H1 Assessment to Support a Bespoke Permit Application for Horse Close Anaerobic Digestion (AD) Plant, Courteenhall, Northamptonshire, NN7 2QF

On behalf of: Acorn Bioenergy Operations Limited

ETL747/2025

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Abbreviations

AEL	Associated Emissions Level
AD	Anaerobic Digester
AQIA	Air Quality Impact Assessment
AW	Ancient Woodland
BAT	Best Available Techniques
BG	Biogas
BUU	Biogas upgrading unit
CH_4	Methane
CHP	Combined heat and power (engine)
CO_2	Carbon dioxide
EA	Environment Agency
EAL	Environmental Assessment Level
ELV	Emission Limit Value
EPR	Environmental Permitting Regulations
ETL	Earthcare Technical Ltd
H1	Environment Agency Horizontal Guidance Note H1
H_2S	Hydrogen sulphide
kWe	Kilowatts electrical output
kWthi	Kilowatts thermal input
LWS	Local wildlife site
MCP	Medium Combustion Plant
MCPD	Medium Combustion Plant Directive
MWe	Megawatts electrical output
MWth	Megawatts thermal input
n/a	Not applicable
NG	Natural gas
NGR	National Grid Reference
NMVOC	Non-methane volatile organic compounds
O_2	Oxygen
PC	Process Contribution
PEC	Predicted environmental concentration
PRV	Pressure relief valve
PVRV	Pressure and vacuum relief valve
SO_2	Sulphur dioxide
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TVOC	Total gaseous and vaporous organic substances, expressed as total organic carbon
VOC	Volatile organic compounds

Executive Summary

The H1 Impact Assessment has been prepared by Earthcare Technical Ltd (ETL) on behalf of Acorn Bioenergy Operations Limited (ABL) to support an application for a new bespoke installation permit for an anaerobic digestion (AD) plant including the use of resultant biogas, biogas upgrader, with carbon dioxide capture and liquefaction at Horse Close AD Plant, Courteenhall, Northamptonshire, NN7 2QF (the Site).

The Environment Agency's H1 Assessment Tool has been used for quantitative assessment of the proposed point source emissions to air including the 2No. CHPs, emergency flare, emergency boiler, emergency generator, emissions abatement plant stack for the Manure Reception Building, underground leachate tank vent, covered Digestate Storage Lagoon carbon filter outlet, Liquid Feedstock Tank carbon filter vent, and Liquid Digestate Off-take point carbon filter.

The process contribution of emissions to air and background concentrations have been compared with relevant environmental standards for the protection of health and ecosystems and Environment Agency significance criteria.

Emission rates of pollutants were based on Medium Combustion Plant Emission Limit Values, Best Available Techniques (BAT) Associated Emissions Levels (AELs) and relevant guidance.

The H1 assessment has determined that the pollutant- Environmental Assessment Levels (EALs) which require further assessment using detailed modelling are as follows.

EALs for human health:

- Nitrogen dioxide (annual and 1-hour mean)
- Carbon monoxide (8-hour mean)
- Benzene (annual and 24-hour mean)
- Sulphur dioxide (15-minute mean)
- Sulphur dioxide (24-hour mean)

EALs for potential impacts on the local and nationally designated ecological sites:

- Nitrogen dioxide (ecological - daily mean)
- Sulphur dioxide (ecological-other vegetation)
- Sulphur dioxide (ecological -lichens and bryophytes)
- Ammonia (ecological-other vegetation)
- Ammonia (ecological -lichens and bryophytes, lower critical level of 1µg/m^3)

1 Introduction

This H1 Assessment (H1) is produced to support an application for a new bespoke Installation Environmental Permit for an anaerobic digestion (AD) plant including the use of resultant biogas for Horse Close AD Plant, located on agricultural land at Couteenhall, Northamptonshire, NN7 2QF centred on National Grid Reference (NGR): SP 77438 52588, herein termed 'the Site'. The plant will be operated by Acorn Bioenergy Operations Limited (ABL), herein termed 'the Operator'.

The permit application, which this H1 supports, is for a bespoke permit based upon Standard Rules Permit *SR2021 No 6: Anaerobic digestion facility, including use of the resultant biogas – installations*[1]. For a Part A installation with an anaerobic digestion capacity of over 100 tonnes of waste, or a combination of waste and non-waste each day and accepting no more than 100,000 tonnes per year.

