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D1 Stack Height Calculation

Client:	BAE Systems (Operations) Ltd, Samlesbury
Project:	Specialist Composite Engineering Facility (SCEF) - Oven LEV System
Date:	9th February, 2026
Document Ref:	CAS25-1263-10-2001

Audit Trail

Issue	Issue Date	Description	Prepared	Checked	Approved
01	09/02/2026	Original Issue	DJP	SCT	

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Executive Summary

This report presents the D1 stack height calculation for the proposed Local Exhaust Ventilation (LEV) system serving the oven within the Specialist Composite Engineering Facility (SCEF) at BAE Systems Samlesbury.

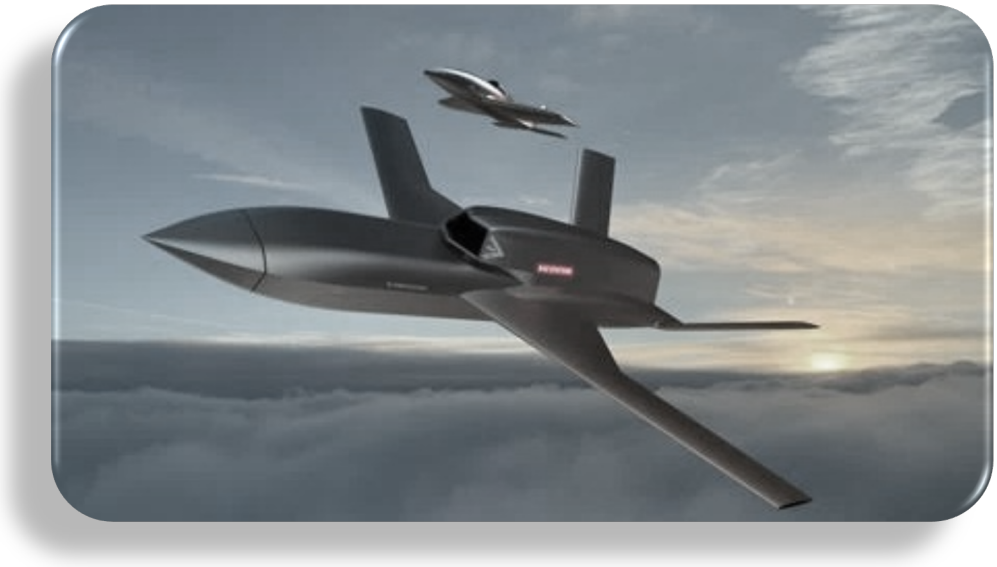
The calculation has been undertaken in accordance with EA Technical Guidance Note (Dispersion) D1 to determine the minimum compliant stack height for adequate atmospheric dispersal of process emissions generated during resin warming and curing operations.

Key Findings

Calculated Stack Height	17.28 metres above ground level
Minimum Compliant Stack Height	18 metres above ground level (rounded up per TGN D1 Section 5.4.7)
Height Above Ridge Line	1.4 metres
Current Design Height	19.6 metres above ground level
Potential Reduction	1.6 metres

The calculation demonstrates that the current design height of 19.6 m (3 m above ridge) exceeds the minimum requirement. The stack height could potentially be reduced to 18 m whilst maintaining compliance with D1 methodology.

It is important to note that TGN D1 was withdrawn by the Environment Agency in 2016 and has been superseded by detailed dispersion modelling approaches (ADMS, AERMOD). However, the D1 methodology remains accepted by HSE for stack height determination. The inherent conservatism of the D1 method means that detailed dispersion modelling would likely demonstrate compliance at a lower stack height, particularly given the favourable stack geometry at this site.



00-00-10 Abbreviations

AGL	Above Ground Level
ADMS	Atmospheric Dispersion Modelling System
Bc	Background Concentration
BS	British Standard
CAS	Chemical Abstracts Service (registry number)
COSHH	Control of Substances Hazardous to Health
D	Discharge Rate (g/s)
DNEL	Derived No-Effect Level
EA	Environment Agency
EH40	HSE Guidance Document - Workplace Exposure Limits
G_d	Guideline Concentration
H	Building Height
HSE	Health and Safety Executive
LEV	Local Exhaust Ventilation
M	Discharge Momentum (m^4/s^2)
P_i	Pollution Index (m^3/s)
Q	Heat Release (MW)
SCEF	Specialist Composite Engineering Facility
SDS	Safety Data Sheet
STEL	Short-Term Exposure Limit (15-minute reference period)
T_d	Discharge Temperature (K)
TGN D1	Technical Guidance Note (Dispersion) D1
TWA	Time-Weighted Average (8-hour reference period)
U	Uncorrected Stack Height (m)
U_b	Uncorrected Stack Height for Buoyancy (m)
U_m	Uncorrected Stack Height for Momentum (m)
WEL	Workplace Exposure Limit

