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Arrow Bio Waste Recycling Facility

Deeside SPV

Air Quality Assessment

April 2026

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1 Introduction

Background and Scope

1.1 Rappor Consultants Limited was commissioned by Deeside SPV to undertake detailed air quality dispersion modelling to support a bespoke Environmental Permit (EP) application for a proposed anaerobic digestion (AD) facility at Arrow Bio Waste Recycling Facility, Weighbridge Road, Deeside, CH5 2LL (the 'Facility').

1.2 The proposals consist of the construction and operation of a waste facility for the management of municipal, commercial and industrial waste, comprising: a waste reception hall with ground level tipping area, sorting hall with associated equipment for separation and processing, a refused (sic) derived fuel (RDF) hall, control room, electrical room and workers facilities, anaerobic digestion tank farm and associated infrastructure.

1.3 This report responds to the Natural Resources Wales (NRW) request for additional information provide in their Non-Material Amendment letter (ref: PAN-028894) which sets out the following requirements:

- The Air Quality report is based on a single Combined Heat and Power (CHP) unit when the application submitted proposes 3no. CHP units. We are also mindful that as time has passed the engine proposed may have changed so this should also be considered.
- The Air Quality report is based on the CHP using biogas as a fuel and does not consider that the CHPs in the application are proposed to be dual fuel (with flexibility to use diesel). The Air Quality impacts from using diesel should be considered by the impact assessment.
- The Air Quality Impact Assessment should consider the backup diesel generators if they are over 1 MWth (and therefore Medium Combustion Plants in their own right)
- The Air Quality Impact Assessment should consider the impact of burning the biogas in the flare.

1.4 It is understood the biogas produced during the AD process will be upgraded to biomethane and injected into the gas transmission grid. A proportion of biomethane will be combusted on site to provide electricity and heat to the process via a series of CHP units,

1.5 While the original application allowed for dual-fuel operation, the current proposal confirms that the CHP units and boiler will operate on biomethane only, with no diesel capability. Diesel use is limited to a 200 kW emergency generator operating for <50 hours/year. An emergency biogas flare is also proposed which will operate during periods of abnormal gas production, breakdown or maintenance.

1.6 The objective of the assessment is to quantify the impacts of proposed combustion sources under worst case operations conditions and to assess compliance with relevant environmental quality standards for the protection of human health and ecological receptors.

1.7 The assessment has been undertaken in accordance with the Environment Agency's (EA) environmental permitting guidance, as applied by NRW.

Site Location

1.8 The facility is located at approximate National Grid Reference (NGR): 331105, 371240, located off Weighbridge Road, Deeside and lies within Flintshire County Council's (FCC) area of administration. The application site is surrounded by existing industrial and commercial premises within the Deeside Industrial Park, including various manufacturing and waste management facilities. To the west of the site beyond the M53 lies the closest residential receptors. The surrounding area of the site includes the following features:

- The A548 and A494 to the north and east;
- River Dee to the south;
- A variety of human receptors including residential dwellings across the towns of Connah's Quay, Shotton and Queensferry and Garden City; and
- Ecological designations including Special Areas of Conservations (SAC), Special Protection Areas (SPA) and Sites of Special Scientific Importance (SSSI).

1.9 There are no Air Quality Management Areas (AQMA) declared within the jurisdiction of the North Wales Authorities, with the closest designation located in Chester 10 km to the east.

1.10 **Figure 1** shows the site location and surrounding environment.

Figure 1 Site Location

2 Guidance and Environmental Standards

2.1 The Air Quality Assessment has been prepared in accordance with the following industry-standard guidance documents:

- Local Air Quality Management Technical Guidance 2022 LAQM (TG22), DEFRA, 2022[1];
- Air emissions risk assessment for your environmental permit, EA, updated 21 July 2025[2];
- Environmental permitting: air dispersion modelling reports, EA, updated 26 March 2024[3]; and
- Specified generators: dispersion modelling assessment, EA, updated 27 March 2023[4].

Air Quality Standards

2.2 The modelling assessment will be undertaken against relevant long-term and short-term environmental standards collective termed Environmental Quality Standards (EQS). Those applicable to this assessment are summarised in Table 1 with relation to human health receptors.

Table 1 Environmental Quality Standards for Human Exposure

Pollutant	Environmental Quality Standards	
	Concentration (µg/m³)	Averaging Periods
Nitrogen dioxide (NO_2)	40	Annual mean, not to be exceeded
	200	1-hour mean; not to be exceeded more than 18 times a year
Sulphur Dioxide (SO_2)	125	24-hour mean; not to be exceeded more than 3 times a year
	350	1-hour mean; not to be exceeded more than 24 times a year
	266	15-min mean; not to be exceeded more than 35 times a year
Total Volatile Organic Compounds (TVOC)*	5	Annual limit
	30	24-hour mean limit

**TVOC emission profile assumed to consist entirely of Benzene (C_6H_6)*

2.3 Carbon monoxide (CO) has been scoped out of the assessment, as there is no applicable MCPD emission limit value and emissions from the proposed facility are expected to be minimal and unlikely to result in significant increases in CO concentrations at sensitive

[1] Local Air Quality Management Technical Guidance 2022 LAQM (TG22), DEFRA, August 2022.
[2] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit - Accessed 14/04/2026
[3] https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports - Accessed 14/04/2026
[4] https://www.gov.uk/guidance/specified-generators-dispersion-modelling-assessment - Accessed 14/04/2026

human receptors. **Table 2** presents the guidance set out in LAQM.TG22[1] on the locations where EQSs apply.

Table 2 Where EQS Apply

Averaging Period	Objectives Should Apply At	Objectives Should Not Apply At
Annual mean	All locations where members of the public might be regularly exposed Building façades of residential properties, schools, hospitals, care homes etc.	Building facades of offices or other places of work where members of the public do not have regular access Hotels, unless people live there as their permanent residence Gardens of residential properties Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
24-hour and 8 hour mean	As above together with hotels, and gardens of residential properties	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
1-hour mean	As above, kerbside sites (for example, pavements of busy shopping streets), parts of car parks, bus stations and railway stations etc. which are not fully enclosed, and any location where members of the public might reasonably be expected to spend one hour or more	Kerbside sites where the public would not be expected to have regular access

Ecological Critical Levels and Loads

2.4 The assessment of impacts upon ecological designations will be undertaken in accordance with the NRW guidance[2]. Predicted impacts will be compared against appropriate Critical Loads (CLo) for nutrient nitrogen and acid deposition and Critical Levels (CLe) obtained from the UK Air Pollution Information System (APIS)[5].

2.5 **Table 3** presents the CLes considered within this assessment. CLes relate to pollutant concentrations in the atmosphere. CLos used in this assessment are detailed in **Table 19** which refers to deposition of pollutants.

Table 3 Critical Levels for the Protection of Vegetation

Pollutant	Critical Level	
	Concentration (µg/m³)	Averaging Periods
NO_X	30	Annual mean
	200	24-hour mean
SO_2	10	Annual mean

5 https://www.apis.ac.uk/app - Accessed 09/04/2026

3 Methodology

Dispersion Modelling Inputs

3.1 ADMS 6 (v6.0.0.1) which is developed by Cambridge Environmental Research Consultants (CERC) Ltd was used to predict pollutant concentrations in the vicinity of the facility to allow comparison against relevant impact significance criteria.

3.2 The modelling software is widely accepted across the industry by consultant, local authorities and NRW. The software utilises hourly meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology and calculates user-selected long-term and short-term averages.

Emission Sources

3.3 The following sources have been considered in the assessment and reflect the proposed on-site combustion sources:

- Combined Heat and Power (CHP) Engine 1 Stack;
- CHP Engine 2;
- CHP Engine 3;
- Standby Boiler; and
- High Temperature Emergency Biogas Flare.

3.4 A 200 kW emergency diesel generator will operate infrequently, for a maximum of 50 hours per year, during emergency scenarios arising from system failure or abnormal gas production. Given the limited operating schedule and the generators thermal input below 1 MW impacts, air quality associated with the emergency generated are considered insignificant and were not assessed further.

3.5 The client has confirmed that emissions associated with the biogas upgrading plant will comprise of 97% methane (CH_4), 2.5% CO, and trace amounts of N_2 and O_2. Given the nature of the gas composition impacts associated with the biogas upgrading process are not anticipated to be significant and have therefore been scoped out of the assessment.

3.6 Table 4 details the identifiers and location of the modelled emission sources. Specific identifiers have been assigned to each emission source for the purposes of this Air Quality Assessment. These identifiers may be subject to change following determination of the application.

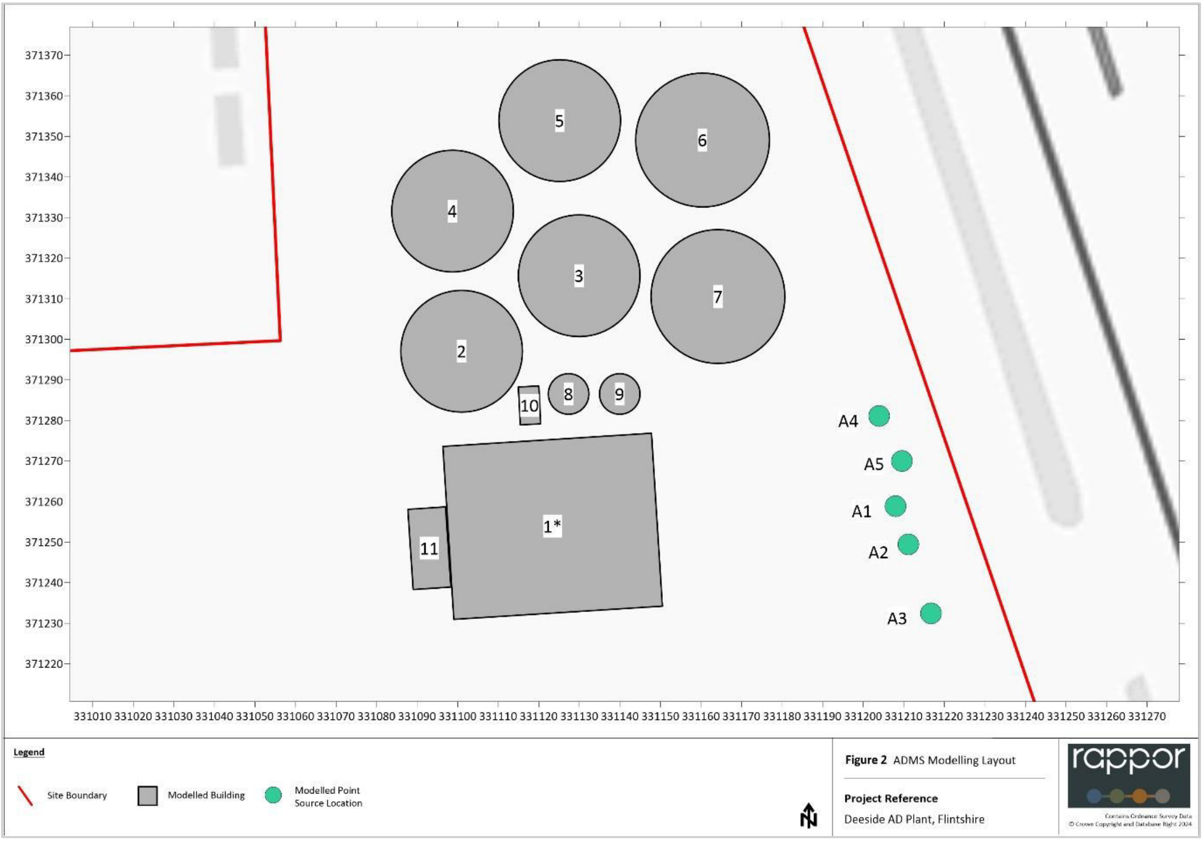
Table 4 Combustion Stack Locations

Identifier		NGR	
		X	Y
A1	CHP Engine 1 - MTU16V4000GS	331208.0	371258.9
A2	CHP Engine 2 - MTU12V4000GS	331211.1	371249.4
A3	CHP Engine 3 - MTU12V4000GS	331216.7	371232.4
A4	Boiler – Viessmann Vitoplex 200	331209.5	371270.0
A5	High Temperature Biogas Flare	331203.9	371281.1

3.7 Emission sources A1-A3 are expected to operate continuously, except during maintenance and planned shutdown. Sources A4 and A5 will operate during emergency conditions. Further information is provided in Section 3.15.

3.8 Figure 2 provide a map of the modelled combustion sources.

Figure 2 ADMS-6 Modelling Inputs



Modelling Inputs

3.9 Relevant pollutant species and averaging periods considered in the assessment are summarised in **Table 5**. Unless stated modelled pollutant species and average periods relate to human exposure.

Table 5 Pollutants Modelled

Pollutant	Modelled As	
	Long Term	Short Term
NO_2	Annual mean	99.79th percentile (%ile) 1-hour mean
NO_x	Annual mean	24-hour mean
SO_2	-	99.9%ile 15-minute mean
	-	99.73%ile 1-hour mean
	-	99.18%ile 24-hour mean
	Annual mean	-
TVOC as Benzene	Annual mean	-
	24-hour mean	-
Nitrogen Deposition	Annual mean	-
Acid Deposition	Annual mean	-

Process Conditions

3.10 Process conditions for emission sources A1 to A3 were obtained from the provided technical datasheets for the proposed Rolls Royce engines (MTU16V4000GS and MTU12V4000GS), and A4 from the Viessmann (Vitoplex 200) technical datasheet. Copies of the datasheets are provided in Appendix B. Process conditions for source A5 were supplied directly by the client.

3.11 **Table 6** provides a summary of the stack parameters for each emission source.

Table 6 Process Stack Conditions

Parameter	Unit	A1	A2	A3	A4	A5
Thermal Inputs	MWth	2.2	1.5	1.5	1.1	-
Stack height	m	10.7	10.7	10.7	10.0	8.5
Stack diameter	m	0.51	0.41	0.41	0.35	1.58
Volumetric flow (wet)	Nm^3/h	8,393(a)	6,404(a)	6,404(a)	2,438(b)	-
Volumetric flow	m^3/s	6.02	4.53	4.53	0.67	4.80(c)
Flue gas efflux velocity	m/s	29.69	34.97	34.97	7.05	2.45
Temperature	˚C	432	422	422	180	1,000(d)
Moisture Content	%	10.5(e)	10.2(e)	10.2(e)	11.0(d)	11.0(d)
Oxygen Content	%	9.0(d)	9.0(d)e	9.0(d)	9.0(d)	14.0(d)

a standard pressure, 0°C
b Based on provided flue gas mass flow rate assuming flue gas density of 0.747 kg/m^3 at 180°C
c Provided by operator
d Assumption based on typical operating values
e CHP flue gas moisture content from provided dry and wet flue gas volume flows.

Emissions

3.12 Emission concentrations for source A1 to A3 are based on the maximum Emission Limit Values (ELVs) specified in Annex II, Part 2, Table 2 of MCP regulations. Source A4 are based on the same approach, however values were taken from Annex II, Part 2, Table 1. ELVs associated with sources A5, were obtained from the EA's statutory guidance[6].

3.13 Emission concentrations detailed in **Table 7** are referenced at STP. Emissions from source A1 to A3 are expressed as dry gas at 15% oxygen, source A4 as dry gas at 3% O2, and source A5 as dry gas at 5% O2.

Table 7 Emission Limit Values

Pollutant	Emission Concentrations (Nmg/m^3)				
	A1[(a)]	A2[(a)]	A3[(a)]	A4[(b)]	A5[(c)]
NO_x (as NO_2)	190	190	190	200	500
SO_2	15	15	15	35	107
CO	-	-	-	-	1,400
TVOC (as Benzene)	-	-	-	-	1,000

a. *For engines and gas turbines burning gaseous fuel other than natural gas.*
b. *For MCPD other than engines and gas turbines burning gaseous fuel other than natural gas.*
c. *SR2021 No 6: Maximum stated ELV for plant burning biogas*

3.14 The mass emissions rates summarised in **Table 8** were calculated to using volume flow rates summarised in **Table 6** and ELVs in **Table 7**.