An H1 risk assessment using the H1 tool, which is intended to be a conservative tool, is used to screen out the pollutants from the proposed emission sources that do not require further assessment. Pollutants that do not screen out would need to be considered in an Air Quality Impact Assessment (AQIA) which would use detailed dispersion modelling.

1.1 Site location

The Proposed Development is located within the administrative area of West Northamptonshire Council. The nearest Air Quality Management Area (AQMA) is situated approximately 7.7km to the north northwest.

The Site is situated approximately 170m southwest of the M1. Land use in the immediate locale is agricultural; there is a permitted poultry Installation located adjacent to the northeast of the Site boundary. The nearest sensitive receptors include commercial premises at East Lodge, Courteenhall, approximately 211m to the north of the proposed site boundary, and a residential property at East Lodge, Courteenhall, located approximately 270m north of the Site. The village of Roade lies over 1.4km west of the Site.

Within 2km of the proposed site, there are two sites of Ancient Woodland (AW), and four Local Wildlife Sites (LWS), and within 10km, one site designated as a Special Protection Area (SPA), Ramsar and Site of Special Scientific Interest (SSSI).

1.2 Site description

Figure 1 shows the proposed green line permit boundary for the AD Plant and the proposed locations of the point source emissions to air.

With specific regard to emissions to air, supporting infrastructure includes the following, where numbering A1-A24 refer to point source emissions, as shown on the emission point plan (Figure 1) and within Table 1 below.

[1]https://www.gov.uk/government/publications/sr2021-no-6-anaerobic-digestion-facility-including-use-of-the-resultant-biogas-installations/sr2021-no-6-anaerobic-digestion-facility-including-use-of-the-resultant-biogas-installations

Table 1 Description of emission points A1-A24

Emission Point Reference	Source
A1	Combined Heat and Power Engine stack 1 (8.7m height stack TEDOM Quanto 1200 1.2MWe)
A2	Combined Heat and Power Engine stack 2 (8.7m height stack (TEDOM Quanto 1200 1.2MWe)
A3	Emergency Flare (10.5m height stack)
A4	Emergency Boiler stack (7m height stack) 500 kWtho (BG)/ 560kWtho (NG)
A5	Emergency Diesel Generator (770 kVA)
A6	Emissions abatement plant stack (Manure Reception Building)
A7	Biogas upgrade unit Pressure Relief Valve (PRV)
A8	Biogas upgrade unit and carbon dioxide recovery vent
A9	Carbon dioxide recovery plant PRV 1
A10	Carbon dioxide recovery plant PRV 2
A11	Compressor PRV 1
A12	Compressor PRV 2
A13	Underground Leachate Tank vent
A14	Pressure and Vacuum Relief Valve (PVRV) on Primary Digester 1
A15	PVRV on Secondary Digester 1
A16	PVRV on Primary Digester 2
A17	PVRV on Secondary Digester 2
A18	PVRV on Tertiary Digester
A19	Covered Digestate Storage Lagoon (12,350m^3 capacity) carbon filter outlet
A20	Liquid Feedstock Tank carbon filter outlet
A21	Liquid Digestate Off-take point carbon filter outlet
A22	PVRV on liquid Digestate Storage Lagoon
A23	Carbon dioxide recovery plant unit carbon dioxide vent
A24	Liquid digestate off-take point carbon filter outlet

The facility will treat around 94,900 tonnes per annum (TPA) of liquid and solid feedstocks comprising livestock waste (poultry litter, farmyard manures and slurry), energy crops and crop residues; and as well as dirty water and several non-hazardous liquid wastes to supplement process water use and reduce consumption of potable water. The 6.2ha of site area was previously arable land and is adjacent to a poultry unit, the manures from which will be treated within the AD Plant.

The site will produce 20,286 Nm^3/y of biogas which will be used on site to generate heat and power and upgraded to biomethane for injection to the National Gas Grid via virtual pipeline and carbon dioxide (CO_2) captured for use or sequestration. In addition, around 26,182 TPA of solid fibre digestate and 67,454 TPA of liquid digestate will be produced to be used as a biofertiliser on local farms.

All solid manure feedstock is received and processed within an enclosed Manure Reception Building which benefits from the continuous operation of an air extraction and emissions abatement plant (emission point **A6**).