00-10-10 Project Definitions

00-10-101 Project Reference

25-MEC-1263-10

00-10-102 Project Title

D1 Stack Height Calculation for the Specialist Composite Engineering Facility (SCEF) – Oven LEV System

00-10-103 Project Stakeholders

'The Client'	'The Client' BAE Systems (Operations) Ltd Samlesbury Aerodrome Balderstone Blackburn Lancashire BB2 7LF United Kingdom
'The Specialist Consultant'	Mechon Ltd Index House St George's Lane Ascot Berkshire SL5 4ET

00-10-104 The Site

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00-10-20 Project Documents

00-10-201 Document Summary

Document Type:
D1 Stack Height Calculation

Document Reference:
CAS25-1263-10-2001

Status:
Stage 2 - Concept Design

00-10-202 Relevant Documents

Reference	Description	Issue	Format
MEC25 2971 10 01	Fee Proposal for D1 Stack Height Calculation - SCEF	01	PDF

00-10-203 Safety Data Sheets

Reference	Description	Issue	Format
CYCOM 890 RTM	Resin System	As provided	PDF
EP2410 RTM	Resin System	As provided	PDF
HiFlow 1078-1 (Parts A & B)	Resin System	As provided	PDF
TR001X-06-H	Resin System	As provided	PDF
TR001X-06-E	Resin System	As provided	PDF
52504 RTM	Resin System	As provided	PDF
BA023	Resin System	As provided	PDF
EX1545 (Parts A & B)	Resin System	As provided	PDF

00-10-204 Other Reference Documents

Reference	Description	Issue	Format
EH40/2005	Workplace Exposure Limits (as amended)	Current	PDF
TGN D1	EA Technical Guidance Note (Dispersion) D1: Guidelines on Discharge Stack Heights for Polluting Emissions	June 1993	PDF

00-10-205 Relevant Drawings

Reference	Description	Issue	Format
N/A			

00-10-30 Introduction

00-10-301 Project Background

BAE Systems (Operations) Ltd is installing an oven within the Specialist Composite Engineering Facility (SCEF) at Samlesbury Aerodrome. The oven will be used primarily for warming resin to reduce viscosity prior to pouring, with secondary uses including part dry-back and post-cure processes.

Nederman has been appointed to design and supply the Local Exhaust Ventilation (LEV) system for the oven. The current design incorporates a discharge stack at 3 metres above the adjacent roof ridge line, resulting in an overall stack height of approximately 19.6 metres above ground level.

Concerns have been raised regarding the visual impact of the proposed stack and the structural support requirements associated with the current height. MECHON has been commissioned to undertake a D1 stack height calculation to determine whether the stack height can be reduced whilst maintaining compliant atmospheric dispersal of process emissions.

00-10-302 Scope of Assessment

This assessment is limited to:

- D1 stack height calculation for pollution dispersal in accordance with EA Technical Guidance Note D1
- Determination of the minimum compliant stack height above the roof ridge line
- Assessment based on building dimensions, discharge parameters, and emission characteristics

The following are excluded from this assessment:

- H1 screening or Air Quality Standards assessment
- Odour impact assessment
- Noise impact assessment
- Atmospheric dispersal modelling beyond D1 methodology
- COSHH assessment or workplace exposure risk assessment
- Planning application preparation or support

00-10-303 Methodology

The assessment has been undertaken in accordance with EA Technical Guidance Note (Dispersion) D1: Guidelines on Discharge Stack Heights for Polluting Emissions.

Note: TGN D1 was withdrawn by the Environment Agency in 2016 and is not the current regulatory guidance. However, it remains a useful and accepted method for calculating effective stack heights, particularly for LEV systems where detailed dispersion modelling may not be proportionate. HSE continues to accept D1 methodology for stack height determination.