Table 8 Emission Rates

Pollutant	Emission Rate (g/s)				
	A1	A2	A3	A4	A5
NO_x (as NO_2)	0.79	0.61	0.61	0.05	0.23
SO_2	0.06	0.05	0.05	0.01	0.05
TVOC (as Benzene)	-	-	-		0.45

Time Varied Emissions

3.15 The operator has confirmed that sources A1 to A3 will operate continuously for 8,760 hours per year. Sources A4 and A5 will operate less frequently during periods of abnormal gas production, breakdown or maintenance and if the CHP units are offline. To provide a robust assessment, annual operating hours were assumed as 730 hours per year to capture extended maintenance and abnormal operation events.

Terrain Data

3.16 Areas of complex terrain have potential to affect the dispersion of pollutants which vary dependent on the height and location of modelled emission sources. Ordnance Survey Landform Panorama terrain data was pre-processed within the ADMS-6 model and covers the facility and surrounding receptor locations.

[6] SR2021 No 6: Anaerobic digestion facility, including use of the resultant biogas – installations, 26th February 2026.

Building Effects

3.17 Buildings can influence the dispersion of pollutant and may lead to increases to ground level concentrations.

3.18 Buildings within 5L of the stack (35 m), where L is the lesser of either the building height or the maximum projected width, or that have a height of more than 40% of the stack (4.0 m) have been included in the dispersion model. This approach follows the principals set out in EA guidance[4] and summarised in **Table 9**.

Table 9 Building Geometries

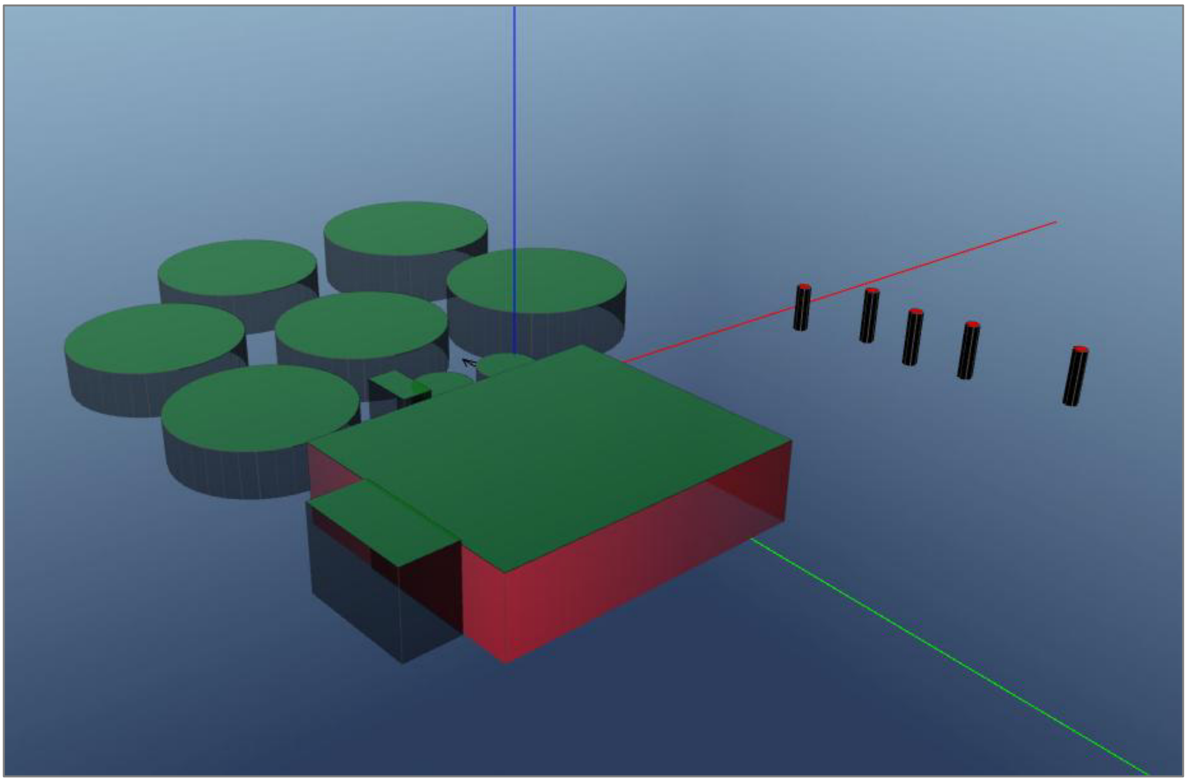
Building		NGR (m)		Height (m)	Width or Diameter (m)	Length (m)	Angle (°)
		X	Y				
1	Fermenter 1	331101.0	371297.1	8.0	30.0	-	-
2	Fermenter 2	331130.0	371315.7	8.0	30.0	-	-
3	Fermenter 3	331098.7	371331.6	8.0	30.0	-	-
4	Post Fermenter	331125.2	371353.9	8.0	30.0	-	-
5	Digestate Storage 1	331160.4	371349.1	10.0	33.0	-	-
6	Digestate Storage 2	331164.2	371310.5	10.0	33.0	-	-
7	Pre Storage Tank 1	331127.3	371286.5	8.0	10.0	-	-
8	Pre Storage Tank 2	331140.0	371286.5	8.0	10.0	-	-
9	Process Building	331123.4	371253.9	13.2	42.7	51.5	176.4
10	Quarantine Tanks	331117.7	371283.7	12.0	9.3	5.0	177.1
11	Abatement System	331093.0	371248.5	14.0	19.8	9.3	176.2

Building heights were provided by the operator

3.19 Reference should be made to **Figure 2** for a graphical representation of the modelled building layout.

3.20 A three-dimensional representation of the building layout is provided in **Figure 3**.

Figure 3 3D Model Layout



Meteorological Data

3.21 Hourly sequential data used in this assessment was taken from Hawarden meteorological station, located 8 km southeast of the facility. Both sites are located within similar rural contexts and share comparable topographies. The choice of this parameter therefore provides a suitable representative of meteorological conditions across the modelled domain.

3.22 Maximum emissions across the five years of meteorological data (2018 - 2022) were assessed to ensure a worst-case assessment. All meteorological data was provided by ADM Ltd. Figure 4 shows the meteorological wind roses.

Figure 4 Wind Roses

Meteorological Parameters

3.23 The roughness length and Monin Obukhov values assigned within the ADMS-6 model are summarised in **Table 10**

Table 10 Meteorological Parameters utilised in Modelling

Location	Roughness Length (m)	Monin-Obukhov length (m)	Description
Site	0.5	30	Parkland Open Suburbia and Mixed Urban and Industrial
Meteorological Station	0.3	10	Agricultural Max and Small Towns

Assessment Extents

3.24 Ambient concentrations were modelled over a 10 km x 10 km area using a nested grid with variable resolutions and distances. The grid comprises the following spacing:

- 5m resolution - within 200 m of the facility;
- 25 m resolution - within 400 m of the facility;
- 50 m resolution - within 1,000 m of the facility;
- 250 m resolution - within 2,000 m of the facility; and
- 500 m resolution - within 5,000 m of the facility.

3.25 Results were subsequently used to produce contour plots within the Surfer visualisation software package.

Sensitive Receptors

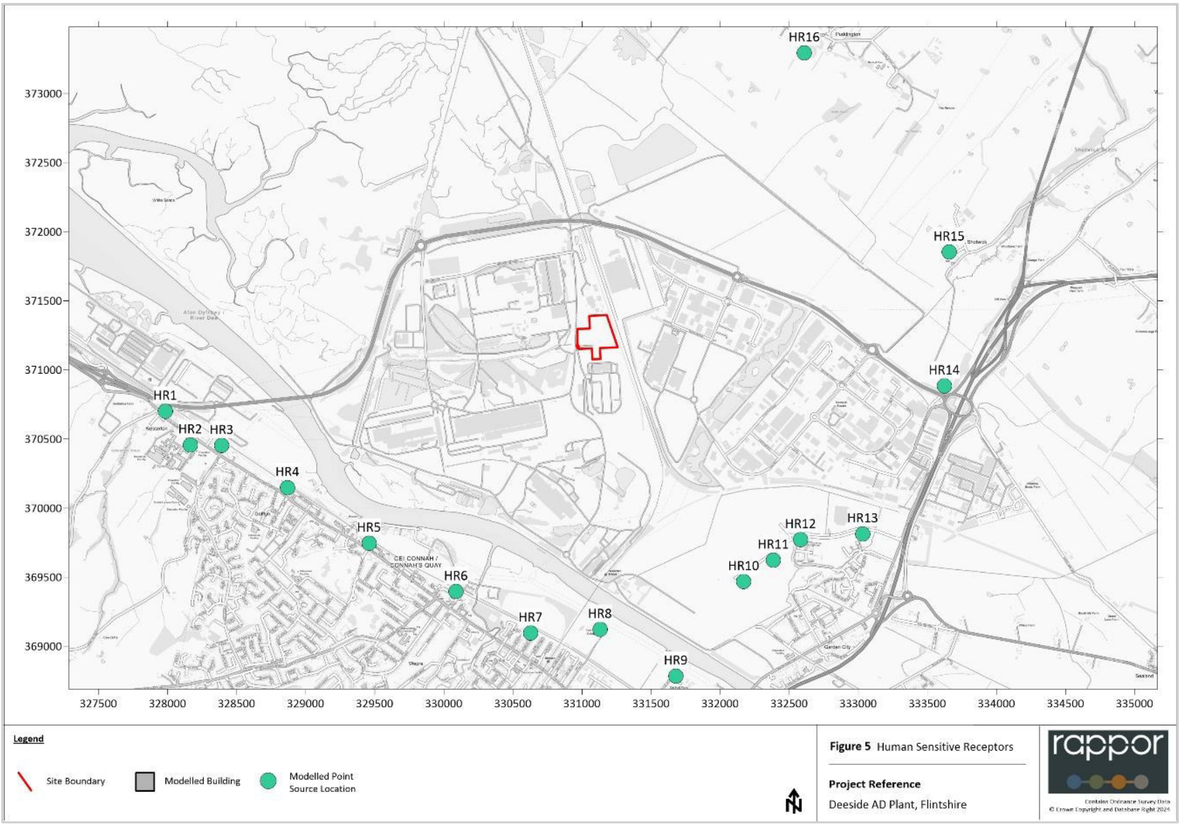
3.26 A sensitive receptor is defined as any location which may be affected by changes in air quality. A desk-top study was undertaken in order to identify sensitive receptor locations which require a detailed assessment. Identified receptors were modelled at the minimum height of relevant exposure, 1.5 m for human receptors and 0 m for ecological receptors.

3.27 Modelled human receptors are summarised in **Table 11** and illustrated in **Figure 5**.

Table 11 Sensitive Human Receptors

Receptor		NGR		Distance from Facility (m)
		X	Y	
HR1	Kelsterton Road	327983.0	370701.0	3,206
HR2	Deeside College	328165.0	370457.0	3,081
HR3	Kelsterton Road	328392.0	370453.0	2,864
HR4	Church Street	328867.5	370148.0	2,530
HR5	High Street	329459.0	369746.0	2,262
HR6	St David Court	330087.7	369395.4	2,141
HR7	Salisbury Street	330627.9	369095.8	2,224
HR8	Shotton Sports Club	331130.1	369121.5	2,139
HR9	Hurlbutts Drive	331678.7	368784.1	2,534
HR10	John Summers Way	332170.3	369468.1	2,067
HR11	John Summers Way	332385.2	369622.6	2,057
HR12	Rollason Grove	332582.5	369772.3	2,072
HR13	Bayley Road	333032.5	369813.1	2,382
HR14	Green Lane West	333622.6	370884.0	2,511
HR15	Vicarage Lane	333657.8	371852.7	2,587
HR16	Old Hall Lane	332608.9	373294.1	2,509

Figure 5 Human Receptor Locations



Ecological

3.28 NRW guidance[2] states that conservation sites need only be considered where they fall within the following distances:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or RAMSAR sites within 10 km of the installation; and
- Site of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs), Local Nature Reserves (LNRs), Local Wildlife Site (LWS) and Ancient Woodlands (AW) within 2 km of the location.

3.29 A desk top study was undertaken using the Multi-Agency Geographic Information for the Countryside (MAGIC)[7] to identify statutory and locally designated sites within the distances stated above. The study confirmed several SPAs, SACs or RAMSAR sites within 10 km and several SSSIs with 2km of the facility. No Ancient Woodlands were identified in the distances. Identified designations are summarised in **Table 12** and **Figure 6**.

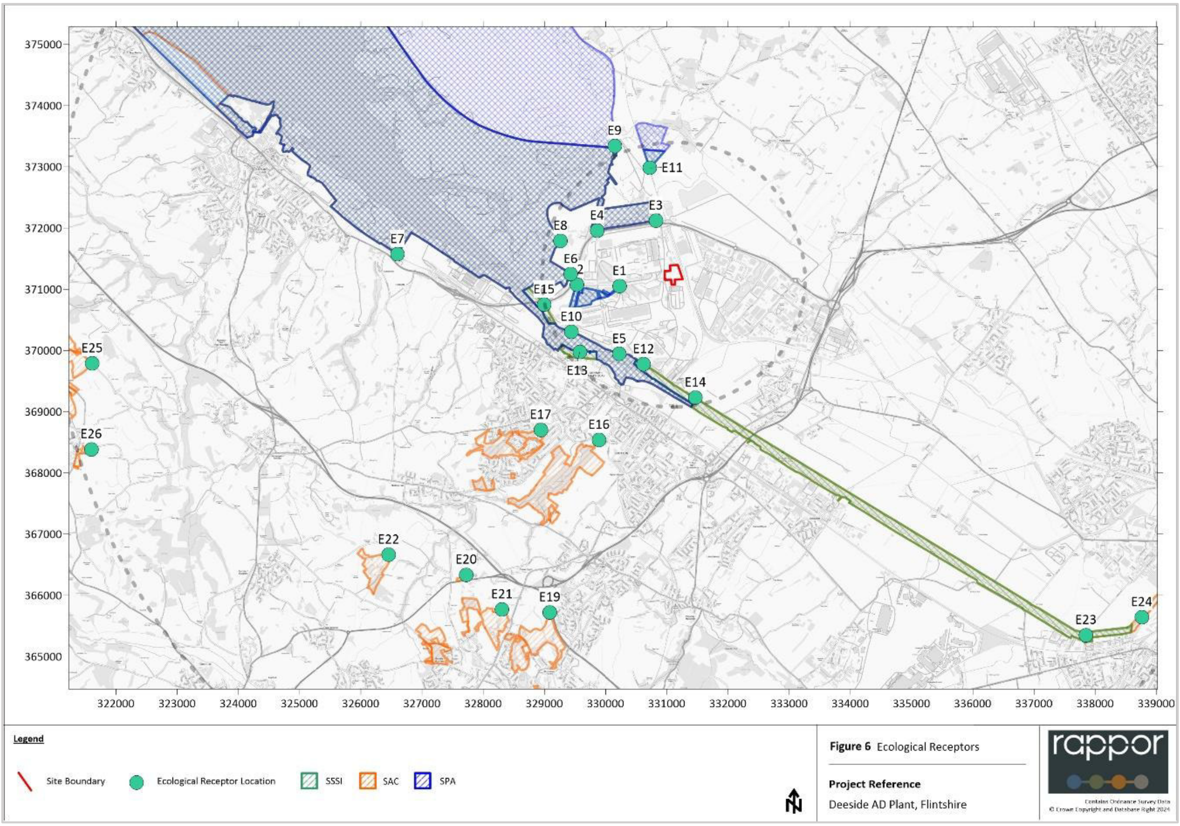
Table 12 Sensitive Ecological Receptors

Receptor		NGR		Distance from Facility (m)
		X	Y	
ER1	Dee Estuary SPA	330227.9	371051.6	936
ER2	Dee Estuary SPA	329531.0	371073.0	1,620
ER3	Dee Estuary SAC	330822.3	372120.9	917