There are two PowerRing Digesters (incorporating a primary and secondary digester in a unique Biogest design) and one Tertiary digester. Each digester will have a PVRV (emission points **A14** to **A18**) to emit biogas or take in air if there is an over-pressure or under-pressure event respectively. PVRVs will not operate during normal operation, over-pressure is managed by operation of the emergency flare (emission point **A3**) before the PVRVs. The operation of the digester PVRVs is therefore not considered within the H1 assessment.

Emissions will be released from the combustion of biogas (BG) in CHP1 including emissions of sulphur dioxide (SO_2), total volatile organic compounds (TVOC), nitrogen oxides (NOx) and carbon monoxide (CO) and from the combustion of natural gas (NG) in CHP2 (TVOC, NOx and CO) from 8.7m height stacks (emission points **A1** and **A2**). The 2No. 1,200 kWe CHPs are required to meet the Medium Combustion Plant (MCP) Directive Emission Limit Values (ELVs) for SO_2 and NOx for new plant.[2] The emissions and monitoring standards that apply to TVOC and CO from biogas fuelled engines are the same as those applied to landfill gas engines under LFTGN08 2010: guidance for monitoring landfill gas engine emissions.[3]

- 107 mg/Nm^3 for SO_2 (5% O_2), MCP ELV (for biogas)
- 500 mg/Nm^3 for NOx (5% O_2), MCP ELV (for biogas)
- 250 mg/Nm^3 for NOx (5% O_2), MCP ELV (for natural gas)
- 1,000 mg/Nm^3 for TVOC (5% O_2), LFTGN08
- 1,400 mg/Nm^3 for CO (5% O_2), LFTGN08

Biogas may be burnt under abnormal operating conditions such as during extended periods of maintenance of the CHPs and/or malfunction of the BUU by the emergency flare (emission point **A3**). The flare should operate for a limited number of hours per year (<10% or <876 hours) as it is only used under abnormal operating conditions. Guidance for monitoring enclosed landfill gas flares (LFTGN 05[4]) sets out the emission standards for enclosed gas flares:

- 150 mg/Nm^3 for NOx (3% O_2), LFTGN 05
- 50 mg/Nm^3 for CO (3% O_2), LFTGN 05
- 10 mg/Nm^3 for TVOC (3% O_2), LFTGN 05

[2] DIRECTIVE (EU) 2015/2193 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants
[3] Environment Agency (2010) LFTGN08 v2 2010: guidance for monitoring landfill gas engine emissions (https://assets.publishing.service.gov.uk/media/5a7d87c140f0b64fe6c24434/LFTGN08.pdf)
[4] Environment Agency (2010) Guidance for monitoring enclosed landfill gas flares LFTGN05 v2 2010 (https://www.gov.uk/government/publications/monitoring-enclosed-landfill-gas-flares-lftgn-05)

The emergency biogas boiler (emission point **A4**) will be used to generate heat for the AD plant when the CHPs are unavailable and/or cannot provide sufficient heat to the AD Plant, for instance in the event of extreme cold weather, or CHP breakdown or prolonged unscheduled maintenance. It has been conservatively assumed in this H1 assessment that the emergency boiler could potentially operate approximately 15% of the time (i.e. for approximately two months) but it is expected it will in practice operate less than 5% of the time. The emergency boiler can run on natural gas if required. The emergency boiler will not be used in normal operation.

The boiler will release emissions to air of NOx, SO_2 and CO from the 7m stack. The 647kWthi (thermal input) biogas-fired emergency standby boiler will meet the MCP Directive ELVs for new plant fired by biogas although it is not an MCP as its thermal input is less than 1MW. There are no BAT-AELs for TVOC and CO, emissions of which will be negligible from the emergency boiler:

- 100mg/Nm^3 for SO_2 (3% O_2), MCP ELV
- 200mg/Nm^3 for NOx (3% O_2), MCP ELV
- No limit set for CO (3% O_2)

An emergency standby diesel generator (770 kVA, 616kWe, 1,867kWthi) (emission point **A5**) will provide power when the CHPs are not operational and if power is not available from the grid. Therefore, it would be used only as an emergency backup operating typically less than 50 hours per year and operating less than 500 hours per year as a 3-year rolling average. It would be exempt from meeting MCPD ELVs and as such is not part of the H1 quantitative assessment.