00-20-10 Processes & Systems

00-20-101 Process Description

The oven will operate at temperatures up to approximately 80°C, with some resin systems requiring temperatures up to 120°C. The primary operations comprise:

- Resin Warming: Heating resin systems to reduce viscosity for pouring and processing. This is the primary use of the oven and involves temperatures typically in the range 40–80°C.
- Part Dry-Back: Drying composite parts to remove moisture prior to bonding operations.
- Post-Cure: Subjecting autoclave-cured parts to elevated temperatures for extended periods to enhance thermal performance.

00-20-102 LEV System

The LEV system has been designed by Nederman to extract process emissions from the oven during operation. Key specifications are summarised in Table 20.102.

Table 20.102 – LEV System Parameters

Parameter	Value
Volumetric Flow Rate	700 m³/h (0.194 m³/s)
Total System Pressure	1,700 Pa
Header Transport Velocity	15.85 m/s
Header/Stack Diameter	125 mm
Current Stack Height (AGL)	19.6 m
Current Height Above Ridge	3.0 m

00-30-10 Chemical Constituents Assessment

00-30-101 Material Inventory

The Client holds Safety Data Sheets for the resin systems to be processed in the oven. A comprehensive review of these SDSs has been undertaken to identify chemical constituents and their associated hazard classifications.

The resin systems reviewed include: CYCOM 890 RTM, EP2410 RTM, HiFlow 1078-1 (Parts A & B), TR001X-06-H, TR001X-06-E, 52504 RTM, BA023, and EX1545 (Parts A & B). The full chemical constituents inventory is provided in Appendix A.

00-30-102 Key Volatile Emissions

The following substances have been identified as likely to be released into the LEV extraction system during thermal curing operations, based on their volatility at process temperatures (40–120°C):

Table 30.102 Key Volatile Emissions

CAS Number	Chemical Name	Hazard	UK WEL
106246-33-7	M-CDEA (4,4'-Methylenebis(3-chloro-2,6-diethylaniline))	H413	No WEL
106264-79-3	DMTDA (Di(methylthio)toluenediamine)	H302, H317	No WEL
50-00-0	Formaldehyde (decomposition product)	H350, H341	2.5 mg/m³
80-05-7	Bisphenol A	H360F	30 mg/m³*

* STEL value; TWA is 10 mg/m³

00-30-103 Selection of Controlling Substance

For the purposes of the D1 assessment, the controlling substance must have an established UK Workplace Exposure Limit to allow derivation of the guideline concentration using the methodology in TGN D1 Section 4.3.3.

Formaldehyde has been selected as the controlling substance on the following basis:

- Clear human health hazard classification including H350 (Category 1B carcinogen), H341 (suspected mutagen), and H314 (causes severe burns)
- Established UK Workplace Exposure Limit in EH40/2005 allowing direct application of D1 methodology
- Generated as thermal decomposition product from phenol-formaldehyde novolac resins present in EP2410 and other systems
- Most stringent derived guideline concentration of substances with established WELs

00-30-104 Guideline Concentration Derivation

Per EA Technical Guidance Note D1, Section 4.3.3, where a pollutant is not listed in Table 1, the guideline concentration is derived as:

Guideline Concentration = STEL ÷ 40

For formaldehyde: UK WEL STEL = 2.5 mg/m³

Guideline Concentration (Gd) = 2.5 ÷ 40 = ***0.0625 mg/m³***

Note: A more conservative emission rate assessment has also been undertaken assuming emission at the Bisphenol A STEL level (30 mg/m³), yielding Gd = 0.75 mg/m³.

As demonstrated in Section 00-30-30, the choice of guideline concentration does not affect the final stack height result, which is governed by discharge momentum rather than pollutant emission rate.

00-30-20 Building and Stack Parameters

00-30-201 Building Dimensions

The oven is located within Building 2/220 (Two Shed) at the SCEF facility. The relevant building parameters are summarised in Table 30.201

Table 30.201 – Building Dimensions

Parameter	Value
Building Height to Ridge (H)	16.6 m
Building Width (B)	> 16.6 m (B > H)
Building Classification	Single, wide building

00-30-202 Stack Location and Geometry

The discharge stack is located on a sloped roof section of the building. Key dimensions are summarised in Table 30.202.

Table 30.202 – Stack Location Parameters

Parameter	Value
Distance from Stack to Ridge	~8 m (along roof slope)
Distance from Stack to Gully	10.2 m (along roof slope)
Total Roof Slope Length	18.2 m
Local Roof Height at Stack	~14.6 m (estimated)
Stack Clearance Above Local Roof	~5 m (at current 19.6 m design)

Note: The stack is positioned approximately 8 m from the ridge line, not at the ridge. This favourable geometry is not accounted for in the D1 methodology, which uses ridge height regardless of stack position. Detailed dispersion modelling would account for this geometry and would likely demonstrate compliance at a lower stack height.

