure OS reference)

Y 274250 (standard 6 figure OS reference)

Distance from subject site 88 km

Mercury average (2005 & 2006)

Metals (as lead) average (2004 to 2007)

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Short Term Guidelines

Data source:

<https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>

Hydrogen chloride	750 $\mu\text{g}/\text{m}^3$	1 hourly EAL
Sulphur dioxide	350 $\mu\text{g}/\text{m}^3$	1 hourly AAD Limit value
Hydrogen Fluoride	160 $\mu\text{g}/\text{m}^3$	1 hourly EAL
Nitrogen dioxide	200 $\mu\text{g}/\text{m}^3$	1 hourly TG16 Table 1.1
Nitric oxide	4400 $\mu\text{g}/\text{m}^3$	1 hourly EAL
Carbon monoxide	14286 $\mu\text{g}/\text{m}^3$	8 hourly TG16 Table 1.1
Particulate matter	85 $\mu\text{g}/\text{m}^3$	Daily Mean, converted to hourly basis
Ozone	171 $\mu\text{g}/\text{m}^3$	Short Term EAL converted to hourly
Cadmium	2.54 $\mu\text{g}/\text{m}^3$	Short Term EAL converted to hourly
Mercury	7.5 $\mu\text{g}/\text{m}^3$	1 hourly EAL
Metals (ass. Lead)	0.42 $\mu\text{g}/\text{m}^3$	Short Term EAL converted to hourly
VOC (ass. Benzene)	353 $\mu\text{g}/\text{m}^3$	1 hourly EAL

Input required for ADMS Screen**Project Name****Source Data**

Height above ground	8.98 m
Internal dia of source	0.35 m
Temperature of Emission	159 °C
Volume flow rate	0.983 m^3/s
Vertical velocity	10.21 m/s

Emissions Data

Nitrogen Oxides (NOx)	0.202 g/s
Carbon Monoxide (CO)	0.058 g/s
Benzene (C6H6)	0 g/s
Particulates (PM10)	0.012 g/s
1.3 Butadiene (C4H6)	0 g/s
Mercury	0.000029 g/s
Sulphur Dioxide (SO2)	0.029 g/s
Nitrogen Dioxide (NO2)	0.000 g/s
Hydrogen Chloride	0.017 g/s

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