Biogas (45 - 60% CH_4 by volume) will enter the BUU where it will be treated to create biomethane (~97% CH_4 by volume) which leaves the BUU. Biogas from the gas holders will be pass through a series of gas treatment steps including cooling, filtration (2No. carbon filters to remove hydrogen sulphide (H_2S) and 1 No. filter for VOCs, compression prior to three-stage membrane filtration which separates the biogas into methane (CH_4) and CO_2.

Under normal operating conditions there will be no emissions from the BUU. Biogas will be released from the Pressure Relief Valve (PRV) on the BUU in over-pressure scenarios only (emission point **A7**). If the CO_2 recovery plant is not operating, then CO_2 is released from the BUU via a stack ('CO_2 vent', emissions point **A8**), as is normal practice when CO_2 capture equipment is not installed. The cleaned gas that is vented must comply with Gas Safety Management Regulations for H_2S and total sulphur, and TVOC at minimal level of detection. The release of CO_2 due to the abnormal operation of the BUU vent or PRV has therefore not been considered within the H1 assessment.

The BUU will be fitted with CO_2 recovery equipment so the remaining CO_2 output stream will not be released to air but captured. The CO_2 is compressed in a two-stage process compressor and passed through an automatic molecular sieve dryer to completely remove moisture. When both the BUU and CO_2 recovery plant are operational, cleaned gas may be released from the PRVs in (abnormal) over-pressure scenarios only (emission points **A9** and **A10**). The BUU compressor has two PRVs (emission points **A11** and **A12**).

The gas (99.9% v/v CO_2 purity) is sent to a CO_2 liquefier; traces of non-condensable gases still contained in the CO_2 gas remain gaseous when the CO_2 transforms to liquid in the liquefier. Any entrained non-condensable gases, such as oxygen, methane, and nitrogen are effectively removed in a stripping tower.

These non-condensable gases are used for regeneration of the dryer, the pure liquid CO_2 flows to a storage tank.

Under normal operating conditions there will be no emissions from the CO_2 recovery unit. CO_2 may also be released via a vent on the CO_2 capture equipment (emission point **A23**), when carbon capture is not being undertaken. The gas treatment technology is designed specifically to remove contaminants and ensure a high level of CO_2 purity. Emissions from the CO_2 recovery plant have therefore not been assessed.

Silage leachate is produced from storage of silage. The leachate runs forwards from the clamps into drainage channels, then to an (54 m^3) underground leachate storage tank, from which it is passed to the process water tanks, then used in the AD process. The leachate storage tank will be fitted with one vent (emissions point **A13**).

Tankers discharge liquid feedstock via sealed pipework into the Liquid Feedstock Tank (402 m^3). The headspace of the Liquid Feedstock Tank will be linked to an impregnated carbon filter outlet (**A20**).

Whole digestate from the Tertiary digester will be screened and pasteurised before being cooled. Pasteurised digestate is pumped to the Hygienized Digestate Tank (80 m^3). Any displaced air during the pasteurisation process will be directed either to the gas line or to the Manure Reception Building emissions abatement plant. Whole digestate is then routed to the 2 No. RC75 Börger type mechanical separators capable of separating 75 m^3/hr and up to 1800 m^3 per day of whole digestate each.

Separated liquor is pumped from the separator to either: the 12,350m^3 covered Digestate Storage Lagoon or the sealed 402 m^3 Digestate Buffer Tank. Any displaced air during this transfer will be directed either to the gas line or to the Manure Reception Building emissions abatement plant. During filling of the lagoon, when the Site is supervised during operational hours, a fan will be used to assist with ventilating displaced air through an impregnated carbon filter outlet (emission point **A19**). The fan will not operate at other times and the connection to the carbon filter sealed.

There will be a PVRV connected to the Liquid Digestate Lagoon as a safety feature to manage over pressure within the lagoon storage system should this occur (emission point **A22)**. This will not operate under normal conditions and therefore this emission point is not considered further within the assessment. Tankers will be filled with liquid digestate at 2No. tanker loading points, each fitted with an impregnated carbon filter emissions abatement system. It is expected that 75% of all vehicle offtake movements will take place at the main site's loading point (emission point **A24**), while the remaining 25% will occur at the loading point adjacent to the digestate lagoon (emission point **A21**).

1.3 About this report

This report describes: the assessment methodology and source data (section 2); the calculated impact (section 3); and concludes in section 4. Appendix A shows the H1 input and output tables.