[7] https://magic.defra.gov.uk/MagicMap.html - Accessed 09/04/2026

Receptor		NGR		Distance from Facility (m)
		X	Y	
ER4	Dee Estuary SAC	329861.0	371958.0	1,457
ER5	Dee Estuary SAC	330224.0	369943.0	1,604
ER6	Dee Estuary SAC	329430.0	371247.0	1,710
ER7	Dee Estuary SAC	326599.3	371573.3	4,551
ER8	Dee Estuary SAC	329263.0	371790.0	1,950
ER9	Dee Estuary SAC	330148.0	373343.0	2,307
ER10	Dee Estuary SAC	329439.0	370304.0	1,951
ER11	Dee Estuary SAC	330722.0	372985.0	1,775
ER12	River Dee and Bala Lake SAC	330622.0	369775.0	1,573
ER13	River Dee and Bala Lake SAC	329577.0	369974.0	2,024
ER14	River Dee and Bala Lake SAC	331468.5	369229.6	2,057
ER15	River Dee and Bala Lake SAC	328996.0	370750.0	2,204
ER16	Connah's Quay SSSI/SAC	329892.5	368538.8	2,994
ER17	Connah's Quay SSSI/SAC	328940.0	368703.0	3,373
ER18	Deeside and Buckley SAC	329089.2	365721.2	5,906
ER19	Deeside and Buckley SAC	329089.2	365721.2	5,906
ER20	Deeside and Buckley SAC	327724.0	366335.0	5,994
ER21	Deeside and Buckley SAC	328306.6	365769.3	6,179
ER22	Deeside and Buckley Newt Sites SAC	326455.0	366663.0	6,564
ER23	River Dee and Bala Lake SAC	337849.0	365350.0	8,941
ER24	Dee Estuary SPA	338760.0	365643.0	9,467
ER25	Halkyn Mountains SAC	321612.0	369788.0	9,641
ER26	Halkyn Mountains SAC	321597.2	368386.0	9,966

Figure 6 Ecological Receptor Locations



3.30 Details of baseline conditions at modelled receptor are summarised in Section 4.

Modelling Conversions

NOx to NO_2

3.31 Predicted ground level NO_X concentrations were converted to NO_2, based upon following factors provided in the NRW guidance[2]:

- 50% for short-term average concentrations; and
- 100% for long-term average concentrations.

15-minute Sulphur Dioxide Concentration Predictions

3.32 Throughout the assessment, 15-minute mean SO_2 concentrations have been calculated using the following correction factor based upon empirical relationships with the 99.9th percentile of 1-hour means, as described in NRW guidance:

- 99.9^{th} percentile of 15-minute means = 1.34 x 99.9^{th} percentile of 1-hour means

Deposition Rates

3.33 Deposition rates were calculated using the conversion factors provided within EA document 'Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06. Predicted pollutant concentrations were multiplied by the relevant deposition velocity and conversion factor to calculate the speciated dry deposition flux. The conversion factors used are presented within **Table 13**.

Table 13 Conversion Factors to Determine Dry Deposition Flux

Pollutant	Grassland Deposition Velocity (m/s)	Forest Deposition Velocity (m/s)	Conversion Factor (μg/m²/s to kg/ha/yr)	Conversion Factor (μg/m²/s to keq/ha/yr)
NO_2	0.0015	0.003	96	6.84
SO_2	0.012	0.024	157.7	9.84

3.34 Predicted ground level pollutant concentrations were converted to kilo-equivalent ion depositions (keq/ha/yr) for comparison with the critical load for acid deposition at each of the identified ecological receptors. The standard conversion factors are shown in **Table 14**.

Table 14 Conversion Factors to Units of Equivalents

Pollutant	Conversion Factors from kg/ha/yr to keq/ha/yr
NO_2	0.07143
SO_2	0.06250

Assessment Criteria and Significance of Impacts

3.35 Guidance for assessing the significance of emissions impacts from point sources are also given in the NRW guidance[4]. Predicted pollutant concentrations are summarised in the following formats:

- Process contribution (PC) - Predicted pollutant concentration as a result of emissions from the site only; and
- Predicted environmental concentration (PEC) - Total predicted pollutant concentration as a result of emissions from the site and existing baseline levels.

Initial Screening Stage

3.36 The significance of predicted impact was assessed in accordance with guidance criteria which states that PCs can be considered insignificant if:

- the long-term PC is less than 1% of the long-term environmental standard; and
- the short-term PC is less than 10% of the short-term environmental standard.

3.37 If both criteria are met predicted impacts can be considered insignificant and no further analysis is required. Exceedances of the 1% or 10% threshold does directly correspond to significant risk or adverse harm.

Second Screening Stage

3.38 If the above criteria are not met, then a second stage of screening is required to determine the impact of the PEC:

- The long-term PEC is less than 70% of the long-term environmental standards; and
- The short-term PC is less than 20% of the short-term environmental standards minus twice the long-term background concentration.

3.39 If both criteria are met during the second stage of screening, then predicted impacts can be considered insignificant. Should these criteria be exceeded then the PEC should be checked against the EQS.

Ecological Screening

3.40 If emissions that affect ecological designations meet both of the following criteria outlined within the NRW guidance[4] can be considered insignificant:

- the short-term PC is less than 10% of the short-term environmental standard for protected conservation areas; and
- the long-term PC is less than 1% of the long-term environmental standard for protected conservation areas.

3.41 If the predicted long-term PC is greater than 1% and the PEC is less than 70% of the long-term environmental standard, the emissions can be considered insignificant. Should the predicted PEC be greater than 70% of the long-term environmental standard, the PEC should be checked against the EQS for the ecological receptor.

3.42 Should the assessment criteria be exceeded, this does not directly indicate that the facility would give rise to significant adverse effects at the designated sites, rather it cannot be immediately screened as insignificant. A suitably qualified ecologist should determine whether predicted effects on air quality would result in a significant effects.

Modelling Uncertainties

3.43 Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- Model uncertainty - due to model limitations;
- Data uncertainty - due to errors in input data, including emission concentration estimates, operational procedures, land use characteristics and meteorology; and
- Variability - randomness of measurements used.

3.44 The analysis of maximum emissions across the five years of meteorological data (2018 - 2022) provides sensitivity analysis which sufficiently accounts for variations in modelled predictions from year to year. Additionally, worse case assumptions regarding the application of emission rates within the model also minimise potential uncertainties.

3.45 The application of maximum ELV concentrations as well as the concurrent and continuous operation of all pollutant sources minimises potential uncertainties. As such, a sufficient degree of confidence can be placed in the results.

3.46 It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in an acceptable model accuracy.

Assumptions

3.47 The following assumptions were made during the dispersion modelling:

- Concurrent operation for emission sources A1 to A3;

- All combustion sources assumed at 100% loading;
- Emission sources A4 to A5 operational for a maximum of 730 hours per year;
- Maximum permitted emission concentrations were applied to all emission sources and likely to provide an overestimation of actual conditions; and
- In accordance with the NRW guidance it was assumed that the entire TVOC emissions consisted of C_6H_6 (benzene) given that the proportions of individual species are unknown. However, It is anticipated that benzene emissions would represent a much smaller proportion of the total TVOC content.

3.48 A review of the NRW Public Register has identified the presence of several proposed or recently consented industrial activities within the assessment extents. However, given the complex nature of surrounding developments, NRW is currently developing a consistent methodology for the assessment of in-combination effects. As such, at the time of preparing this assessment, it is understood that no further action is required in respect of an in-combination air quality assessment.

Dispersion Modelling Report Requirements

3.49 **Table 15** provides the checklist of dispersion modelling report requirements.

Table 15 Dispersion Modelling Report Requirements

Item	Location within Report
Location map	Figure 1
List of pollutants modelled and relevant guidelines	Table 1, Table 3
Details of modelled scenarios	Table 5
Details of relevant ambient concentrations used	Section 4
Model description and justification	Section 3.1
Table of emission parameters used	Table 6, Table 7, Table 8
Details of modelled domain and receptors	Table 11, Table 12
Details of meteorological data used	Section 3.21, Figure 4
Details of terrain treatment	Section 3.16
Details of building treatment	Section 3.17, Table 9

4 Baseline Conditions and Sensitive Receptors

Baseline

4.1 Existing air quality conditions in the vicinity of the installation were identified in order to provide a baseline for assessment. These are detailed in the following sections.

Local Air Quality Management

4.2 As required by the Environment Act (1995), Flintshire County Council has undertaken regular Review and Assessment of air quality within its area of administration. This process has identified that no pollutant concentrations are currently exceeding the respective Air Quality Objectives (AQOs). Consequently, no Air Quality Management Areas (AQMAs) have been declared within the county. The nearest declared AQMA is located within Chester City Centre, approximately 10 km southwest of the facility.

Local Air Quality Monitoring

4.3 Monitoring of pollutant concentrations is undertaken by Flintshire throughout their areas of administration. A review of the most recent North Wales Air Quality Status Report[8] identified several NO_2 diffusion tubes close to the facility. Monitored concentrations from 2024 are summarised in **Table 16**.

Table 16 Monitoring Locations and Results

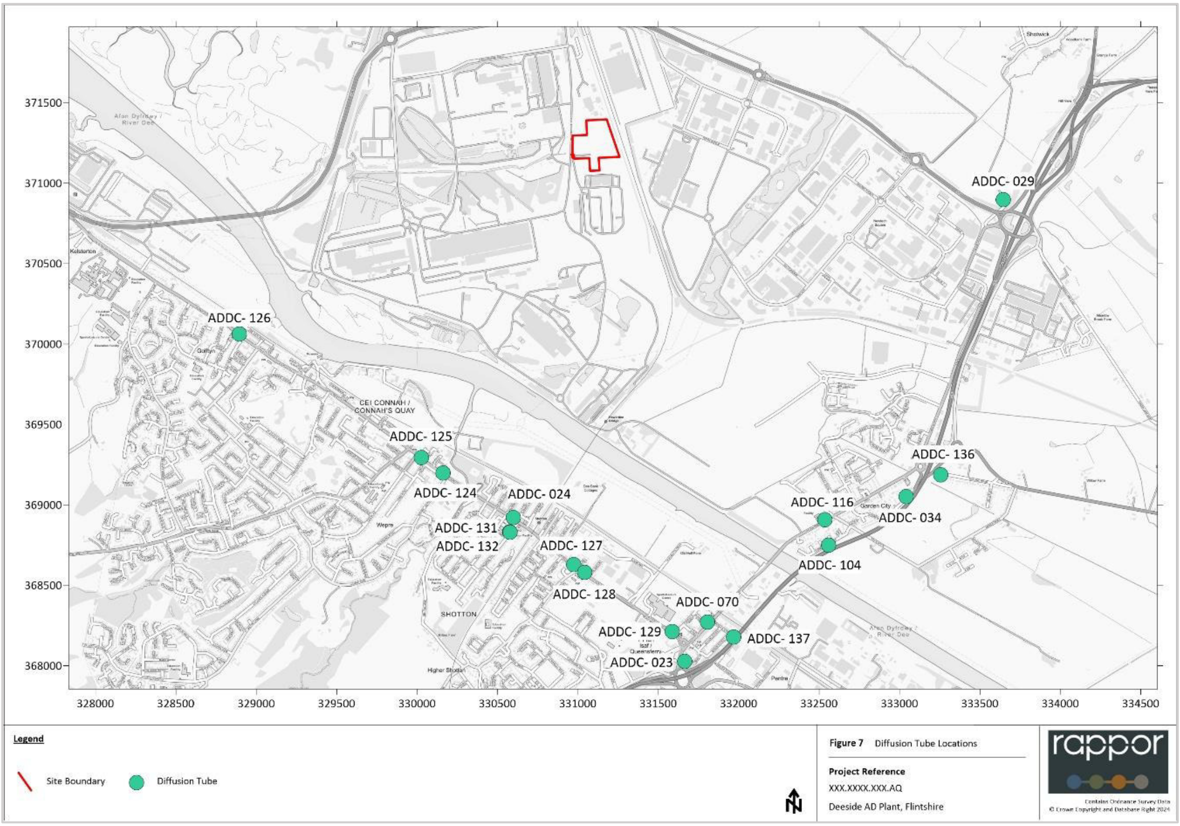
ID and Location		TYPE	NGR		2024 Concentration (ug/m^3)
			X	Y	
125	98 High Street	Kerbside	330027	369295	19.7
124	66 High Street	Kerbside	330161	369198	27.3
024	32 Chester Road West, Shotton	Kerbside	330599	368922	18.9
132	Croes Atti School, Shotton	Roadside	330576	368831	9.7
131	Croes Atti School, Shotton	Roadside	330577	368830	9.8
029	Green Lane West, Sealand	Rural	333645	370898	12.1
126	102 Church Street	Kerbside	328895	370063	15.5
127	91 Chester Road, Shotton	Kerbside	330972	368628	22.7
128	111 Chester Road East, Shotton	Kerbside	331041	368580	22.8
116	Sealand School, Welsh Road	Kerbside	332535	368907	13.5
104	Claremont Avenue	Kerbside	332558	368750	14.7
034	89 Riverside Park, Garden City	Roadside	333040	369051	13.0
136	18 Sealand Road, Sealand	Kerbside	333256	369187	11.2
070	43 Station Road, Queensferry	Roadside	331806	368271	15.7
129	38 Chester Road, Queensferry	Kerbside	331585	368212	23.9
137	51 Dundas Street, Queensferry	Kerbside	331968	368178	26.0

[8] 2025 Air Quality Progress Report, North Wales Authorities Collaborative Project, September 2025

ID and Location		TYPE	NGR		2024 Concentration (ug/m^3)
			X	Y	
023	4, Belvedere Close, Queensferry	Urban Background	331663	368028	19.0

4.4 Monitoring results do not indicate exceedances of the annual mean AQO for NO_2 at any monitoring locations, with a maximum concentration of 27.3 μg/m^3 at Site 124. It is considered that the use of Tube 023 as a background concentration would provide a conservative representative of baseline conditions across the assessment extents. **Figure 7** provides a map of the monitoring locations.

Figure 7 Monitoring Locations



Background Pollutant Concentrations

4.5 Pollutant background concentrations for the site, monitoring and receptor locations have been obtained from various sources including DEFRA background maps, national monitoring networks and the APIS website[5].

4.6 Predictions of background pollutant concentrations on a 1 km by 1 km grid basis have been produced by DEFRA[9] for the entire of the UK to assist LAs in their Review and Assessment of air quality. The assessment extents, including human sensitive receptors, are located across numerous NGR squares. Data for these locations was downloaded from the DEFRA and summarised in **Table 17**.

[9] https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2021 – Accessed 09/04/2026

Table 17 Predicted Long Term Background Pollutant Concentrations

Receptors	Grid Square	Predicted Background Concentration (µg/m³)				
		NO_x	NO_2	SO_2	CO	TVOC
HR1	327500,370500	7.48	5.93	3.47	512.00	0.27
HR2-HR4	328500,370500	9.01	7.08	3.75	522.00	0.29
HR5	329500,369500	9.58	7.50	3.86	552.00	0.31
HR6-HR7	330500,369500	9.40	7.37	4.07	576.00	0.35
HR8	331500,369500	9.44	7.40	3.89	598.00	0.36
HR9	331500,368500	10.59	8.24	4.66	606.00	0.37
HR10 – HR12	332500,369500	10.15	7.91	4.29	602.00	0.36
HR13	333500,369500	11.72	9.06	4.24	596.00	0.35
HR14	333500,370500	16.68	12.49	4.74	588.00	0.33
HR15	333500,371500	11.33	8.78	4.11	580.00	0.33
HR16	332500,373500	8.87	6.97	3.54	568.00	0.31
MAX		**16.68**	**12.49**	**606.00**	**0.37**	**4.74**

4.7 Background concentrations of NO_x and NO_2, were obtained from DEFRA background predictions for 2026, while SO_2, CO and VOC concentrations were obtained from the 2001[10] base maps. These are the most reliable and recent predictions available and are therefore considered to provide a reasonable representation of background concentrations in the vicinity of the site.