00-30-203 Discharge Parameters

The discharge parameters for the LEV system are summarised in Table 30.203.

Table 30.203 – Discharge Parameters

Parameter	Symbol	Value
Stack Diameter	D	0.125 m
Volumetric Flow Rate	V	0.194 m^3/s
Discharge Velocity)	W	15.84 m/s
Discharge Temperature	Td	313 K (40°C)
Ambient Temperature	Ta	283 K (10°C)

00-30-30 D1 Stack Height Calculation

00-30-301 Input Parameters Summary

The input parameters for the D1 calculation are summarised in Table 30.301.

Table 30.301 – D1 Calculation Input Parameters

Parameter	Symbol	Value	Unit
Emission Rate	D	0.0058	g/s
Guideline Concentration	G_d	0.0625	mg/m³
Background Concentration	B_c	0	mg/m³
Volumetric Flow Rate	V	0.194	m³/s
Stack Diameter	d	0.125	m
Discharge Velocity	w	15.84	m/s
Discharge Temperature	T_d	313	K
Building Height to Ridge	H	16.6	m

Note: The emission rate of 0.0058 g/s is based on a conservative assumption that emissions occur at the STEL concentration level, representing worst-case abnormal conditions. In normal operation, actual emissions would be significantly lower. However, as demonstrated below, the emission rate does not affect the final result as the stack height is governed by discharge momentum.

00-30-302 Pollution Index Calculation

Per TGN D1 Section 4, the Pollution Index is calculated as:

$$P_i = 1000 \times \frac{D}{(G_d - B_c)}$$
$$= 1000 \times \frac{0.0058}{(0.0625 - 0)}$$
$$= 92.8\, m^3/s$$

00-30-303 Heat Release Calculation

Per TGN D1 Section 5.2, the heat release is calculated below where ρ = 1.2 kg/m³ (air density) and C_p = 1005 J/kg·K (specific heat capacity):

$$Q = V \times \rho \times C_p \times \frac{T_d - T_a}{10^6}$$
$$= 0.194 \times 1.2 \times 1005 \times (313 - 283) / 10^6$$
$$= 7.03\, kW = 0.007\, MW$$

The calculated heat release of 7.03 kW is below the 30 kW threshold specified in TGN D1 Section 5.4.4. Below this threshold, buoyancy effects are considered negligible and calculation of U_b does not apply. In such cases, the uncorrected stack height is determined by momentum alone, therefore U = U_m.

00-30-304 Discharge Momentum Calculation

Per TGN D1 Section 5.3, the discharge momentum is calculated as:

$$M = \frac{283}{T_d} \times V \times w$$
$$= (283/313) \times 0.194 \times 15.84$$
$$= 0.904 \times 0.194 \times 15.84$$
$$= 2.78\, m^4/s^2$$

00-30-305 Uncorrected Stack Height (Um)

Per TGN D1 Section 5.3.3, the minimum U_m based on discharge momentum is:

$$U_m(minimum) = 0.82 \times M^{0.32}$$
$$= 0.82 \times 2.78^{0.32}$$
$$= 0.82 \times 1.39$$
$$= 1.14\, m$$

The absolute minimum value of U_m for any value of M is 1 m (TGN D1 Section 5.3.4). Therefore :

$$\underline{U_m = 1.14\, m}$$

Since there is no value of U_b (heat release < 30 kW), discharge momentum dominates and therefore:

$$U = U_m = 1.14\, m$$

00-30-306 Building Height Correction

Per TGN D1 Section 5.4.4, a building correction is required if U < 2.5H. Since:

$$U = 1.14\, m < 2.5 \times H = 2.5 \times 16.6 = 41.5\, m$$

$\underline{U < 41.5\, m \therefore \text{ building correction is required}}$.