2 Assessment methodology

2.1 H1 Emissions to Air Screening Assessment

The H1 screening evaluation has been undertaken following H1 methodology, set out in Environment Agency (EA) guidance[5] and using the EA H1 Assessment Tool spreadsheet (v9.2). [6]

2.2 Assessment Criteria

2.2.1 Air Quality Standards and Critical Levels – Human Health

Table 2 sets out those Air quality strategy (AQS) objectives, Ambient Air Directive (AAD) Limit Values and Environmental Assessment Levels (EALs) for the protection of human health that are relevant to this assessment in determining receptor exposure. In the H1 Assessment Tool these are all referred to as EALs. Emissions are specified as TVOC for which there are no AQS. TVOCs are therefore assessed as benzene, one component of TVOCs for which there is an AQS.

Table 2 Air Quality Standards and critical levels for human health

Substance	Emission period	Limit (average)	Standard	Exceedances[1]
Ammonia	1 hour	2,500 µg/m^3	EAL	None
Ammonia	Annual	180 µg/m^3	EAL	None
Benzene	24 hour	30 µg/m^3	EAL	None
Benzene	Annual	5 µg/m^3	AAD Limit Value and AQS Objective	None
Carbon monoxide	8 hour running average across a 24-hour period	10,000 µg/m^3	AAD Limit Value	None
Nitrogen dioxide	1 hour	200 µg/m^3	AAD Limit Value	Up to 18 1-hour periods
Nitrogen dioxide	Annual	40 µg/m^3	AAD Limit Value	None
Sulphur dioxide	15 minutes	266 µg/m^3	UK AQS Objective	Up to 35 15-minute periods
Sulphur dioxide	1 hour	350 µg/m^3	AAD Limit Value	Up to 24 1-hour periods
Sulphur dioxide	24 hour	125 µg/m^3	AAD Limit Value	Up to 3 24-hour periods

Notes: from https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit
[1]number of times a year that the limit may be exceeded
AQS: Air quality strategy; AAD: Ambient Air Directive; EAL: Environmental Assessment Level

[5] Environment Agency and Department for Environment, Food & Rural Affairs, Air emissions risk assessment for your environmental permit (last updated 7 January 2025), Available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [Accessed February 2025]
[6] Atmospheric Dispersion Modelling Liaison Committee, H1 Risk Assessment Tool, Available at: https://admlc.com/h1-tool/ [Accessed January 2025]

2.2.2 Environmental standards for protected conservation areas

The AQS objectives and AAD Limit Values for the protection of vegetation and ecosystems applicable to this assessment are presented in Table 3.

Table 3 Environmental Standards for protected conservation areas

Substance	Target	Emission period
Ammonia	1 µg/m^3 where lichens or bryophytes (including mosses, landworts and hornwarts) are present. 3 µg/m^3 where they are not present.	Annual
Sulphur dioxide[1]	10 µg/m^3 where lichens or bryophytes are present 20 µg/m^3 where they are not present	Annual
Nitrogen oxides (expressed as nitrogen dioxide)[2]	30 µg/m^3	Annual
Nitrogen oxides (expressed as nitrogen dioxide)	75 µg/m^3 200 µg/m^3 for detailed assessments where the ozone is below the AOT40[7] critical level and sulphur dioxide is below the lower critical level of 10 µg/m^3	Daily
Notes: from https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [1]20 µg/m^3 is an AAD Limit Value if you have nature or conservation sites in the area; [2]30 µg/m^3 is an AAD Limit Value		

[7] The sum of difference between hourly ozone concentration and 40ppb for each hour when the concentration exceeds 40ppb during a relevant growing season (May to July). Available at: AOT40 — European Environment Agency (europa.eu) [Accessed February 2025]

Environment Agency Risk Assessment Guidance

The current evaluation is based on EA risk assessment guidance[5] to determine the significance of the predicted impact. The guidance provides screening criteria for quantifying the environmental impacts of emissions to air. The criteria include long and short-term EALs.

The guidance considers initial H1 screening and then detailed modelling. At the initial screening stage, **Test 1**, long-term and short-term concentrations due to the sources entered, referred to as the Process Contribution (PC) can be screened out from further assessment if:

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

The second stage of screening, **Test 2**, considers the background concentration as well as the PC.