4.8 To provide a conservative assessment the maximum concentrations presented in **Table 17** were applied to all modelled human receptors. An exemption was made for NO_2 concentrations which are based of the urban background monitor A023 providing a background concentration of 19 µg/m³.

Ecological Baseline

4.9 Background deposition rates and concentrations were downloaded from the APIS website and are summarised in **Table 18** for each receptor.

Table 18 Background Deposition Rates and Concentrations

ID	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keq/ha/yr)	Background Concentration (µg/m³)	
			NO_x	SO_2
E1	16.7	1.4	11.0	2.8
E2	16.4	1.4	10.8	2.5
E3	16.3	1.4	12.7	2.4
E4	16.4	1.4	10.8	2.5
E5	16.0	1.4	10.3	2.6
E6	16.4	1.4	10.8	2.5
E7	16.0	1.4	10.3	1.8

10 https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2001 – Accessed 09/04/2026

ID	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keq/ha/yr)	Background Concentration (µg/m³)	
			NO_x	SO_2
E8	16.4	1.4	10.8	2.5
E9	16.2	1.4	10.0	2.0
E10	16.8	1.4	14.2	4.8
E11	16.3	1.4	12.7	2.4
E12	16.0	2.3	10.3	2.6
E13	17.2	2.4	11.4	3.1
E14	17.6	2.5	10.9	2.5
E15	17.6	2.5	10.6	2.4
E16	31.1	2.5	10.0	2.5
E17	30.6	2.4	9.8	2.5
E18	18.2	2.5	11.5	2.3
E19	31.9	2.5	11.5	2.3
E20	30.7	2.4	9.6	1.7
E21	31.3	2.4	10.4	2.1
E22	30.4	2.4	7.4	1.5
E23	20.9	2.9	10.3	2.4
E24	21.3	3.0	12.0	2.9
E25	16.6	2.2	5.9	1.3
E26	16.7	2.2	5.9	1.3

4.10 CLos are designated within the UK based on the sensitivity and relevant features of the receiving habitat. The CLos for nitrogen and acid deposition are presented in **Table 19**.

Table 19 Nitrogen and Acid Critical Loads

ID	Nitrogen Critical Load (kgN/ha/yr)		Acid Critical Load (kgN/ha/yr)		
	Min	Min	CLominN	CLomaxN	CLomaxS
E1	5	15	0.86	4.86	4.00
E2	5	15	0.86	4.86	4.00
E3	5	10	0.50	0.95	0.45
E4	5	10	0.50	0.95	0.45
E5	5	10	0.50	0.95	0.45
E6	5	10	0.50	0.95	0.45
E7	5	10	0.50	0.95	0.45
E8	5	10	0.50	0.95	0.45
E9	5	10	0.50	0.95	0.45
E10	5	10	0.50	0.95	0.45
E11	5	15	0.86	4.86	4.00

ID	Nitrogen Critical Load (kgN/ha/yr)		Acid Critical Load (kgN/ha/yr)		
	Min	Min	CLominN	CLomaxN	CLomaxS
E12	2	10	0.14	0.89	0.74
E13	2	10	0.14	0.89	0.74
E14	2	10	0.14	0.89	0.74
E15	2	10	0.14	0.89	0.74
E16	10	15	0.14	1.59	1.45
E17	10	15	0.14	1.59	1.45
E18	6	10	0.36	1.83	1.47
E19	10	15	0.14	1.59	1.45
E20	10	15	0.14	1.59	1.45
E21	10	15	0.14	1.59	1.45
E22	10	15	0.14	1.59	1.45
E23	2	10	0.14	0.89	0.74
E24	2	10	0.14	0.89	0.74
E25	5	10	0.14	0.86	0.72
E26	5	10	0.14	0.86	0.72

Short term Background Concentrations

4.11 It was assumed that the short-term background concentration of a substance is twice its long-term concentration as advised by the NRW guidance[2].

5 Results

5.1 Dispersion modelling was undertaken using the inputs described in Section 3. The results presented in this section reflect the maximum effected receptor across the study area over the five-year meteorological dataset. Full modelling results at each of the assessed receptors are provided in **Appendix A**.

Human

Table 20 Maximum Predicted Human Impacts

Pollutant	Receptor	Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
Annual Mean NO_2	HR12	0.5	19.5	**1.3**	48.8
1- Hour Mean NO_2	HR12	4.5	42.5	2.3	2.8
1-hour mean SO_2	HR12	0.7	10.2	0.2	0.2
15-minute SO_2	HR12	1.0	10.5	0.4	0.4
24-hour Mean SO_2	HR12	0.2	9.7	0.2	0.2
Annual Mean TVOC	HR12	<0.01	0.4	0.1	7.5
24- Hour Mean TVOC	HR12	0.1	0.9	2.6	17.4

5.2 Most long-term PCs are below the 1% screening threshold, with exception of annual mean NO_2 which marginally exceed the 1% (1.3%). PC% at HR11 and HR13 also exceed the 1% threshold. All short-term PCs are well below the 10% threshold, with a maximum of 2.8% for 24- Hour Mean TVOC and are therefore screened out as insignificant.

5.3 Annual mean NO_X PECs are well below relevant EQS at all receptors, with a maximum PEC of 48.8% of the EQS for annual mean NO_2. In accordance with NRW guidance as PECs below 70% of the EQS impacts are screened as insignificant and do not require further assessment.

5.4 Overall all predicted PECs are well below the EQS confirming that emissions from the facility will have a negligible impact on local air quality and are considered acceptable.

Ecological

Table 21 Maximum Predicted Ecological Impacts

Pollutant	Receptor	Concentration/Deposition µg/m³, kgN/ha/yr or keq/ha/yr		Proportion of EQS (%)	
		PC	PEC	PC	PEC
Concentrations					
Annual Mean NO_X	E3	2.16	14.90	**7.2**	49.7
24- Hour Mean NO_X	E3	10.93	36.41	5.5	18.2
Annual Mean SO_2	E3	0.17	4.78	**1.7**	47.8
Deposition Rates					
Nitrogen - Min CLo	E3	0.31	31.94	**6.2**	**880.6**

Pollutant	Receptor	Concentration/Deposition µg/m³, kgN/ha/yr or keq/ha/yr		Proportion of EQS (%)	
		PC	PEC	PC	PEC
Nitrogen - Max CLo	E3	0.31	31.94	**3.1**	**213.0**
Acid	E3	0.04	2.49	**4.5**	**281.6**

5.5 The maximum long-term PCs exceed 1% of the relevant CLe and CLo and the annual mean NOx and SO_2 PCs exceeds the 1% short-term screening threshold.

5.6 At receptor E3 (SAC), the PC proportion of the EQS cannot initially be screened out for annual mean NO_x and SO_2, and both nitrogen and acid deposition. The PC proportion at ecological receptors E9 and E11 also exceed the 1% threshold for annual mean NO_X, and both nitrogen and acid deposition.

5.7 Annual mean NOx and SO_2 PECs are below 70% of the relevant critical levels and can therefore be screened out as insignificant. However, PECs for nitrogen and acid deposition exceed 70% of the relevant critical loads at E3, E9 and E11. These impacts cannot therefore be screened out as insignificant.

5.8 Whilst impacts at the SAC cannot be screened out at this stage, this does not indicate that significant effects will occur. In accordance with NRW guidance, the results should be subject to detailed review by a suitably qualified ecologist in order to determine overall significance.

6 Conclusion

6.1 Dispersion modelling of on-site combustion processes a the Arrow Bio Waste Recycling Facility was undertaken using ADMS 6. Impacts at sensitive receptors were quantified and the results compared with the relevant EQSs and significance criteria provided by the NRW. Predicted impacts were based on the proposed operating procedures for the facility.

6.2 Impacts were based on the Facility emitting the maximum permitted pollutant concentrations, as well as the use of the maximum predicted concentrations over five assessment years. As such, predicted concentrations are considered to represent a robust assessment.

6.3 Operational impacts on human health were considered to be not significant. Impacts at most receptors could be screened out based on PCs being less than 1% or 10% of the relevant EQS. Where PC exceedances were predicted, the PECs were below 70% or 20% of the EQS at all receptors. On that basis, impacts on pollutant concentrations at all human receptors were considered acceptable.

6.4 At ecological receptors E3, E9 and E11, impacts could not be screened out as insignificant due to exceedances of screening thresholds nitrogen and acid deposition. Impacts associated with annual mean NOx and SO_2 were screened out as insignificant based on PECs being less than 70% of the relevant EQS. It is therefore recommended that impacts at E3, E9 and E11 are subject to review by a suitably qualified ecologist to determine overall significance relating to deposition rates, taking account of feature-specific CLos, baseline conditions and site sensitivity.

6.5 Impacts at all other ecological receptors were screened as insignificant.

6.6 Based on the predictions and the use of conservative assumptions, including worst-case emission limit values and meteorological conditions over a five-year period, the overall air quality impacts of the Facility are considered to be negligible and acceptable.

6.7 In terms of air quality, the proposal is therefore considered acceptable for permitting purposes.

Appendix A - Modelling Results

Human Health Results

Table 22 Predicted Annual Mean NO_2 Impacts

ID	Name	Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
HR1	Kelsterton Road	0.03	19.03	0.1	47.6
HR2	Deeside College	0.04	19.04	0.1	47.6
HR3	Kelsterton Road	0.04	19.04	0.1	47.6
HR4	Church Street	0.05	19.05	0.1	47.6
HR5	High Street	0.07	19.07	0.2	47.7
HR6	St David Court	0.09	19.09	0.2	47.7
HR7	Salisbury Street	0.08	19.08	0.2	47.7
HR8	Shotton Sports Club	0.09	19.09	0.2	47.7
HR9	Hurlbutts Drive	0.08	19.08	0.2	47.7
HR10	John Summers Way	0.31	19.31	0.8	48.3
HR11	John Summers Way	0.44	19.44	**1.1**	48.6
HR12	Rollason Grove	0.52	19.52	**1.3**	48.8
HR13	Bayley Road	0.44	19.44	**1.1**	48.6
HR14	Green Lane West	0.19	19.19	0.5	48.0
HR15	Vicarage Lane	0.19	19.19	0.5	48.0
HR16	Old Hall Lane	0.15	19.15	0.4	47.9
MAX	**HR12**	**0.52**	**19.52**	**1.3**	**48.8**

Table 23 Predicted 24-hour Mean NO_2 Impacts

ID	Name	Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC*
HR1	Kelsterton Road	1.55	39.55	0.8	1.0
HR2	Deeside College	1.91	39.91	1.0	1.2
HR3	Kelsterton Road	2.07	40.07	1.0	1.3
HR4	Church Street	3.13	41.13	1.6	1.9
HR5	High Street	3.34	41.34	1.7	2.1
HR6	St David Court	4.24	42.24	2.1	2.6
HR7	Salisbury Street	3.45	41.45	1.7	2.1
HR8	Shotton Sports Club	3.73	41.73	1.9	2.3
HR9	Hurlbutts Drive	2.85	40.85	1.4	1.8
HR10	John Summers Way	3.92	41.92	2.0	2.4
HR11	John Summers Way	4.43	42.43	2.2	2.7
HR12	Rollason Grove	4.53	42.53	2.3	2.8
HR13	Bayley Road	3.91	41.91	2.0	2.4
HR14	Green Lane West	3.14	41.14	1.6	1.9
HR15	Vicarage Lane	2.97	40.97	1.5	1.8
HR16	Old Hall Lane	3.24	41.24	1.6	2.0
MAX	**HR12**	**4.53**	**42.53**	**2.3**	**2.8**

*PC/EQS minus twice the background concentration

Table 24 Predicted Annual Mean TVOC Impacts

ID	Name	Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC*
HR1	Kelsterton Road	<0.01	0.37	<0.1	7.4
HR2	Deeside College	<0.01	0.37	<0.1	7.4
HR3	Kelsterton Road	<0.01	0.37	<0.1	7.4
HR4	Church Street	<0.01	0.37	<0.1	7.4
HR5	High Street	<0.01	0.37	<0.1	7.4
HR6	St David Court	<0.01	0.37	<0.1	7.4
HR7	Salisbury Street	<0.01	0.37	<0.1	7.4
HR8	Shotton Sports Club	<0.01	0.37	<0.1	7.4
HR9	Hurlbutts Drive	<0.01	0.37	<0.1	7.4
HR10	John Summers Way	<0.01	0.37	0.1	7.5
HR11	John Summers Way	0.01	0.38	0.1	7.5
HR12	Rollason Grove	0.01	0.38	0.1	7.5
HR13	Bayley Road	<0.01	0.37	0.1	7.5
HR14	Green Lane West	<0.01	0.37	<0.1	7.4
HR15	Vicarage Lane	<0.01	0.37	<0.1	7.4
HR16	Old Hall Lane	<0.01	0.37	<0.1	7.4
MAX	**HR12**	**0.01**	**0.38**	**0.1**	**7.5**

Table 25 Predicted 24-hour Mean TVOC Impacts

ID	Name	Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC*
HR1	Kelsterton Road	0.04	0.78	0.8	15.6
HR2	Deeside College	0.04	0.78	0.8	15.6
HR3	Kelsterton Road	0.04	0.78	0.8	15.6
HR4	Church Street	0.04	0.78	0.9	15.7
HR5	High Street	0.04	0.78	0.9	15.7
HR6	St David Court	0.10	0.84	2.1	16.9
HR7	Salisbury Street	0.08	0.82	1.6	16.4
HR8	Shotton Sports Club	0.06	0.80	1.2	16.0
HR9	Hurlbutts Drive	0.10	0.84	1.9	16.7
HR10	John Summers Way	0.09	0.83	1.7	16.5
HR11	John Summers Way	0.12	0.86	2.3	17.1
HR12	Rollason Grove	0.13	0.87	2.6	17.4
HR13	Bayley Road	0.11	0.85	2.3	17.1
HR14	Green Lane West	0.06	0.80	1.3	16.1
HR15	Vicarage Lane	0.05	0.79	1.0	15.8
HR16	Old Hall Lane	0.06	0.80	1.2	16.0
MAX	**HR12**	**0.13**	**0.87**	**2.6**	**17.4**

*PC/EQS minus twice the background concentration

Table 26 Predicted 24-hour Mean SO_2 Impacts

ID	Name	Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC*
HR1	Kelsterton Road	0.04	9.52	0.0	0.0
HR2	Deeside College	0.04	9.52	0.0	0.0
HR3	Kelsterton Road	0.05	9.53	0.0	0.0
HR4	Church Street	0.07	9.55	0.1	0.1
HR5	High Street	0.11	9.59	0.1	0.1
HR6	St David Court	0.14	9.62	0.1	0.1
HR7	Salisbury Street	0.09	9.57	0.1	0.1
HR8	Shotton Sports Club	0.08	9.56	0.1	0.1
HR9	Hurlbutts Drive	0.07	9.55	0.1	0.1
HR10	John Summers Way	0.17	9.65	0.1	0.2
HR11	John Summers Way	0.20	9.68	0.2	0.2
HR12	Rollason Grove	0.24	9.72	0.2	0.2
HR13	Bayley Road	0.23	9.71	0.2	0.2
HR14	Green Lane West	0.10	9.58	0.1	0.1
HR15	Vicarage Lane	0.11	9.59	0.1	0.1
HR16	Old Hall Lane	0.07	9.55	0.1	0.1
MAX	**HR12**	**0.24**	**9.72**	**0.2**	**0.2**