For a single, wide building (B > H), per TGN D1 Section 5.4.5, Equation 18:

$$C = H + 0.6 \times U$$
$$C = 16.6 + 0.6 \times 1.14$$
$$C = 16.6 + 0.68$$
$$C = 17.28\, m$$

00-30-307 Final Stack Height

Per TGN D1 Section 5.4.7, calculated stack height C should be rounded up to the nearest metre:

$$\underline{C = 18\, m}$$

00-30-40 Sensitivity Analysis

00-30-401 Governing Factor

The D1 calculation demonstrates that the minimum stack height is governed by discharge momentum, not pollutant emission rate. The uncorrected height U_m (1.14 m) is determined solely by the momentum parameter M, which depends on volumetric flow rate, discharge velocity, and temperature.

Even if the emission rate were reduced to zero, the minimum Um would remain at 1.14 m, giving a final stack height of 17.28 m (rounding to 18 m).

00-30-402 Building Height Sensitivity

Building height is the dominant factor in the corrected stack height calculation (C = H + 0.6U). The following table shows the sensitivity of the result to building height:

H [m]	C [m]	Rounded [m]	Note
16.0	16.68	17	Rounds to 17 m
16.2	16.88	17	Rounds to 17 m
16.4	17.08	18	Threshold
16.6	17.28	18	Base case
16.8	17.48	18	-

For C to round down to 17 m, the building ridge height would need to be confirmed as 16.3 m or less.

00-30-403 Stack Position

The stack is located approximately 8 m from the ridge line along the sloped roof. At this position, the local roof height is approximately 14.6 m, giving a clearance of approximately 5 m between the stack outlet and the roof surface at the current 19.6 m design height.

The D1 methodology does not account for stack position relative to the ridge; it uses the maximum building height (ridge) regardless of where the stack is located. This is a conservative assumption. Detailed dispersion modelling would account for the actual geometry and would likely demonstrate that the favourable stack position (8 m from ridge) provides better dispersion characteristics than assumed by D1.

00-40-10 Minimum Compliant Stack Height

00-40-101 D1 Calculation Result

Parameter	Value
Calculated Stack Height (C)	17.28 m
Minimum Compliant Stack Height (rounded up)	18 m AGL
Height Above Ridge Line	1.4 m
Current Design Height	19.6 m AGL
Potential Height Reduction	1.6 m

00-40-102 Compliance Check

The minimum compliant stack height of 18 m satisfies the following TGN D1 requirements:

- Section 6.2.2: Stack height (18 m) exceeds 3 m above ground level.
- Section 6.2.3: Stack height (18 m) exceeds uncorrected height U (1.14 m).
- Section 6.2.4: Stack height (18 m) exceeds building height (16.6 m) within 5Um distance.
- Section 6.1.1: Discharge velocity (15.84 m/s) exceeds minimum requirement of 10 m/s for heat release < 0.1 MW.

00-50-10 Conclusions and Recommendations

00-50-101 D1 Calculation Conclusions

The D1 stack height calculation demonstrates that the minimum compliant stack height for the SCEF oven LEV system is 18 metres above ground level, equating to 1.4 metres above the building ridge line.

The current design height of 19.6 m (3 m above ridge) exceeds the minimum requirement by 1.6 m. The stack height could therefore be reduced to 18 m whilst maintaining compliance with D1 methodology.

The calculation result is governed by discharge momentum, not pollutant emission rate. Even under the most conservative emission assumptions, the minimum stack height remains at 18 m due to the momentum-based correction for building effects.

00-50-102 Limitations of D1 Methodology

It is important to note that TGN D1 was withdrawn by the Environment Agency in 2016. The methodology has been superseded by detailed dispersion modelling approaches using software such as ADMS-5 and AERMOD, which are now the accepted standard for air quality assessment.

The D1 methodology has several inherent limitations that result in conservative (higher) stack height predictions:

It uses simplified worst-case meteorological assumptions rather than site-specific meteorological data. It does not account for stack position relative to the building ridge, treating all stacks as if located at the highest point. It uses a single building height correction that does not reflect complex roof geometries. It applies generic dispersion coefficients rather than site-specific terrain and roughness parameters.

00-50-103 Recommendation: Detailed Dispersion Modelling

Given the favourable stack geometry at this site (stack located 8 m from ridge, with approximately 5 m clearance above the local roof surface), detailed dispersion modelling using ADMS-5 would likely demonstrate compliance at a lower stack height than the D1 calculation suggests.

ADMS modelling would account for: the actual stack position relative to the ridge and building wake effects; site-specific meteorological conditions; the sloped roof geometry; and realistic emission scenarios based on process operating conditions.

Should the Client wish to pursue further stack height reduction, MECHON would recommend commissioning an ADMS dispersion modelling assessment. This approach is consistent with current Environment Agency guidance and would provide a more accurate and defensible basis for stack height determination than the withdrawn D1 methodology.