Defra provides maps of 2025 background concentrations of NOx and NO_2 on a 1km x 1km gridded basis that have been projected from a reference year of 2021;[8] and data for SO_2 and benzene for 2023, CO for 2010, also on a 1km x 1km basis.[9] Defra guidance states that the concentrations for SO_2, benzene and CO can be used, unadjusted for future years, such as 2025. Background 2025 concentrations have been determined using background monitoring data (for NO_2),[10] otherwise the maps and factors have been used, which are shown in Table 11. Background concentrations of ammonia (NH_3) are not part of the Defra mapped data and have been obtained from APIS.[11] For each pollutant, the maximum background value for human and/or ecological receptor locations have been applied in the screening assessment.

The Predicted Environmental Concentration (PEC) is the sum of the PC and background concentration. A further assessment is not needed if:

- for human receptors only, the short-term PC is less than 20% of the short-term environmental standards minus twice the long-term background concentration i.e., less than 20% of the 'Headroom', and
- the long-term PEC is less than 70% of the long-term environmental standards.

In accordance with the guidance, it is not necessary to calculate PEC for short-term targets. For an ecological receptor, if the short-term PC exceeds 10% of the EAL, detailed modelling is required.

If the PC cannot be screened out on that basis, the guidance outlines further steps, including detailed modelling, which may lead to a requirement to carry out a cost-benefit analysis.

[8] Defra, Background Maps, Available at: https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html (Accessed January 2025].
[9] Defra, UK AAIR, Modelled background pollution data, Available at: https://uk-air.defra.gov.uk/data/pcm-data [Accessed 17 January 2025]
[10] West Northamptonshire Council 2024 Air Quality Annual Status Report, 3rd September 2024. https://www.westnorthants.gov.uk/environmental-health/air-quality/air-quality-reports-and-data.
[11] Air Pollution Information System, Available at www.apis.ac.uk, [Accessed January 2025]

2.3 H1 Inputs – Process Emissions

Table 4 details the H1 input parameters for the point source emissions; the input data entered in the H1 Assessment Tool is shown in Appendix A, Table 7 and Table 8. It has been assumed that the CHP will operate 100% of the time and, as a worst case, that the emergency boiler will operate for approximately 2 months (15% of the time) and the emergency flare for 10% of the time. This is a conservative estimate as the boiler will typically operate for approximately 5% of the time.

Emissions are specified as TVOC for which there are no AQS. There is an AQS for benzene, one component of TVOC. An AEA Technology report on the Speciation of UK emissions of non-methane volatile organic compounds (2002)[12] reported on a series of VOC species profiles available for stationary combustion sources, covering a range of both fuel types and scale of combustion. The benzene fraction in industrial and commercial combustion of natural gas was reported to be less than 10% of the non-methane volatile organic compounds (NMVOCs), a subset of TVOC. For flares the NMVOC ELV is usually given as half that of TVOC, so the flare it has been assumed that 5% of the TVOC emission is benzene. The assumption is conservative as benzene is one component of NMVOC. For the CHPs, monitoring data from another AD site has shown that NMVOC, of which benzene is a component, is less than 2% of TVOC, so benzene has been assessed as 2% of TVOC. Both assumptions are conservative as benzene is one component of NMVOC.

Emissions have been assumed to meet the MCP ELVs where applicable (section 1.2). For the boiler, emissions of TVOC and CO will be negligible.

The effective stack height has been calculated for each point source in accordance with EA guidance and are provided in Table 4 and Table 5.[13]

[12] N R Passant (2002) Speciation of UK emissions of non-methane volatile organic compounds. Reference: AEAT/ENV/R/0545 Issue 1

[13] Gov.uk Air emissions risk assessment for your environmental permit: Effective height of release: impact of nearby buildings (https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit) (accessed June 2025).

Table 4 CHPs, emergency flare and emergency boiler emission parameters (A1-A4)