*PC/EQS minus twice the background concentration

Table 27 Predicted 1-hour Mean SO_2 Impacts

ID	Name	Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC*
HR1	Kelsterton Road	0.23	9.71	0.1	0.1
HR2	Deeside College	0.25	9.73	0.1	0.1
HR3	Kelsterton Road	0.28	9.76	0.1	0.1
HR4	Church Street	0.43	9.91	0.1	0.1
HR5	High Street	0.48	9.96	0.1	0.1
HR6	St David Court	0.61	10.09	0.2	0.2
HR7	Salisbury Street	0.50	9.98	0.1	0.1
HR8	Shotton Sports Club	0.58	10.06	0.2	0.2
HR9	Hurlbutts Drive	0.41	9.89	0.1	0.1
HR10	John Summers Way	0.62	10.10	0.2	0.2
HR11	John Summers Way	0.70	10.18	0.2	0.2
HR12	Rollason Grove	0.72	10.20	0.2	0.2
HR13	Bayley Road	0.61	10.09	0.2	0.2
HR14	Green Lane West	0.49	9.97	0.1	0.1
HR15	Vicarage Lane	0.46	9.94	0.1	0.1
HR16	Old Hall Lane	0.51	9.99	0.1	0.1
MAX	**HR12**	**0.72**	**10.20**	**0.2**	**0.2**

*PC/EQS minus twice the background concentration

Table 28 Predicted 15-minute Mean SO_2 Impacts

ID	Name	Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC*
HR1	Kelsterton Road	0.44	9.92	0.2	0.2
HR2	Deeside College	0.54	10.02	0.2	0.2
HR3	Kelsterton Road	0.57	10.05	0.2	0.2
HR4	Church Street	0.74	10.22	0.3	0.3
HR5	High Street	0.81	10.29	0.3	0.3
HR6	St David Court	0.96	10.44	0.4	0.4
HR7	Salisbury Street	0.81	10.29	0.3	0.3
HR8	Shotton Sports Club	0.83	10.31	0.3	0.3
HR9	Hurlbutts Drive	0.65	10.13	0.2	0.3
HR10	John Summers Way	0.93	10.41	0.4	0.4
HR11	John Summers Way	0.96	10.44	0.4	0.4
HR12	Rollason Grove	0.97	10.45	0.4	0.4
HR13	Bayley Road	0.84	10.32	0.3	0.3
HR14	Green Lane West	0.72	10.20	0.3	0.3
HR15	Vicarage Lane	0.71	10.19	0.3	0.3
HR16	Old Hall Lane	0.77	10.25	0.3	0.3
MAX	**HR12**	**0.97**	**10.45**	**0.4**	**0.4**

*PC/EQS minus twice the background concentration

Ecological Results

Table 29 Predicted Annual Mean NO_2 Impacts

ID	Concentration (µg/m³)		Proportion of EQS (%)	
	PC	PEC	PC	PEC
ER1	0.17	11.20	0.6	37.3
ER2	0.08	10.87	0.3	36.2
ER3	2.16	14.90	**7.2**	49.7
ER4	0.24	11.03	0.8	36.8
ER5	0.13	10.42	0.4	34.7
ER6	0.08	10.87	0.3	36.2
ER7	0.02	10.31	0.1	34.4
ER8	0.09	10.88	0.3	36.3
ER9	0.75	10.78	**2.5**	35.9
ER10	0.07	14.25	0.2	47.5
ER11	0.76	13.50	**2.5**	45.0
ER12	0.11	10.40	0.4	34.7
ER13	0.08	11.46	0.3	38.2
ER14	0.09	11.00	0.3	36.7
ER15	0.05	10.65	0.2	35.5
ER16	0.05	10.05	0.2	33.5
ER17	0.05	9.86	0.2	32.9
ER18	0.01	11.50	0.0	38.3
ER19	0.01	11.50	0.0	38.3
ER20	0.02	9.57	0.1	31.9
ER21	0.01	10.43	0.0	34.8
ER22	0.01	7.44	0.0	24.8
ER23	0.07	10.33	0.2	34.4
ER24	0.06	12.02	0.2	40.1
ER25	0.01	5.90	0.0	19.7
ER26	0.01	5.87	0.0	19.6
MAX	**2.16**	**14.90**	**7.2**	**49.7**

Table 30 Predicted 24-hour NO_2 Impacts

ID	Concentration (µg/m³)		Proportion of EQS (%)	
	PC	PEC	PC	PEC
ER1	4.03	26.09	2.0	13.0
ER2	1.96	23.54	1.0	11.8
ER3	10.93	36.41	5.5	18.2
ER4	3.20	24.78	1.6	12.4
ER5	3.38	23.96	1.7	12.0
ER6	1.85	23.43	0.9	11.7
ER7	0.46	21.04	0.2	10.5
ER8	1.54	23.12	0.8	11.6

ID	Concentration (µg/m³)		Proportion of EQS (%)	
	PC	PEC	PC	PEC
ER9	4.30	24.36	2.1	12.2
ER10	2.02	30.38	1.0	15.2
ER11	3.68	29.16	1.8	14.6
ER12	2.31	22.89	1.2	11.4
ER13	2.21	24.97	1.1	12.5
ER14	1.45	23.27	0.7	11.6
ER15	1.45	22.65	0.7	11.3
ER16	1.30	21.30	0.6	10.6
ER17	1.39	21.01	0.7	10.5
ER18	0.37	23.35	0.2	11.7
ER19	0.37	23.35	0.2	11.7
ER20	0.54	19.64	0.3	9.8
ER21	0.44	21.28	0.2	10.6
ER22	0.47	15.33	0.2	7.7
ER23	0.60	21.12	0.3	10.6
ER24	0.49	24.41	0.2	12.2
ER25	0.32	12.10	0.2	6.1
ER26	0.20	11.92	0.1	6.0
MAX	**10.93**	**36.41**	**5.5**	**18.2**

Table 31 Predicted Annual Mean SO_2 Impacts

ID	Concentration (µg/m³)		Proportion of EQS (%)	
	PC	PEC	PC	PEC
ER1	0.01	2.78	0.1	27.8
ER2	0.01	2.51	0.1	25.1
ER3	0.17	2.57	**1.7**	25.7
ER4	0.02	2.52	0.2	25.2
ER5	0.01	2.60	0.1	26.0
ER6	0.01	2.51	0.1	25.1
ER7	0.00	1.75	0.0	17.5
ER8	0.01	2.51	0.1	25.1
ER9	0.06	2.06	0.6	20.6
ER10	0.01	4.78	0.1	47.8
ER11	0.06	2.46	0.6	24.6
ER12	0.01	2.60	0.1	26.0
ER13	0.01	3.13	0.1	31.3
ER14	0.01	2.55	0.1	25.5
ER15	0.00	2.41	0.0	24.1
ER16	0.00	2.48	0.0	24.8
ER17	0.00	2.50	0.0	25.0
ER18	0.00	2.30	0.0	23.0

ID	Concentration (µg/m³)		Proportion of EQS (%)	
	PC	PEC	PC	PEC
ER19	0.00	2.30	0.0	23.0
ER20	0.00	1.72	0.0	17.2
ER21	0.00	2.12	0.0	21.2
ER22	0.00	1.52	0.0	15.2
ER23	0.01	2.39	0.1	23.9
ER24	0.00	2.89	0.0	28.9
ER25	0.00	1.26	0.0	12.6
ER26	0.00	1.34	0.0	13.4
MAX	**0.17**	**4.78**	**1.7**	**47.8**

Table 32 Nitrogen Deposition Impacts

ID	Annual Mean Nitrogen Deposition (kgN/ha/yr)		Proportion of CLo (min) (%)		Proportion of CLo (max) (%)	
	PC	PEC	PC	PEC	PC	PEC
ER1	0.02	16.70	0.5	334.1	0.2	111.4
ER2	0.01	16.45	0.2	329.0	0.1	109.7
ER3	0.31	16.63	6.2	332.6	**3.1**	**166.3**
ER4	0.03	16.47	0.7	329.5	0.3	164.7
ER5	0.02	16.01	0.4	320.2	0.2	160.1
ER6	0.01	16.45	0.2	329.0	0.1	164.5
ER7	0.00	15.99	0.1	319.9	0.0	159.9
ER8	0.03	16.47	0.5	329.3	0.3	164.7
ER9	0.11	16.32	**2.2**	**326.4**	**1.1**	**163.2**
ER10	0.01	16.82	0.2	336.4	0.1	168.2
ER11	0.11	16.43	**2.2**	**328.6**	0.7	109.5
ER12	0.02	16.01	0.8	800.3	0.2	160.1
ER13	0.01	17.20	0.6	860.1	0.1	172.0
ER14	0.01	17.61	0.6	880.6	0.1	176.1
ER15	0.01	17.61	0.4	880.4	0.1	176.1
ER16	0.02	31.12	0.2	311.2	0.1	207.4
ER17	0.01	30.62	0.1	306.2	0.1	204.2
ER18	0.00	18.21	0.0	303.5	0.0	182.1
ER19	0.00	31.94	0.0	319.4	0.0	213.0
ER20	0.01	30.70	0.1	307.0	0.0	204.6
ER21	0.00	31.29	0.0	312.9	0.0	208.6
ER22	0.00	30.38	0.0	303.8	0.0	202.6
ER23	0.01	20.94	0.5	1047.0	0.1	209.4
ER24	0.01	21.31	0.4	1065.4	0.1	213.1
ER25	0.00	16.57	0.0	331.4	0.0	165.7
ER26	0.00	16.72	0.0	334.4	0.0	167.2
MAX	**0.31**	**31.94**	**6.2**	**880.6**	**3.1**	**213.0**

Table 33 Acid Deposition Impacts

ID	Predicted Annual Mean Acid Deposition Rate (keq/ha/yr)		Proportion of CLo-maxN (%)	
	PC	PEC	PC	PEC
ER1	0.003	1.41	0.1	29.1
ER2	0.002	1.41	0.0	29.1
ER3	0.043	1.43	**4.5**	**151.0**
ER4	0.005	1.41	0.5	149.1
ER5	0.003	1.39	0.3	146.7
ER6	0.002	1.41	0.2	148.8
ER7	0.000	1.39	0.0	146.5
ER8	0.004	1.41	0.4	149.0
ER9	0.015	1.37	**1.6**	**144.9**
ER10	0.001	1.42	0.2	149.8
ER11	0.015	1.41	0.3	28.9
ER12	0.002	2.33	0.2	263.5
ER13	0.002	2.44	0.2	275.9
ER14	0.002	2.49	0.2	281.6
ER15	0.001	2.49	0.1	281.5
ER16	0.002	2.47	0.1	155.5
ER17	0.002	2.44	0.1	153.6
ER18	0.000	2.48	0.0	135.7
ER19	0.001	2.48	0.0	156.0
ER20	0.001	2.40	0.0	151.0
ER21	0.001	2.43	0.0	152.9
ER22	0.001	2.37	0.0	149.1
ER23	0.001	2.93	0.2	331.2
ER24	0.001	2.97	0.1	335.7
ER25	0.000	2.20	0.0	254.9
ER26	0.000	2.22	0.0	257.3
MAX	0.043	2.49	4.5	281.56

Appendix B – Technical Datasheets

VIESMANN

VITOPLEX 200

Low temperature oil/gas boiler
700 to 1950 kW

Datasheet

Part no. and prices: See pricelist

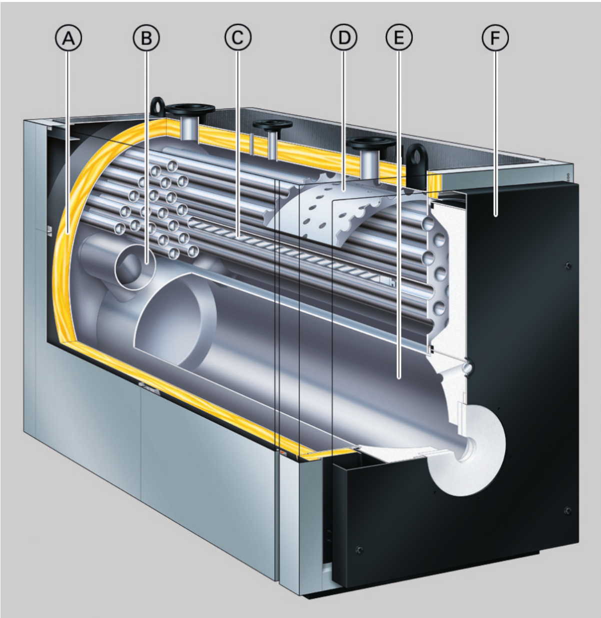
VITOPLEX 200 Type SX2A

Low temperature oil/gas boiler
- **Three-pass boiler**
- **For operation with modulating boiler water temperature**
- **With the Vitotrans 300 flue gas/water heat exchanger as a condensing unit**

5797333 GB 4/2022

Benefits at a glance

- Economical and environmentally responsible thanks to modulating boiler water temperature
- Standard seasonal efficiency [to DIN] for operation with fuel oil: 89 % (H_s) [gross cv].
- Optional stainless steel flue gas/water heat exchanger for higher standard seasonal efficiency [to DIN], utilising the condensing effect
- Three-pass boiler with low combustion chamber loading, resulting in clean combustion with low emissions
- Wide water galleries and large water capacity provide excellent natural circulation and reliable heat transfer.
- Long burner runtimes and less cycling, due to large water content, protect the environment.
- Compact design for easy handling into boiler rooms – important for modernisation projects
- Easy to use Vitotronic control unit with colour touchscreen
- Integral LAN interface for internet communication and integral WiFi for service interface.
- Economical and safe operation of the heating system through the Vitotronic control system with communication capability which, in conjunction with Vitogate 300 (accessories), enables integration into building management systems.
- Vitocontrol control panel can be supplied on request.



Ⓐ Highly effective thermal insulation
Ⓑ Hot gas flue (second pass)
Ⓒ Hot gas flue (third pass)
Ⓓ Water deflector with return injectors
Ⓔ Combustion chamber (first pass)
Ⓕ Boiler door

5797333

Boiler specification

Specification

Rated heating output	**kW**	**700**	**900**	**1100**	**1300**	**1600**	**1950**
Rated heat input	kW	761	978	1196	1413	1739	2120
CE designation According to Gas Appliances Directive		CE-0085BQ0020					
Permiss. flow temperature (= safety temperature)	°C	110 (up to 120 °C on request)					
Permiss. operating temperature	°C	95					
Permiss. operating pressure	bar	6					
	kPa	600					
Pressure drop on the hot gas side	mbar	2.7	4.6	4.0	5.7	8.2	8.5
	Pa	270	460	400	570	820	850
Boiler body dimensions							
Length (dim. k)*1	mm	2200	2500	2450	2670	3075	3075
Width (dim. c)	mm	1085	1085	1180	1180	1280	1280
Height (incl. connectors) (dim. e)	mm	1670	1670	1900	1900	2120	2120
Total dimensions							
Total length (dim. f)	mm	2280	2580	2530	2750	3175	3175
Total width							
– Incl. control unit (dim. a)	mm	1460	1460	1555	1555	1660	1660
– Excl. control unit (dim. b)	mm	1285	1285	1380	1380	1485	1485
Total height (incl. lifting eyes) (dim. h)	mm	1690	1690	1920	1920	2140	2140
Height of anti-vibration boiler supports (under load)	mm	37	37	37	37	37	37
Foundation							
Length	mm	1900	2200	2150	2300	2700	2700
Width	mm	1200	1200	1300	1300	1400	1400
Combustion chamber diameter	mm	620	620	720	720	720*2	720*2
Combustion chamber length	mm	1700	2000	1930	2150	2530	2530
Weight of boiler body	kg	1620	1870	2120	2340	3000	3580
Total weight Boiler with thermal insulation and boiler control unit	kg	1725	1985	2255	2485	3180	3760
Boiler water **capacity**	Litres	935	1325	1525	1690	2510	2420
Boiler connections							
Boiler flow and return	PN 6 DN	100	100	125	125	150	150
Safety connection (safety valve)	PN 16 DN	50	50	65	65	65	65
Drain (male thread)	R	1¼	1¼	1¼	1¼	1¼	1¼
Flue gas parameters*3 Temperature (at 60 °C boiler water temperature)							
– At rated heating output	°C	180					
– At partial load	°C	125					
Temperature (at 80 °C boiler water temperature)	°C	195					
Flue gas mass flow rate							
– With natural gas	kg/h	1.5225 x combustion output in kW					
– With EL fuel oil	kg/h	1.5 x combustion output in kW					
Flue gas connection	Ø mm	300	300	350	350	400	400
Total gas capacity Combustion chamber, hot gas flues, return pipes, reversing chamber and flue gas collector	m^3	0.90	1.00	1.35	1.45	2.50	2.50
Standard seasonal efficiency [to DIN] (for operation with fuel oil) At heating system temperature 75/60 °C	%	89 (H_s) [gross cv]					
Standby loss $q_{B,70}$	%	0.15	0.13	0.13	0.12	0.13	0.11

*1 *Boiler door removed.*

*2 *Conical combustion chamber 720/840 mm (combustion chamber diameter front/rear)*

*3 *Calculation values for sizing the flue system to EN 13384 relative to 13.2 % CO_2 for EL fuel oil and 10 % CO_2 for natural gas.*
Flue gas temperatures captured as gross values at 20 °C combustion air temperature.
The details for partial load refer to an output of 60 % of rated heating output. If the partial load differs (depending on operating mode), calculate the flue gas mass flow rate accordingly.