A preliminary assessment suggests that ADMS modelling could potentially demonstrate compliance at 17 m or lower, which would satisfy both the technical requirements for dispersion and the Client's concerns regarding visual impact and structural support.

00-60-10 Assumptions and Limitations

00-60-101 Assumptions

The following assumptions have been made in this assessment:

Building ridge height of 16.6 m has been derived from the current stack design (19.6 m) less the stated clearance above ridge (3 m). This should be verified against architectural drawings.

Background concentration has been assumed as zero. This is standard practice for D1 calculations where the site is not in an Air Quality Management Area.

Discharge temperature of 313 K (40°C) accounts for mixing of hot oven extraction air with ambient LEV intake air. Actual discharge temperature may vary depending on oven operating conditions and proportion of make-up air.

Emission rate has been calculated assuming worst-case concentration at STEL level. In normal operation, actual emissions will be significantly lower.

Building width exceeds building height (B > H), classifying it as a single, wide building for the purposes of the building correction formula.

00-60-102 Limitations

TGN D1 was withdrawn by the Environment Agency in 2016 and is not current regulatory guidance. However, it remains accepted by HSE for stack height determination and provides a conservative screening approach.

The D1 methodology does not account for the favourable stack position (8 m from ridge) at this site. Detailed dispersion modelling would provide a more accurate assessment.

This assessment addresses pollution dispersal only. Odour impact, noise impact, and other environmental assessments may be required by the local planning authority and are outside the scope of this report.

The minimum velocity requirement of 10 m/s is based on heat release. If operational conditions change such that the discharge velocity falls below this threshold, the stack height calculation would need to be revisited.

Appendix A - Material Inventory

1 Material Inventory

The following table presents the complete inventory of chemical constituents identified from Safety Data Sheets (SDS) for the resin systems to be processed. Data extracted from SDS documents for: CYCOM 890 RTM, EP2410 RTM, HiFlow 1078-1 (Parts A & B), TR001X-06-H, TR001X-06-E, 52504 RTM, BA023, and EX1545 (Parts A & B).

CAS Number	Chemical Name	Conc. (%)	Hazard Codes	Source Material(s)
106246-33-7	4,4'-Methylenebis(3-chloro-2,6-diethylaniline) (M-CDEA)	30-100	H413	CYCOM 890, EP2410, TR001X-06-H
28768-32-3	4,4'-methylenebis[N,N-bis(2,3-epoxypropyl)aniline] (TGMDA/MY721)	5-100	H317, H341, H411	EP2410, CYCOM 890
71604-74-5	m-(2,3-epoxypropoxy)-N,N-bis(2,3-epoxypropyl)aniline	10-50	H302, H317, H341, H373, H411	EP2410, TR001X-06-E
5026-74-4	p-(2,3-epoxypropoxy)-N,N-bis(2,3-epoxypropyl)aniline	10-50	H302, H317, H341, H373, H411	EP2410, CYCOM 890
1675-54-3	Bisphenol A diglycidyl ether (BADGE)	30-60	H315, H317, H319, H411	HiFlow 1078-1 Part A, 52504 RTM
9003-36-5	Phenol-formaldehyde polymer glycidyl ether (Novolac)	5-30	H315, H317, H319, H411	EP2410, HiFlow 1078-1 Part A
25068-38-6	Bisphenol A epoxy resin	30-60	H315, H317, H319, H411	HiFlow 1078-1 Part A
80-05-7	4,4'-isopropylidenediphenol (Bisphenol A)	0.1-1	H317, H318, H335, H360F	52504 RTM
106264-79-3	Di(methylthio)toluenediamine (DMTDA)	10-30	H302, H317, H400, H410	HiFlow 1078-1 Part B
19900-69-7	4,4'-Methylenebis(2,6-diisopropylaniline)	30-60	H302, H317, H373, H411	HiFlow 1078-1 Part B
16298-38-7	4,4'-Methylenebis(2-isopropyl-6-methylaniline)	10-30	H302, H317, H373, H411	HiFlow 1078-1 Part B
13680-35-8	4,4'-Methylenebis(2,6-diethylaniline)	1-10	H302, H317, H411	HiFlow 1078-1 Part B
—	Bisphenol F-epichlorohydrin resin	60-100	H315, H317, H319, H411	BA023
—	Epoxy Resin (proprietary)	10-30	H315, H317, H319	BA023
—	Cyanate Ester E	60-100	H302, H315, H319, H335, H373	EX1545 Part A
—	Epoxy (proprietary)	10-30	H302, H315, H317, H319, H411	EX1545 Part A
—	Aromatic Amine B	60-100	H302, H312, H315, H317, H319, H411	EX1545 Part B
—	Di-nonyl phenol	1-10	H319, H411	EX1545 Part B
—	Aromatic Amine E	10-30	H302, H317, H373, H411	EX1545 Part B