Parameter	Units	CHP A1 (BG) [1]	CHP A2 (NG) [2]	Emergency flare (A3) [3]	Emergency boiler (A4) [4]
Location	Easting, Northing	477444, 252701	477451, 252706	477369, 252700	477456, 252693
Fuel	-	Biogas	Natural gas	Biogas	Biogas/ Natural gas
Electrical output	kWe	1,200	1,200	-	-
Thermal output	kWtho	n/a	n/a	-	500 (BG) 560 (NG)
Stack height	m	8.7	8.7	10.51	7.0
Effective stack height	m	0	0	2.5	0
Internal diameter at exit	m	0.4	0.4	1.864	0.25
Volume flow rate (dry)	Nm^3/s	1.04	1.19	4.5	0.14
Volume flow rate (wet)	Am^3/s	2.21	2.51	57.5	0.30
Velocity	m/s	17.6	20.0	21.1	6.01
Temperature	°C	150	150	1,000	180
Exit concentration SO_2	mg/Nm^3	107 (ELV, 5% O_2)	n/a	n/a	100 (ELV, 3% O_2)
Exit concentration TVOC	mg/Nm^3	1,000 (ELV, 5% O_2) (20) [5]	1,000 (ELV, 5% O_2) (20) [5]	10 (ELV, 3% O_2) (0.5) [6]	n/a
Exit concentration NOx	mg/Nm^3	500 (ELV, 5% O_2)	250 (ELV, 5% O_2)	150 (ELV, 3% O_2)	200 (ELV, 3% O_2)
Exit concentration CO	mg/Nm^3	1,400 (ELV, 5% O_2)	1,400 (ELV, 5% O_2)	50 (ELV, 3% O_2)	n/a

Notes:

[1] CHP1, TEDOM Quanto 1200 TCG2020V12, fuelled by biogas (Appendix B). ELVs are the MCP Directive values for new plant (Annex II, Part 2, Table 2: gaseous fuels other than natural gas). Flue gas diameter and height were advised by ABL based on similar plant. The exhaust gas volume flow rate (wet) is from the manufacturer's datasheet; the oxygen (8%) and moisture content (10%) were estimated based on monitoring data from comparable engines.

[2] CHP2, TEDOM Quanto 1200 TCG2020V12, fuelled by natural gas (Appendix B). ELVs are the MCP Directive values for new plant (Annex II, Part 2, Table 2: natural gas). Flue gas diameter and height were advised by ABL. The exhaust gas volume flow rate (wet) was taken from the manufacturer's datasheet; the oxygen (8%) and moisture content (10%) were estimated based on monitoring data from comparable engines.

[3] Based on GT Himmel flare, MTU 3000-HT-GVD. Maximum capacity 2,600 Nm^3/h biogas. Flame temperature > 1,000°C (Appendix C). Data on ELVs, temperature and volume flow rate were supplied by the manufacturer. Emission rates shown are for continuous operation; for long-term impact it has been assumed the flare will operate for a maximum of 10% of the time. The oxygen and moisture content were estimated based on a first principles calculation.

[4] Boiler parameters based on a specification for 560 kW, Veissmann Vitoplex 200, Type SX2A, Dual fuel: oil/gas boiler (Appendix D). ELVs for SO_2 and NOx are the MCP Directive values for new plant (Annex II, Part 2, Table 1). The specification was used to reference volumetric flow rates; the oxygen (4.3%) and moisture (15.2%) content of the exhaust gas have been referenced from monitoring data from the same boiler at Wardley Biogas AD Facility (16 November 2020). Emission rates shown are for continuous operation; for long-term impact it has been assumed the emergency boiler will operate for a maximum of 15% of the time.

[5] TVOC emission rates have been calculated on the basis of the likely benzene component: represented as 2% of TVOC emissions from the CHP i.e. 2% of TVOC ELV of 1,000 mg/m^3. Brackets denote the adjusted benzene emission concentration; the release concentration of 20 mg/m^3 is used as input in H1 screening.

[6] Benzene emissions have been represented as 5% of TVOC emissions from the emergency flare i.e., 5% of TVOC ELV of 10 mg/m^3. Brackets denote the benzene emission concentration; the release concentration of 0.5 mg/m^3 is used as input in H1 screening.

Table 5 Stack and emission parameters: A6, A13, A19-A24

Parameter	Units	(A6) Emissions abatement plant stack[1]	(A13) Leachate tank vent[2]	(A19) Covered Digestate Storage Lagoon carbon filter outlet [4]	(A20) Liquid Feedstock Tank carbon filter	(A21) Liquid Digestate Offtake point carbon filter [8]	(A24) Liquid digestate offtake point carbon filter [9]
Location	NGR (X,Y) m	477396, 252632	477396, 252639	477421, 252533	477439, 252674	477421, 252522	477368, 252575
Stack height	m	15.5	0.1	2.0	2.0	2.0	2.0
Effective stack height	m	2.6	0	3.3	0	3.3	0
Internal diameter at stack exit	m	0.70	0.34 [10]	0.20	0.15	0.15	0.15
Volume flow rate (dry)	Nm^3/s	-	-	-	-	-	-
Volume flow rate (wet)	Am^3/s	5.14	0.009	0.069	0.001	0.018	0.018
Exit velocity	m/s	13.4	0.1	2.21	0.05	1.01	1.01
Temperature	°C	22.5	Ambient	Ambient	Ambient	Ambient	Ambient
Exit concentration NH_3	mg/Nm^3	20.0	32.3 (2.9) [3]	969 (19) [5]	508 (20) [7]	1.19 (0.06) [9]	1.19 (0.18) [9]
Exit concentration Odour	ou_E/Nm^3	1,000	10,000 (900) [3]	10,000 (200) [5, 6]	10,000 (400) [7]	10,000 (184) [9]	10,000 (551) [9]