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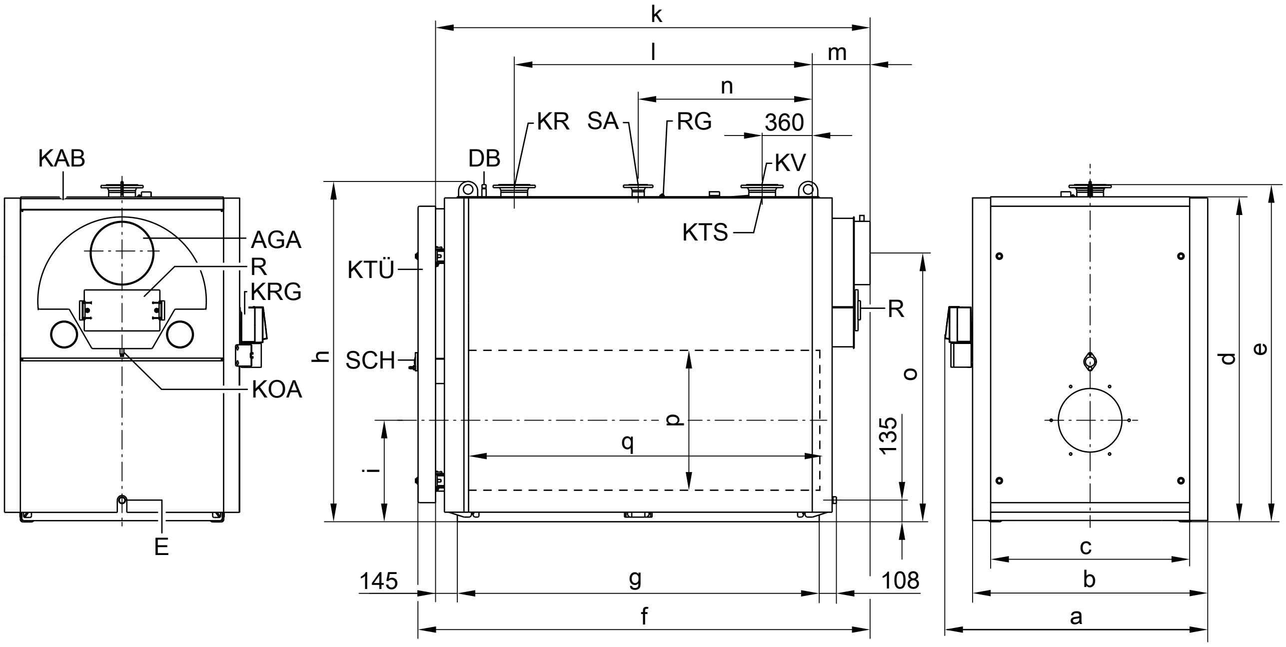
Rated heating output	kW	700	900	1100	1300	1600	1950
Matching Vitotrans 300							
– Gas operation	Part no.	Z007212		Z007213		Z007214	
– Oil operation	Part no.	Z007215		Z007216		Z007217	
Rated heating output Boiler with Vitotrans 300							
– Gas operation	kW	773.5	994.5	1215.0	1436.0	1768.0	2154.0
– Oil operation	kW	750.0	964.0	1179.0	1393.0	1715.0	2090.0
CE designation Vitotrans 300 in conjunction with boiler as a condensing unit		CE-0085BS0287					
Pressure drop on the hot gas side Boiler with Vitotrans 300	mbar	3.2	5.4	5.2	7.3	10.0	10.1
	Pa	320	540	520	730	1000	1010
Total length Boiler with Vitotrans 300 excl. burner	mm	3820	4120	3670	3890	4140	4470

Dimensions



AGA Flue outlet
DB Female connection for maximum pressure limiter (R ½, male thread)
E Drain
KAB Boiler cover (walk-on)
KOA Condensate drain
KR Boiler return
KRG Boiler control unit
KTS Boiler water temperature sensor (shown offset)
KTÜ Boiler door
KV Boiler flow
R Cleaning aperture
RG Female connection for additional control equipment (R ½, male thread)
SA Safety connection (safety valve)
SCH Inspection port

Table of dimensions

Rated heating output	kW	700	900	1100	1300	1600	1950
a	mm	1460	1460	1555	1555	1660	1660
b	mm	1285	1285	1380	1380	1485	1485
c	mm	1085	1085	1180	1180	1280	1280
d	mm	1590	1590	1815	1815	2035	2035
e	mm	1670	1670	1900	1900	2120	2120
f	mm	2280	2580	2530	2750	3175	3175
g (length of base rails)	mm	1775	2075	2005	2225	2610	2610
h	mm	1690	1690	1920	1920	2140	2140
i	mm	525	525	580	580	640	640
k (handling dimension)	mm	2200	2500	2450	2670	3075	3075
l	mm	1420	1720	1650	1870	2250	2250

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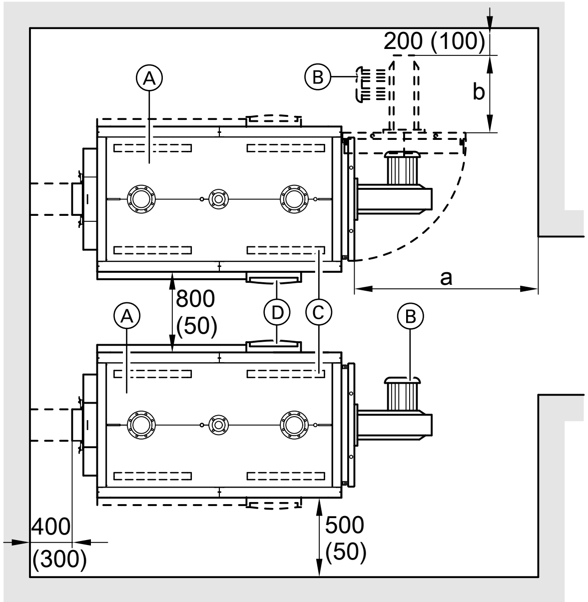
Boiler specification (cont.)

Rated heating output	kW	700	900	1100	1300	1600	1950
m	mm	280	280	300	300	320	320
n	mm	890	1040	1005	1115	1305	1305
o	mm	1270	1270	1480	1480	1690	1690
p	∅ mm	620	620	720	720	720[*4]	720[*4]
q	mm	1700	2000	1930	2150	2530	2530

Dim. k: With boiler door removed

Siting

Minimum clearances



Ⓐ Boiler
Ⓑ Burner
Ⓒ Anti-vibration boiler supports
Ⓓ Boiler control unit

Observe the stated dimensions to ensure straightforward installation and maintenance. Where space is tight, only the minimum clearances (dimensions in brackets) need to be maintained. In the delivered condition, the boiler door is fitted so it opens to the right. The hinge pins can be repositioned so the door opens to the left.

Table of dimensions

Rated heating output	kW	700	900	1100	1300	1600	1950
a	mm	2000	2000	2200	2400	2900	2900
b	mm	Installed burner length					

Dim. a: Maintain this space in front of the boiler to enable the hot gas flues to be cleaned.
If the control units are fitted on opposite sides of the boilers, the 800 mm clearance between the individual boilers can be reduced to 50 mm.

Siting conditions
- Prevent air contamination by halogenated hydrocarbons (e.g. as contained in sprays, paints, solvents and cleaning agents)
- Prevent very dusty conditions
- Prevent high levels of humidity
- Prevent frost and ensure good ventilation

Otherwise the system may suffer faults and damage.
In rooms where air contamination through **halogenated hydrocarbons** may occur, install the boiler only if adequate measures can be taken to provide a supply of uncontaminated combustion air.

Burner installation

Fit the burner plate included in the standard delivery to the hinged boiler door.
The burner must be fitted to the burner plate; mounting it directly onto the boiler door without a burner plate is not possible.
Drill the supplied burner plate on site, in accordance with the burner dimensions.

Burner plates can be prepared at the factory on request (chargeable option). If this is required, state the burner make and type when ordering.
The flame tube must protrude from the thermal insulation of the boiler door.
The burner must not exceed a total weight of 180 kg, otherwise supports will need to be provided on site.

*[*4] Conical combustion chamber 720/840 mm (combustion chamber diameter front/rear)*

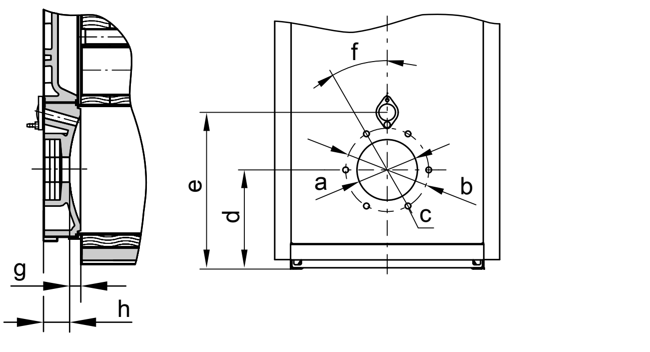
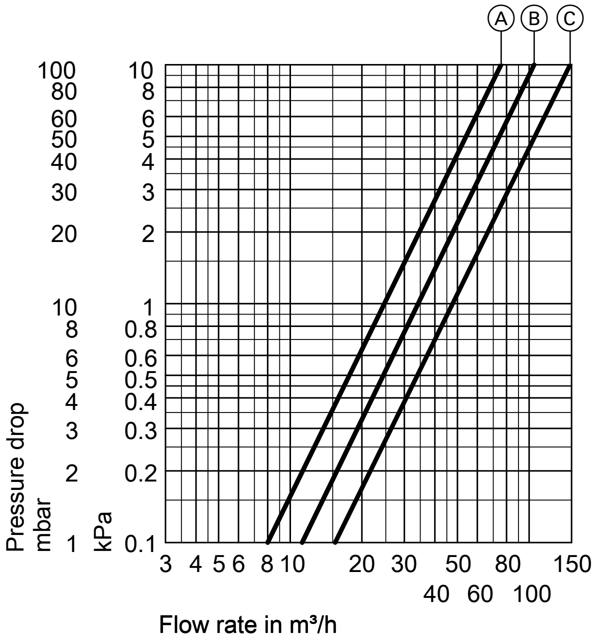


Table of dimensions

Rated heating output	**kW**	**700**	**900**	**1100**	**1300**	**1600**	**1950**
a	∅ mm	350	350	400	400	400	400
b	∅ mm	400	400	490	490	490	490
c	Quantity/ thread	6/M12					
d	mm	525	525	580	580	640	640
e	mm	785	785	885	885	970	970
f	°	15	15	30	30	30	30
g	mm	75	75	75	75	75	75
h	mm	150	150	150	150	170	170

Pressure drop on the heating water side



Ⓐ Rated heating output 700 and 900 kW
Ⓑ Rated heating output 1100 and 1300 kW
Ⓒ Rated heating output 1600 and 1950 kW

The Vitoplex 200 is only suitable for fully pumped hot water heating systems.

Vitotrans 300 specification

Specification

Vitotrans 300 – gas operation – oil operation	 Part no. Part no.	 Z007212 Z007215	 Z007213 Z007216	 Z007214 Z007217
Rated boiler heating output	kW	620-900	630-1300	1600-2000
Rated heating output of the Vitotrans 300 for				
– gas operation	from kW	62.0	63.0	160.0
	to kW	94.5	136.0	204.0
– oil operation	from kW	43.0	44.0	115.0
	to kW	64.0	93.0	140.0
Permiss. operating pressure	bar	6	6	6
	kPa	600	600	600
Permiss. flow temperature (= safety temperature)	°C	110 (120)	110 (120)	110 (120)
Pressure drop on the hot gas side	mbar	0.4-0.8	0.4-1.6	1.0-1.75
	Pa	40-80	40-160	100-175
Flue gas mass flow rate	from kg/h	1010	1057	2670
	to kg/h	1500	2160	3300
Overall dimensions				
Total length (dim. f)	mm	1046	1046	1200
Total width (dim. m), incl. mating flanges	mm	1097	1097	1226
Total height (dim. i)	mm	1783	1783	2024
Transport dimensions				
Length (dim. f)	mm	1046	1046	1200
Width (dim. m), excl. mating flanges	mm	989	989	1112
Height (dim. a)	mm	1674	1674	1915
Total weight heat exchanger incl. thermal insulation	kg	355	355	470
Content				
Heating water	litres	215	215	295
Flue gas	m^3	0.336	0.336	0.544
Connections				
Heating water flow and return	PN 16 DN	100	100	125
Condensate drain	∅ mm	32	32	32
Flue gas connection*5	DN	300	300	350

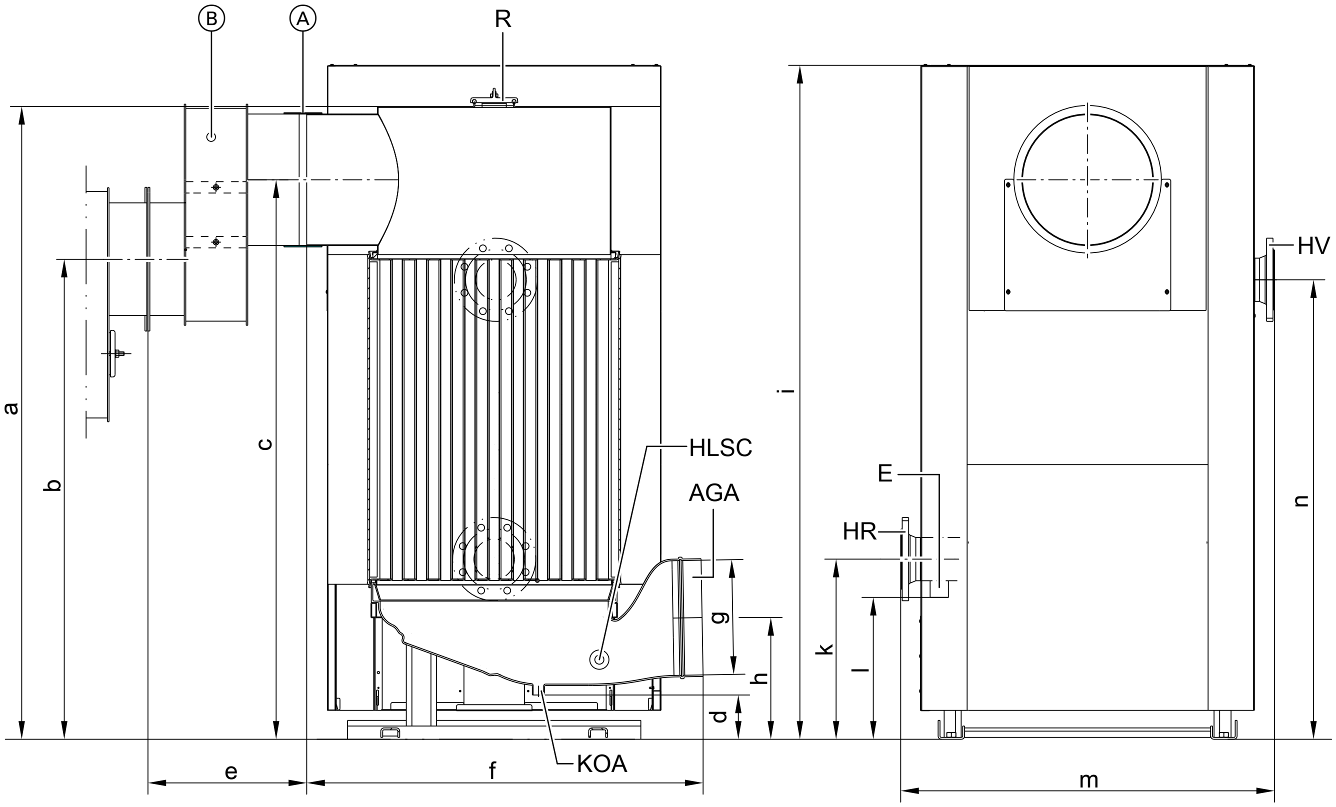
Rated heating output range of the Vitotrans 300 and flue gas temperature
Heating output of the Vitotrans 300 with flue gas cooling of 200/65 °C during gas operation and 200/70 °C during oil operation, with a heating water temperature rise in the Vitotrans 300 from 40 °C to 42.5 °C.
For conversion to other temperatures, see chapter "Output data".

