

STACK HEIGHT CALCULATION using HMIP Guidance Note D1

Contract Rubery Crematorium

Contract No Sales

Including 200 mg/m<sup>3</sup> NO<sub>x</sub>, assuming 50% is NO<sub>2</sub>

Comment Facultatieve Technologies Single

Operator Tony Readman

Date 17-Jan-20

Building dimensions (m)		Height (m)	Width (m)	Dist (m)	Within 5Um
<b>This is the building attached to the stack</b>		<b>4.3</b>	<b>25</b>		
Other Buildings					

**Summarised Calculation Result**

Minimum height required 6.0 m For a single building wider than  
 5Um 7.8 m it is high:

Area category used in this calculation (where applicable)

4 Partially developed area

Stack diameter or circular equ mm 250

	Flue 1	Flue 2	Flue 3	Flue 4	Flue 5
Gas volume (Am <sup>3</sup> /h)	2326				
Moisture content (% v/v)	11.92				
Gas temperature (°C)	130.00				
Oxygen content (% dry v/v)	13.31				
Efflux velocity (m/s)	13.17				
1)<3d, 2)<Um/2, 3)<5Um, 4)>5Um	1				

<b>Pollutants</b>	14				
(mg/m <sup>3</sup> @ 11% O <sub>2</sub> dry)	PG5/2(12)				
Hydrogen chloride	30				
Sulphur dioxide	50				
Hydrogen Fluoride					
Nitrogen dioxide	100				
Nitric oxide	65				
Carbon monoxide	100				
Particulate matter	20				
Ozone					
Cadmium					
Mercury	0.05				
Metals					
Volatile Organic Compounds	20				

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Background conc	User Defined			
Hydrogen chloride		0.0161	mg/m <sup>3</sup>	from D1 tables for area 4
Sulphur dioxide		0.00484	mg/m <sup>3</sup>	from DEFRA, 2020
Hydrogen Fluoride		0.0098	mg/m <sup>3</sup>	from D1 tables for area 4
Nitrogen dioxide		0.0233	mg/m <sup>3</sup>	from DEFRA, 2020
Nitric oxide		0.1000	mg/m <sup>3</sup>	from D1 tables for area 4
Carbon monoxide		0.3110	mg/m <sup>3</sup>	from DEFRA, 2020
Particulate matter		0.0253	mg/m <sup>3</sup>	from DEFRA, 2020
Ozone		0.1300	mg/m <sup>3</sup>	from D1 tables for area 4
Cadmium			mg/m <sup>3</sup>	
Mercury		3.33E-06	mg/m <sup>3</sup>	from CEH
Metals		1.384E-05	mg/m <sup>3</sup>	from CEH
Volatile Organic Compounds		0.6715	mg/m <sup>3</sup>	from DEFRA, 2020

Short term guideline (mg/m <sup>3</sup> )	User Defined	1	2	3	4	5
Hydrogen chloride	0.750	0.750	0.750	0.750	0.750	0.750
Sulphur dioxide	0.350	0.350	0.350	0.350	0.350	0.350
Hydrogen Fluoride	0.160	0.160	0.160	0.160	0.160	0.160
Nitrogen dioxide	0.200	0.200	0.200	0.200	0.200	0.200
Nitric oxide	4.400	4.400	4.400	4.400	4.400	4.400
Carbon monoxide	14.286	14.286	14.286	14.286	14.286	14.286
Particulate matter	0.085	0.085	0.085	0.085	0.085	0.085
Ozone	0.171	0.171	0.171	0.171	0.171	0.171
Cadmium	0.003	0.003	0.003	0.003	0.003	0.003
Mercury	0.008	0.008	0.008	0.008	0.008	0.008
Metals	0.000	0.000	0.000	0.000	0.000	0.000
Volatile Organic Compounds	0.195	0.195	0.195	0.195	0.195	0.195