Note: "—" indicates proprietary formulation where CAS number not disclosed. Concentrations given as ranges per manufacturer SDS declarations.

2. Key Volatile Emissions — Substances Likely to be Released

The following substances have been identified as likely to be released into the LEV extraction system during thermal curing operations. This assessment considers:

• Volatile amine hardeners with measurable vapour pressure at cure temperatures (120–200°C)

• Thermal decomposition products from phenolic/novolac resin systems

Substances excluded: High molecular weight epoxy resins that crosslink into the cured matrix (e.g., BADGE, TGMDA) and non-volatile polymeric components.

CAS Number	Chemical Name	Conc. (%)	Hazard Codes	UK WEL/STEL	Notes
106246-33-7	4,4'-Methylenebis(3-chloro-2,6-diethylaniline) (M-CDEA)	30–100	H413	No UK WEL	DNEL: 0.625 mg/m³
106264-79-3	Di(methylthio)toluenediamine (DMTDA)	10–30	H302, H317, H400, H410	No UK WEL	No published DNEL
50-00-0	Formaldehyde	Decomp.	H301, H311, H314, H317, H341, H350	TWA: 2.5 mg/m³, STEL: 2.5 mg/m³	Carcinogen (1B)
108-95-2	Phenol	Decomp.	H301, H311, H314, H341	TWA: 7.8 mg/m³, STEL: 16 mg/m³	Sk notation
Various	Other methylenedianiline derivatives	10–60	H302, H317, H373, H411	No UK WEL	Use M-CDEA DNEL

3. Selection of Controlling Substance

For the purposes of the D1 assessment, the controlling substance must have an established UK Workplace Exposure Limit to allow derivation of the guideline concentration using the methodology in TGN D1 Section 4.3.3.

M-CDEA (CAS 106246-33-7) — Although the most prevalent volatile constituent, M-CDEA carries only H413 (environmental hazard — harmful to aquatic life). It does not have human health inhalation hazard classifications and has no UK Workplace Exposure Limit. While a DNEL of 0.625 mg/m³ exists, applying the D1 methodology (1/40 of STEL) to a DNEL is not methodologically appropriate.

Formaldehyde (CAS 50-00-0) — Selected as the controlling substance for D1 calculation on the following basis:

- Clear human health hazard classification including H350 (Category 1B carcinogen), H341 (suspected mutagen), and H314 (causes severe burns)
- Established UK Workplace Exposure Limit in EH40/2005 allowing direct application of D1 methodology
- Generated as thermal decomposition product from phenol-formaldehyde novolac resins present in EP2410 and other systems

- Most stringent derived guideline concentration of substances with established WELs

4. UK Workplace Exposure Limit

Per EH40/2005 (current GB edition), the UK WEL for formaldehyde is:

- 8-hour TWA: 2 ppm (2.5 mg/m³)
- 15-minute STEL: 2 ppm (2.5 mg/m³)

Note: The UK did not adopt the revised EU limit of 0.3 ppm (0.37 mg/m³) introduced under EU Directive 2019/130, as the implementation date fell after the end of the Brexit transition period. This was confirmed in Parliamentary Written Question HL3278 (October 2021).

5. Guideline Concentration Derivation

Per EA Technical Guidance Note D1, Section 4.3.3, where a pollutant is not listed in Table 1, the guideline concentration is derived as:

$$Guideline\ Concentration = STEL \div 40$$

Substance	CAS Number	UK WEL STEL	D1 Guideline Conc.	Derivation
Formaldehyde	50-00-0	2.5 mg/m³	0.0625 mg/m³	STEL ÷ 40

The D1 guideline concentration for formaldehyde is therefore 0.0625 mg/m³ (62.5 µg/m³).

This value will be used as the benchmark concentration for the D1 stack height calculation to determine the minimum compliant discharge height for adequate atmospheric dispersion.