

STACK HEIGHT CALCULATION using HMIP Guidance Note D1

Contract Blackley Crematorium

Contract No Sales

Including 200 mg/m³ NO_x, assuming 50% is NO₂

Comment Facultative Technologies Double

Operator Tony Readman

Date 5-Aug-21

Building dimensions (m)		Height (m)	Width (m)	Dist (m)	Within 5Um
This is the building attached to the stack		6.21	14.3		
Other Buildings	East Chapel roof	6.68	22	11.8	no
	West Chapel roof	6.68	18	12.7	no
	Main roof	7.88	21	12.3	no

Summarised Calculation Result

Corrected height (m) 7.53 m

For a single building wider than

Minimum height required 8.0 m

it is high:

5Um 10.3 m

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)	4612				
Moisture content (% v/v)	12.02				
Gas temperature (°C)	130.00				
Oxygen content (% dry v/v)	13.23				
Efflux velocity (m/s)	13.32				
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	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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Moor Road
Leeds LS10 2DD, England
Phone : +44 (0)113 276 8888
Fax : +44 (0)113 271 8188
E-mail : info@facultative-technologies.co.uk

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Background conc	User Defined			
Hydrogen chloride		0.0161	mg/m ³	from D1 tables for area 4
Sulphur dioxide		0.00956	mg/m ³	from DEFRA, 2021
Hydrogen Fluoride		0.0098	mg/m ³	from D1 tables for area 4
Nitrogen dioxide		0.0291	mg/m ³	from DEFRA, 2021
Nitric oxide		0.1000	mg/m ³	from D1 tables for area 4
Carbon monoxide		0.3987	mg/m ³	from DEFRA, 2021
Particulate matter		0.0228	mg/m ³	from DEFRA, 2021
Ozone		0.1300	mg/m ³	from D1 tables for area 4
Cadmium		0.0001	mg/m ³	from DEFRA, 2021
Mercury		3.33E-06	mg/m ³	from CEH
Metals		1.384E-05	mg/m ³	from CEH
Volatile Organic Compounds		0.0008	mg/m ³	from DEFRA, 2021

Short term guideline	User Defined			
Hydrogen chloride		0.750	mg/m ³	EAL
Sulphur dioxide		0.350	mg/m ³	AAD Limit value
Hydrogen Fluoride		0.160	mg/m ³	EAL
Nitrogen dioxide		0.200	mg/m ³	TG16 Table 1.1
Nitric oxide		4.400	mg/m ³	EAL
Carbon monoxide		14.286	mg/m ³	TG16 Table 1.1, converted to hourly
Particulate matter		0.085	mg/m ³	TG16 Table 1.1, converted to hourly
Ozone		0.171	mg/m ³	TG16 Table 1.1, converted to hourly
Cadmium		0.003	mg/m ³	AAD Target value
Mercury		0.008	mg/m ³	EAL
Metals		0.000	mg/m ³	AAD Limit value
Volatile Organic Compounds		0.195	mg/m ³	EAL

Discharge rate g/s	Flue 1	Flue 2	Flue 3	Flue 4	Flue 5
Gas volume (Nm ³ /s @11% O ₂)	0.592	0.000	0.000	0.000	0.000
Hydrogen chloride	0.018	0.000	0.000	0.000	0.000
Sulphur dioxide	0.030	0.000	0.000	0.000	0.000
Hydrogen Fluoride	0.000	0.000	0.000	0.000	0.000
Nitrogen dioxide	0.059	0.000	0.000	0.000	0.000
Nitric oxide	0.039	0.000	0.000	0.000	0.000
Carbon monoxide	0.059	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	24.181	0.000	0.000	0.000	0.000
Sulphur dioxide	86.881	0.000	0.000	0.000	0.000
Hydrogen Fluoride	0.000	0.000	0.000	0.000	0.000
Nitrogen dioxide	346.072	0.000	0.000	0.000	0.000
Nitric oxide	8.973	0.000	0.000	0.000	0.000
Carbon monoxide	4.260	0.000	0.000	0.000	0.000
Particulate matter	190.895	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	3.945	0.000	0.000	0.000	0.000
Metals	0.000	0.000	0.000	0.000	0.000
Volatile Organic Compounds	60.914	0.000	0.000	0.000	0.000

	Flue 1	Flue 2	Flue 3	Flue 4	Flue 5
Total acid indices	111.062	0.000	0.000	0.000	0.000
Overall index per flue (m ³ /s)	346.072	0.000	0.000	0.000	0.000
Heat released (MW) {0.03-100}	0.132	0.000	0.000	0.000	0.000
Factor a	-0.943				
Factor b	0.486				
Momentum (m ⁴ /s ²) {1-20000}	11.981	0.000	0.000	0.000	0.000
Factor x	-2.630				
Factor y	5.227				
Factor z	-4.599				

Calc.buoyancy height 1.95 m

Minimum buoyancy height 1.33 m

Uncorr.buoyancy height $U_b =$ 1.95 m

Calc.momentum height 2.07 m

Minimum momentum height 1.82 m

Uncorr.momentum height $U_m =$ 2.07 m

Min(U_b, U_m) 1.95 m

U_m/U_b 1.06 m

Calculated height 7.53 m

Corrected height (m) 7.53 m

Minimum stack height required is 8.00 m

"5 U_m " (m) 10.34 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	10.2	0.0	0.0	0.0	0.0
Discharge Momentum	10.1	0.0	0.0	0.0	0.0
Minimum Efflux Velocity Required	10.2	0.0	0.0	0.0	0.0

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Operator Tony Readman
Date 5-Aug-21

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 384359 (standard 6 figure OS reference)
 Y 403642 (standard 6 figure OS reference)
 what3words castle.panels.mock

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	2021 data
Carbon monoxide	2001 data
Particulate matter	2021 data
Cadmium	CEH Annual Mean, Beacon Hill
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=2018>

Manchester 155

Local_Auth_Code 155

Grid Reference X 384500 (standard 6 figure OS reference)

(1km square centre) Y 403500 (standard 6 figure OS reference)

geo_area 6

EU_zone_agglom_01 3

Distance from subject site 200 m

Sulphur dioxide 2 × Annual Mean SO₂, LAQM-TG16, box 7.13

Nitrogen dioxide 2 × Annual Mean NO₂ LAQM-TG16, box 7.13

Carbon monoxide 2 × Annual Mean CO adjusted to 2021

Particulate matter 2 × Annual Mean PM₁₀ LAQM-TG16, box 7.13

Volatile Organic Compounds assumed as Benzene 2 × Annual Mean Benzene adjusted to 2021

Mercury and other metals

Data source: UK Pollutant Deposition portal http://www.pollutantdeposition.ceh.ac.uk/heavy_metals
Beacon Hill

Grid Reference X 451950 (standard 6 figure OS reference)

Y 314150 (standard 6 figure OS reference)

Distance from subject site 112 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, converted to hourly
Particulate matter	85 $\mu\text{g}/\text{m}^3$	24 hourly TG16 Table 1.1, converted to hourly
Ozone	171 $\mu\text{g}/\text{m}^3$	8 hourly TG16 Table 1.1, 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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Cremation & Incineration Equipment

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