Pressure drop on the hot gas side
Pressure drop on the hot gas side at rated heating output. The burner must overcome the hot gas pressure drop of the boiler, the Vitotrans 300 and the flue pipe.

Tested quality
CE designation according to current EC Directives at a permissible flow temperature (safety temperature) of up to 110 °C to EN 12828.

*5 *For connection dimensions see dimensioned drawing*

Dimensions



Ⓐ	Connection collar
Ⓑ	Offset flue adaptor, only with Z007 212 and Z007 215 for Vitoplex boilers
AGA	Flue outlet
E	Drain connector
HR	Heating water return (inlet)
HV	Heating water flow (outlet)
KOA	Condensate drain
R	Cleaning aperture
HLSC	Fem. connection for flue gas high limit safety cut-out

Dimensions

Part no.		Z007212 Z007215	Z007213 Z007216	Z007214 Z007217
a	mm	1674	1674	1825
b	mm	1270	1480	1690
c	mm	1480	1480	1690
d	mm	116	116	116
e	mm	420	15	15
f	mm	1046	1046	1200
g (internal)	∅ mm	301	301	352
h	mm	321	321	356
i	mm	1783	1783	1934
k	mm	476	476	580
l	mm	375	375	469
m	mm	989	989	1112
n	mm	1215	1215	1297

Note
Height is adjustable for Vitotrans 300.

Delivered condition

Heat exchanger body with fitted flue gas header and integral feet. Mating flanges and screws are fitted to the connector.

1 Box with thermal insulation for flue gas/water heat exchanger
1 Box with collar
1 Crate with offset flue adaptor
1 Box with thermal insulation for offset flue adaptor

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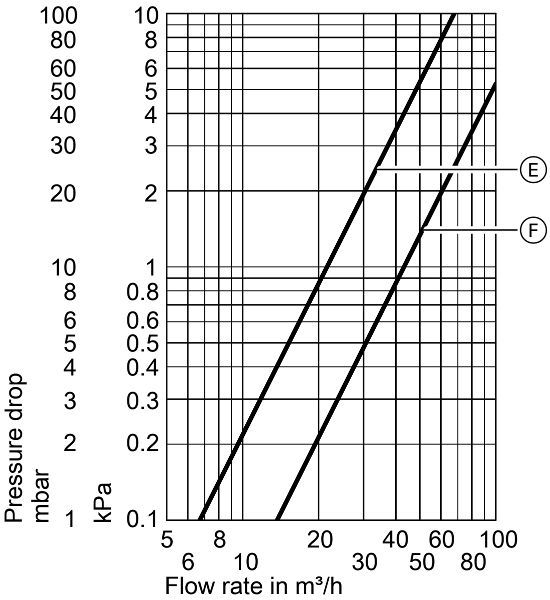
Pressure drop on the heating water side

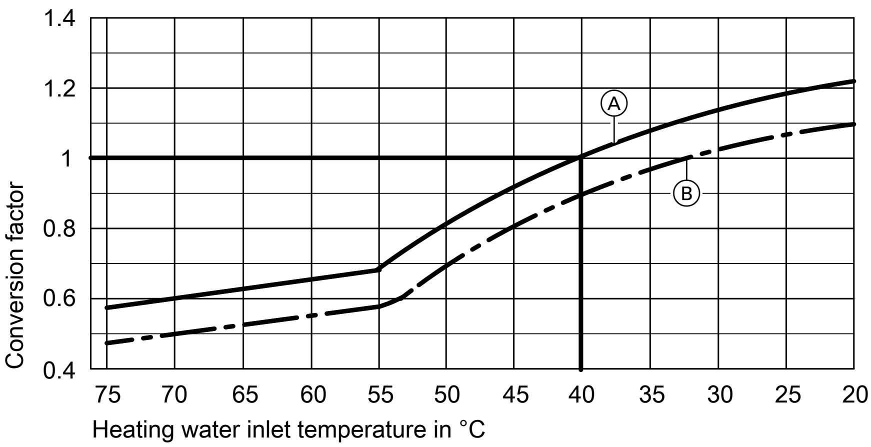
Part no. Z007212 to Z007217



Part no.	Curve
Z007212 Z007213 Z007215 Z007216	Ⓔ
Z007214 Z007217	Ⓕ

Output data

Vitotrans 300 for gas operation



Ⓐ Flue gas inlet temperature 200 °C
Ⓑ Flue gas inlet temperature 180 °C

Conversion of the output data
The heating output data of the Vitotrans 300 flue gas/water heat exchanger refers to a flue gas inlet temperature of 200 °C and a heating water inlet temperature into the heat exchanger of 40 °C.

For different conditions the heating output can be calculated by multiplying the specified rated heating output by the conversion factor established from the diagram.

Delivered condition of the boiler

Boiler shell with fitted boiler door, fitted cleaning cover and permanently fitted boiler cover.
Mating flanges are fitted to all connectors.
The adjusting screws and burner plate can be found inside the combustion chamber.

2 Boxes with thermal insulation and 1 cleaning brush
1 Box with boiler control unit and 1 bag with technical documentation
1 Coding card and technical documentation for Vitoplex 200

Control unit versions

For a single boiler system

- **Vitotronic 100, type CC1E**
  For the control unit with a constant boiler water temperature.
  For weather-compensated or room temperature-dependent operation in conjunction with an external control unit.
- **Vitotronic 200, type CO1E**
  For weather-compensated operation and mixer control for up to 2 heating circuits with mixer. For the 2 heating circuits with mixer, the accessory "Extension for heating circuits 2 and 3" is required.

For a multi boiler system (up to 8 boilers)

- **Vitotronic 300, type CM1E**
  For weather-compensated operation of a multi boiler system. This Vitotronic control unit also handles control of the boiler water temperature of a boiler within this multi boiler system.
  Vitotronic 100, type CC1E and LON communication module
  To control the boiler water temperature for each additional boiler in the multi boiler system.
- **Vitocontrol 100-M/200-M multi mode system controller**
  For weather-compensated cascade control of boilers with Vitotronic 100 control unit and a Vitobloc 200 CHP unit or other heat generator.

Multi mode system controller in the control panel

For single and multi boiler systems

Vitocontrol 100-M
- For operation of multi mode heating systems with up to 4 heat generators, with various combinations of oil/gas boilers, heat pumps, CHP units and solid fuel boilers. The Vitocontrol 100-M can operate a range of defined standard schemes. The schemes are available via the Viessmann Schematic Browser. For the compatibility of the Vitocontrol 100-M in conjunction with Viessmann control units, see the compatibility list. Connection to ViScada for web-based system visualisation is available as an option. This requires an internet connection.
  Viessmann Schematic Browser: **www.viessmann-schemes.com**
  Compatibility list: **www.vitocontrol.info**

Vitocontrol 200-M
- For the operation of customer-specific multi mode energy systems with any number of heat generators in various combinations, as well as cooling, solar, ventilation and electricity components. Solutions are based on a modular system and can be flexibly extended with new functions and process applications. Connection to ViScada for web-based system visualisation is available as an option. This requires an internet connection.

Boiler accessories

See pricelist and "Boiler accessories" datasheet.

Operating conditions with Vitotronic boiler control units

For water quality requirements, see the technical guide to this boiler

		Requirements	
Operation with burner load		**≥ 60 %**	**< 60 %**
1.	Heating water flow rate	None	
2.	Boiler return temperature (minimum value)	– Oil operation 40 ºC – Gas operation 53 ºC	– Oil operation 53 ºC – Gas operation 58 ºC
3.	Lower boiler water temperature	– Oil operation 50 ºC – Gas operation 60 ºC	– Oil operation 60 ºC – Gas operation 65 ºC
4.	2-stage burner operation	Stage 1: 60 % of rated heating output	No minimum load required
5.	Modulating burner operation	Between 60 and 100 % of rated heating output	No minimum load required
6.	Reduced mode	Single boiler systems and lead boiler in multi boiler systems – Operation with lower boiler water temperature Lag boilers in multi boiler systems – Can be shut down	
7.	Weekend setback	As per reduced mode	

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Operating conditions with Vitotronic boiler control units (cont.)

System examples
*Available system examples: See **www.viessmann-schemes.com**.*

Notes

Installing a suitable burner

Delivery without burner.
Suitable pressure-jet oil/gas burners are available from Weishaupt or ELCO and should be ordered separately (see pricelist). Delivery direct from Weishaupt or ELCO.
The material of the burner head must be suitable for operating temperatures of at least 500 ºC.

Pressure-jet oil burner
The burner must be tested and designated to EN 267.

Pressure-jet gas burner
The burner must be tested to EN 676 and be identified with the CE designation.

Burner adjustment
Adjust the oil or gas throughput of the burner to suit the rated boiler heating output.

Permissible flow temperatures

Hot water boiler for permiss. flow temperatures (= safety temperatures)

- Up to 110 °C
  CE designation:
  CE-0085 in accordance with the Gas Appliances Directive
- Above 110 °C (up to 120 °C on request)
  CE designation:
  CE-0035 in compliance with the Pressure Equipment Directive
  For operation with safety temperatures in excess of 110 °C additional safety equipment is required.
  – Boilers with a safety temperature **above 110 °C** must be supervised in accordance with the Operational Safety Ordinance [Germany]. In accordance with conformity assessment diagram no. 5 of the Pressure Equipment Directive, these boilers must be classed as category IV.
    The system must be tested prior to initial commissioning.
    – Annually – external inspection, inspection of the safety equipment and water quality.
    – Every 3 years – internal inspection, alternatively carry out a water pressure test.
    – Every 9 years – water pressure test; for max. test pressure, see the type plate.
    The test must be carried out by an approved inspection body (e.g. TÜV [in Germany]).

Further information on design/engineering

See the technical guide to this boiler.

Tested quality

CE designation according to current EC Directives

ÖVGW Quality Mark for gas and water equipment

Subject to technical modifications.

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Technical Data Sheet — *mtu* 16V4000 GS

TD_0031_L64_2028_50_250_EN_SI_V3	**GG16V4000D1**			
Application			**Power Generation**	
Operation mode			**Grid Parallel**	
Engine type			**16V4000L64FNER EU**	
Voltage / Frequency	V / Hz	**400**		**50**
Cooling water temperature (in / out)	°C		**78 / 91**	
NOx emissions (dry, 5 % O_2)	mg/m³ i.N.		**< 250**	
Mixture cooler 1st stage water temperature (in)	°C			
Mixture cooler 2nd stage water temperature (in)	°C		**45**	
Exhaust gas temperature	°C		**432**	
Catalytic converter			**not included**	
Special equipment				
Elevation above sea level	m / mbar	**100**		**1000**
Combustion air temperature	°C		**25**	
Maximum ambient air dew point on site	°C		**19.0**	
Standard specifications and regulations			**VDE-AR-N 4110**	

Energy balance	**%**	**100**	**75**	**50**
Electrical Power [2,3]	kW	2028	1521	1014
Energy input [4,5]	kW	4751	3626	2549
Thermal output total [6]	kW	2149	1682	1252
Thermal output engine (block, lube oil, 1st stage mixture cooler) [6]	kW	1093	808	554
Thermal output mixture cooler 1st stage[6]	kW			
Thermal output mixture cooler 2nd stage [6]	kW	145	99	62
Exhaust heat optional (120 °C) [6]	kW	(1056)	(874)	(698)
Engine power ISO 3046-1 [2]	kW	2080	1560	1044
Generator efficiency at power factor = 1	%	97.5	97.5	97.1
Electrical efficiency [4]	%	42.7	42.0	39.8
Total efficiency	%	87.9	88.3	88.9
Power consumption [7]	kW			
Combustion air / Exhaust gas				
Combustion air volume flow [1]	m³ i.N./h	7995	6000	4047
Combustion air mass flow	kg/h	10328	7751	5228
Exhaust gas volume flow, wet [1]	m³ i.N./h	8398	6307	4263
Exhaust gas volume flow, dry [1]	m³ i.N./h	7517	5635	3791
Exhaust gas mass flow, wet	kg/h	10677	8016	5415
Exhaust temperature after turbocharger	°C	432	463	523
Reference fuel [8]				
Natural gas			CH_4 >95 Vol.%	
Sewage gas			not applicable	
Biogas			not applicable	
Landfill gas			not applicable	
Propane HD 5			not applicable	
Fuel requirements [9]				
Nominal rated methane number	MN		70	
Range of heating value: design / operation range without power derating	kWh/m³ i.N.		10.0 - 10.5 / 8.0 - 11.0	
Exhaust gas emissions [5,8] Compliance with emissions standards only for ≥ 1014 kWel				
		Raw emissions		**Emissions with Aftertreatment**
NOx, stated as NO_2 (dry, 5 % O_2)	mg/m³ i.N.	< 250		
CO (dry, 5 % O_2)	mg/m³ i.N.	< 1000		
HCHO (dry, 5 % O_2)	mg/m³ i.N.	< 130		
VOC (dry, 5 % O_2)	mg/m³ i.N.			
Otto-gas engine, lean burn operation with turbocharging				
Number of cylinders / configuration		16	/	v
Engine type			16V4000L64FNER EU	
Engine speed	1/min		1500	
Bore	mm		170.0	
Stroke	mm		210.0	
Displacement	dm³		76.27	
Mean piston speed	m/s		10.5	
Compression ratio			12.5	
BMEP at nominal engine speed min-1	bar	21.8		
Lube oil consumption [10]	dm³/h	0.36		
Exhaust back pressure min. - max. after module	mbar - mbar		30 - 60	
Turbocharger setting			H55-TA65	
Generator				
Generator type			LVSI804T2Wdg12	
Rating power (temperature rise class F) [11]	kVA		2800	
Insulation class / temperature rise class			H / F	
Winding pitch			2/3	
Protection			IP 23	
Max. allowable p.f. inductive (overexcited) / capacitive (underexcited) [12]			0.8 / 0.95	
Voltage tolerance / frequency tolerance	%		+/- 10 / +/- 5	
Engine cooling water system				
Coolant temperature (in / out), design	°C	78 / 91		
Coolant flow rate, constant [13,14]	m³/h	80.0		
Pressure drop, design [14] Cv value [13,15]	bar / m³/h	3.3		44.5
Max. operation pressure (coolant before engine)	bar		6	
Mixture cooler 1st stage, external				
Coolant temperature (in / out), design	°C			
Coolant volumetric flow, design, constant [13,14]	m³/h			
Pressure drop, design [14] Cv value [13,15]	bar / m³/h			
Min. coolant flow rate / min. operation gauge pressure	m³/h / bar			
Max. operation pressure before mixture cooler	bar			