Discharge rate g/s	Flue 1	Flue 2	Flue 3	Flue 4	Flue 5
Gas volume (Nm <sup>3</sup> /s @11% O <sub>2</sub> )	0.296	0.000	0.000	0.000	0.000
Hydrogen chloride	0.009	0.000	0.000	0.000	0.000
Sulphur dioxide	0.015	0.000	0.000	0.000	0.000
Hydrogen Fluoride	0.000	0.000	0.000	0.000	0.000
Nitrogen dioxide	0.030	0.000	0.000	0.000	0.000
Nitric oxide	0.019	0.000	0.000	0.000	0.000
Carbon monoxide	0.030	0.000	0.000	0.000	0.000
Particulate matter	0.006	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	0.006	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	12.091	0.000	0.000	0.000	0.000
Sulphur dioxide	42.846	0.000	0.000	0.000	0.000
Hydrogen Fluoride	0.000	0.000	0.000	0.000	0.000
Nitrogen dioxide	167.348	0.000	0.000	0.000	0.000
Nitric oxide	4.486	0.000	0.000	0.000	0.000
Carbon monoxide	2.117	0.000	0.000	0.000	0.000
Particulate matter	99.504	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	1.973	0.000	0.000	0.000	0.000
Metals	0.000	0.000	0.000	0.000	0.000
Volatile Organic Compounds	-12.416	0.000	0.000	0.000	0.000

	Flue 1	Flue 2	Flue 3	Flue 4	Flue 5
Total acid indices	54.937	0.000	0.000	0.000	0.000
Overall index per flue (m <sup>3</sup> /s)	167.348	0.000	0.000	0.000	0.000
Heat released (MW) {0.03-100}	0.066	0.000	0.000	0.000	0.000
Factor a	-0.886				
Factor b	0.484				
Momentum (m <sup>4</sup> /s <sup>2</sup> ) {1-20000}	5.975	0.000	0.000	0.000	0.000
Factor x	-2.904				
Factor y	5.416				
Factor z	-2.437				

Calc. buoyancy height 1.55 m  
 Minimum buoyancy height 1.16 m  
 Uncorr. buoyancy height  $U_b =$  1.55 m

Calc. momentum height 1.57 m  
 Minimum momentum height 1.45 m  
 Uncorr. momentum height  $U_m =$  1.57 m

Min( $U_b, U_m$ ) 1.55 m  
 $U_m/U_b$  1.01 m  
 Calculated height 5.25 m

Corrected height (m) 5.25 m  
 Minimum stack height required is 6.00 m  
 "5 $U_m$ " (m) 7.84 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	9.8	0.0	0.0	0.0	0.0
Discharge Momentum	9.8	0.0	0.0	0.0	0.0
Minimum Efflux Velocity Required	10.0	0.0	0.0	0.0	0.0

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Contract Rubery Crematorium  
Contract No Sales  
Comment Facultatieve Technologies Single  
Operator Tony Readman  
Date 17-Jan-20

### 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	397894 (standard 6 figure OS reference)
Y	277942 (standard 6 figure OS reference)
what3words	swing.poems.shades

#### 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	2020 data
Carbon monoxide	2001 data
Particulate matter	2020 data
Mercury	CEH Annual Mean, Beacon Hill
Metals	CEH Annual Mean, Beacon Hill
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=2015>

[Bromsgrove 38](#)

Local_Auth_Code	38
Grid Reference X	397500 (standard 6 figure OS reference)
(1km square centre) Y	277500 (standard 6 figure OS reference)
geo_area	6
EU_zone_agglom_01	35
Distance from subject site	592 m

Sulphur dioxide	2 × Annual Mean SO <sub>2</sub>
Nitrogen dioxide	2 × Annual Mean NO <sub>2</sub>
Carbon monoxide	2 × Annual Mean CO adjusted to 2020
Particulate matter	2 × Annual Mean PM <sub>10</sub>
Volatile Organic Compounds assumed as Benzene	2 × Annual Mean Benzene adjusted to 2020

Mercury and other metals

Data source: UK Pollutant Deposition portal <http://www.uk-pollutantdeposition.ceh.ac.uk/>  
[Beacon Hill](#)

Grid Reference X	451950 (standard 6 figure OS reference)
Y	314150 (standard 6 figure OS reference)
Distance from subject site	65 km

Mercury 2 × Annual Mean (2005 & 2006) Hg

Metals (as lead) 2 × Annual Mean (2004 to 2007) Metals

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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)	195 $\mu\text{g}/\text{m}^3$	1 hourly EAL



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