Technical Data Sheet

mtu 16V4000 GS

TD_0031_L64_2028_50_250_EN_SI_V3		GG16V4000D1				
Mixture cooler 2nd stage, external						
Coolant temperature (in / out), design		°C	45 / 49.4			
Coolant volumetric flow, design, constant [13] [14]		m³/h	32.0			
Pressure drop, design [14]	Cv value [13] [15]	bar / m³/h	0.42			50.1
Max. operation pressure before mixture cooler		bar		6		
Heating circuit interface						
Engine coolant temperature (in / out), design		°C				
Heating water temperature (in / out), design		°C				
Heating water flow rate, design [14] [16]		m³/h				
Pressure drop in heat exchanger, design [14]	Cv value [15] [16]	bar / m³/h				
Max. operation gauge pressure (heating water)		bar				
Room ventilation						
Genset ventilation heat [17]		kW		119		
Inlet air temperature: (min./design/max.)		°C		20 / 25 / 30		
Min. engine room temperature [18]		°C		15		
Max. temperature difference ventilation air (in / out)		°C		20		
Min. supply air volume flow rate (combustion + ventilation) [19]		m³ i.N./h		24500		
Gearbox		**%**	**100**	**75**		
Efficiency		%				
Starter battery						
Nominal voltage / power / capacity required		V / kW / Ah		24 / 2 x 9 / --		
Filling quantities						
First filling quantity lube oil / refilling amount lube oil		dm³		365 / 330		
Coolant in engine circuit		dm³		270		
Coolant in mixture cooler		dm³		25		
Heating water for plate heat exchanger [20]		dm³				
Lube oil for gearbox		dm³				
Gas regulation line						
Nominal size / gas pressure min. - max. (at gas regulation line inlet)		DN / mbar - mbar	100			142 - 250
Engine sound level [21] (1 meter distance, free field) +3 dB(A) for total A-weighted level tolerance; + 5 dB for single octave level						
Frequency		Hz	**63**	**125**	**250**	**500**
Sound pressure level		dB	84.8	90.5	90.0	93.0
Frequency		Hz	**1000**	**2000**	**4000**	**8000**
Sound pressure level		dB	92.5	91.8	99.2	101.4
Linear total sound pressure level		Lin dB	104.8			
A-weighted total sound pressure level		dB(A)	104.4			
A-weighted total sound power level		dB(A)	124.1			
Undampened exhaust noise [21] (1 meter distance to outlet within 90�, free field) +3 dB(A) for total A-weighted level tolerance; + 5 dB for single octave level						
Frequency		Hz	**63**	**125**	**250**	**500**
Sound pressure level		dB	113.9	119.8	111.9	104.5
Frequency		Hz	**1000**	**2000**	**4000**	**8000**
Sound pressure level		dB	97.1	96.8	94.0	83.9
Linear total sound pressure level		Lin dB	121.6			
A-weighted total sound pressure level		dB(A)	108.0			
A-weighted total sound power level		dB(A)	120.6			
Dimensions (aggregate)						
Length		mm		~ 5400		
Width		mm		~ 1900		
Height		mm		~ 2300		
Weight		kg		~ 17500 (~ 16500)		
Power derating						
Design drawing						
Load step						
Maintenance plan						
Configuration change				No		
Boundary conditions and consumables						
Systems and consumables have to conform to the following actual company standards:				A001072		

1) Normal cubic meter at 1013 mbar and T = 273 K
2) Prime power operation will be designed specific to the project
3) Generator gross power at nominal voltage, power factor = 1 and nominal frequency (ISO 8528-6)
4) According to ISO 3046 (+ 5 % tolerance), using reference fuel used at nominal voltage, power factor = 1 and nominal frequency
5) Emission values during grid parallel operation
6) Thermal output at layout temperature; tolerance +/- 8 %
7) Max. admissible cos phi depending on voltage in accordance with the requirements of the valid 'Standard specifications and regulations'
8) Deviations from the layout parameters respectively the reference fuel can have influence on the obtained efficiency and exhaust emissions
9) Functional capability
10) Reference value at nominal load (without amount of oil exchange) oil density set to 860g/l
11) If the voltage tolerance is greater than +/-5%, the theoretical service life of the insulation system may be reduced due to the permanent max. nominal conditions of the generator.
12) Max. allowable cos phi at nominal power (view of producer)
13) Stated values for cooling fluid composition 65% water and 35% glycol, adaption for use of other cooling fluid composition necessary
The system design must consider the tolerance.
14) Pressure loss at reference flow rate
15) The Cv value declares the volumetric flow in m³/h at a pressure drop of 1 bar. Min. and max. flow rate limits are defined.
16) Stated values for pure water, adaption for other cooling fluid composition necessary
17) Only generator- and surface losses
18) Frost-free conditions must be guaranteed
19) Amount of ventilation air must be adapted to the gas safety concept
20) Assemblies including pipe work
21) All sound pressure levels at nominal load, according to ISO 8528-10 and ISO 6798.
22) Max. admissible cos phi depending on voltage in accordance with the requirements of the valid 'Standard specifications and regulations'

Technical Data Sheet **MTU 12V4000 GS**

TD_0178_L64_1521_50_250_EN_SI_V2	**GG12V4000D1**			
Voltage / Frequency	V / Hz	**400**	**/**	**50**
Cooling water temperature (in / out)	°C		**78 / 90**	
NOx emissions (dry, 5 % O_2)	mg/m³ i.N.		**< 250**	
Mixture cooler 1st stage water temperature (in)	°C			
Mixture cooler 2nd stage water temperature (in)	°C		**45**	
Exhaust gas temperature	°C		**422**	
Catalytic converter			**not included**	
Special equipment				
Elevation above sea level	m / mbar	**100**	**/**	**1000**
Combustion air temperature	°C		**25**	
Relative combustion air humidity	%		**30**	
Standard specifications and regulations			**VDE-AR-N 4110**	

Energy balance	**%**	**100**	**75**	**50**
Electrical Power [2) 3)]	kW	1521	1140	760
Energy input [4) 5)]	kW	3560	2729	1920
Thermal output total [6)]	kW	1608	1260	938
Thermal output engine (block, lube oil, 1st stage mixture cooler) [6)]	kW	828	602	416
Thermal output mixture cooler 1st stage [6)]	kW			
Thermal output mixture cooler 2nd stage [6)]	kW	116	79	50
Exhaust heat optional (120 °C) [6)]	kW	(780)	(658)	(522)
Engine power ISO 3046-1 [2)]	kW	1560	1170	784
Generator efficiency at power factor = 1	%	97.5	97.4	97.0
Electrical efficiency [4)]	%	42.7	41.8	39.6
Total efficiency	%	87.9	87.9	88.4
Power consumption [7)]	kW			
Combustion air / Exhaust gas				
Combustion air volume flow [1)]	m³ i.N./h	6100	4573	3069
Combustion air mass flow	kg/h	7880	5908	3965
Exhaust gas volume flow, wet [1)]	m³ i.N./h	6404	4806	3233
Exhaust gas volume flow, dry [1)]	m³ i.N./h	5748	4302	2878
Exhaust gas mass flow, wet	kg/h	8148	6112	4108
Exhaust temperature after turbocharger	°C	422	458	516
Reference fuel [8)]				
Natural gas			CH_4 >95 Vol.%	
Sewage gas			not applicable	
Biogas			not applicable	
Landfill gas			not applicable	
Fuel requirements [9)]				
Nominal rated methane number	MN		70	
Range of heating value: design / operation range without power derating	kWh/m³ i.N.		10.0 - 10.1 / 8.0 - 11.0	
Exhaust gas emissions [5) 8)] Compliance with emissions standards only for ≥ 760 kWel				
NOx, stated as NO_2 (dry, 5 % O_2)	mg/m³ i.N.	< 250		
CO (dry, 5 % O_2)	mg/m³ i.N.	< 1300		
HCHO (dry, 5 % O_2)	mg/m³ i.N.	< 130		
VOC (dry, 5 % O_2)	mg/m³ i.N.			
Otto-gas engine, lean burn operation with turbocharging				
Number of cylinders / configuration		12	/	v
Engine type			12V4000L64FNER EU	
Engine speed	1/min		1500	
Bore	mm		170.0	
Stroke	mm		210.0	
Displacement	dm³		57.2	
Mean piston speed	m/s		10.5	
Compression ratio			12.5	
BMEP at nominal engine speed min-1	bar	21.8		
Lube oil consumption [10)]	dm³/h	0.27		
Exhaust back pressure min. - max. after module	mbar - mbar		30 - 60	
Generator				
Rating power (temperature rise class F) [11)]	kVA		1935	
Insulation class / temperature rise class			H / F	
Winding pitch			2/3	
Protection			IP 23	
Max. allowable p.f. inductive (overexcited) / capacitive (underexcited) [12)]			0.8 / 0.95	
Voltage tolerance / frequency tolerance	%		± 10 / ± 5	
Engine cooling water system				
Coolant temperature (in / out), design	°C	78 / 90		
Coolant flow rate, constant [13) 14)]	m³/h	63.92		
Pressure drop, design [14)] Cv value [13) 15)]	bar / m³/h	2.8	/	38.7
Max. operation pressure (coolant before engine)	bar		6	
Exhaust gas heat exchanger (EGHE)				
Exhaust gas temperature (out)	°C			
Coolant temperature (in / out), design	°C			
Coolant volumetric flow, constant [13) 14)]	m³/h			
Pressure drop, design [14)] Cv value [13) 15)]	kPa / m³/h		/	
Min. coolant flow rate / min. operation gauge pressure	m³/h / bar		/	
Max. operation pressure (coolant water)	bar			

A Rolls-Royce solution

TD_0178_L64_1521_50_250_EN_SI_V2		GG12V4000D1			
Mixture cooler 1st stage, external					
Coolant temperature (in / out), design		°C			
Coolant volumetric flow, design, constant 13) 14)		m³/h			
Pressure drop, design 14)	Cv value 13) 15)	bar / m³/h		/	
Min. coolant flow rate / min. operation gauge pressure		m³/h / bar		/	
Max. operation pressure before mixture cooler		bar			
Mixture cooling 2nd stage, external					
Coolant temperature (in / out), design		°C	45 / 48.4		
Coolant volumetric flow, design, constant 13) 14)		m³/h	32.0		
Pressure drop, design 14)	Cv value 13) 15)	bar / m³/h	0.42	/	50.6
Max. operation pressure before mixture cooler		bar		6	
Heating circuit interface					
Engine coolant temperature (in / out), design		°C			
Heating water temperature (in / out), design		°C			
Heating water flow rate, design 14) 16)		m³/h			
Pressure drop, design 14)	Cv value 15) 16)	bar / m³/h		/	
Max. operation gauge pressure (heating water)		bar			
Room ventilation					
Genset ventilation heat 17)		kW		88	
Inlet air temperature: (min./design/max.)		°C		20 / 25 / 30	
Min. engine room temperature 18)		°C		15	
Max. temperature difference ventilation air (in / out)		°C		20	
Min. supply air volume flow rate (combustion + ventilation) 19)		m³ i.N./h		18500	
Gearbox		**%**	**100**	**75**	**50**
Efficiency		%			
Starter battery					
Nominal voltage / power / capacity required		V / kW / Ah		24 / 9 / --	
Filling quantities					
First filling quantity lube oil / refilling amount lube oil		dm³		320 / 280	
Coolant in engine circuit		dm³		200	
Coolant in mixture cooler		dm³		20	
Heating water for plate heat exchanger 20)		dm³			
Lube oil for gearbox		dm³			
Gas regulation line					
Nominal size / gas pressure min. - max. (at gas regulation line inlet)		DN / mbar - mbar	80	/	144 - 250

Engine sound level 21) (1 meter distance, free field) +3 dB(A) for total A-weighted level tolerance; + 5 dB for single octave level					
Frequency	Hz	**63**	**125**	**250**	**500**
Sound pressure level	dB	83.3	87.4	88.6	91.3
Frequency	Hz	**1000**	**2000**	**4000**	**8000**
Sound pressure level	dB	90.1	87.3	92.9	103.9
Linear total sound pressure level	Lin dB	104.9			
A-weighted total sound pressure level	dB(A)	104.5			
A-weighted total sound power level	dB(A)	123.9			
Undampened exhaust noise 21) (1 meter distance to outlet within 90°, free field) +3 dB(A) for total A-weighted level tolerance; + 5 dB for single octave level					
Frequency	Hz	**63**	**125**	**250**	**500**
Sound pressure level	dB	118.5	120.3	110.8	102.2
Frequency	Hz	**1000**	**2000**	**4000**	**8000**
Sound pressure level	dB	92.9	92.3	92.1	82.5
Linear total sound pressure level	Lin dB	122.8			
A-weighted total sound pressure level	dB(A)	108.4			
A-weighted total sound power level	dB(A)	121.3			

Dimensions (aggregate)		
Length	mm	~ 4600
Width	mm	~ 1900
Height	mm	~ 2300
Gross weight (dry weight)	kg	~ 13000 (~ 12000)
Power derating		
Maximum ambient air dew point on site	°C	19.0
Combustion air temperature		specific to the project
Mixture cooler coolant temperature (in)		specific to the project
Methane number		specific to the project
Boundary conditions and consumables		
Systems and consumables have to conform to the following actual company standards:		A001072

1) Normal cubic meter at 1013 mbar and T = 273 K
2) Prime power operation will be designed specific to the project
3) Generator gross power at nominal voltage, power factor = 1 and nominal frequency
4) According to ISO 3046 (+ 5 % tolerance), using reference fuel used at nominal voltage, power factor = 1 and nominal frequency
5) Emission values during grid parallel operation
6) Thermal output at layout temperature; tolerance +/- 8 %
7) Power consumption of all electrical consumers which are mounted at the module / genset
8) Deviations from the layout parameters respectively the reference fuel can have influence on the obtained efficiency and exhaust emissions
9) Functional capability
10) Reference value at nominal load (without amount of oil exchange) oil density set to 860g/l
11) Generator (at nominal power) max. 1000 m height of location and max. 40 °C intake air temperature; else power derating
12) Max. allowable cos phi at nominal power (view of producer)
13) Stated values for cooling fluid composition 65% water and 35% glycol, adaption for use of other cooling fluid composition necessary
The system design must consider the tolerance.
14) Pressure loss at reference flow rate
15) The Cv value declares the volumetric flow in m³/h at a pressure drop of 1 bar. Min. and max. flow rate limits are defined.
16) Stated values for pure water, adaption for other cooling fluid composition necessary
17) Only generator- and surface losses
18) Frost-free conditions must be guaranteed
19) Amount of ventilation air must be adapted to the gas safety concept
20) Assemblies including pipe work
21) All sound pressure levels at nominal load, according to ISO 8528-10 and ISO 6798.
22) Max. admissible cos phi depending on voltage in accordance with the requirements of the valid 'Standard specifications and regulations'

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