Notes:

[1] Emissions abatement system designed and supplied by Centri-Air AB. Data on the extraction system flow rates and design parameters taken from the data sheet (Appendix E). NH_3 concentrations (29ppm or 20 mg/m^3 at 22.5°C) based on technical specification; odour concentrations are based on BAT-AEL for channelled emissions (1,000 ou_E/Nm^3). The BAT-AEL for NH_3 and odour is not necessarily applicable where waste is derived principally from manure.

[2] Underground leachate tank vent: stack height, diameter and volume flow rates based on assumptions. Exit concentrations of NH_3 have been calculated based on the nitrogen content of fresh matter in the feedstock (5.3kg total N/tonne) derived from the feedstocks used within the process. Odour concentrations based on measured odour concentrations for a digestate storage lagoon (AS Modelling & Data, 2017[14]). A 55% reduction to emissions has been applied to account for dilution of the leachate by surface water run-off.

[3] Brackets indicate values used, factored to account for 55% reduction in emissions due to dilution of leachate stored and 80% due to containment within the underground tank.

[4] 1No. carbon filter outlet: stack height, diameter and volume flow rates based on assumptions. NH_3 concentrations have been calculated based on the nitrogen content of fresh matter in the feedstock (5.3kg total N/tonne) derived from the feedstocks used within the process. Odour concentrations based on measured odour concentrations for a digestate storage lagoon.[14]

[5] NH_3 concentration at outlet based on upper BAT limit of 20 mg/m^3 (29ppm at 22.5°).

[6] Brackets indicate values used for modelling, factored to account for 90% reduction in emissions due to containment within a digestate storage lagoon, and a further 80% reduction in emissions through the carbon filter.

[14] A S Modelling & Data (2017) A Dispersion Modelling Study of the Impact of Odour from the Proposed Biofertilizer Storage Lagoon at land west of Hangman Stone Lane, near High Melton in South Yorkshire.

[7] NH_3 concentrations have been calculated based on the nitrogen content of slurry (4.2kg total N/tonne) that may be used within the process. Odour concentrations based on measured odour concentrations for a digestate storage lagoon.[15] Brackets indicate values used for modelling, factored to account for 80% reduction in emissions due to containment within the tank, and a further 80% reduction in emissions through the carbon filter.
[8] Digestate off-take point with carbon filter abatement system. Stack height, diameter and volume flow rates from carbon filter based on assumptions. NH_3 concentrations have been calculated based on the nitrogen content of fresh matter in the feedstock (5.3kg total N/tonne) derived from the feedstocks used within the process. Odour concentrations based on measured odour concentrations for a digestate storage lagoon.[15]
[9] Emission rates have been factored to account for: 75% of offtake movements occurring at emission point A24 and the remaining 25% at emission point A21; together with intermittent tanker filling, assuming constant rate Monday to Friday, 10 hours per day, Saturday 5 hours per day (2,860 hours/ year), with a further reduction of 80% in emissions through a carbon filter.
[10] Equivalent diameter.

[15] A S Modelling & Data (2017) A Dispersion Modelling Study of the Impact of Odour from the Proposed Biofertilizer Storage Lagoon at land west of Hangman Stone Lane, near High Melton in South Yorkshire.

3 Impact assessment

Output tables from the H1 Assessment Tool are shown in Appendix A, Table 9 to Table 12. Table 9 shows the long-term and short-term PCs and EALs for each pollutant.

3.1 Air Impact Screening

Test 1 of the assessment compared the long-term and short-term PCs calculated by the H1 Assessment Tool with the relevant EALs for both operating scenarios.

Test 2 compared the long-term PECs are compared with the EALs and the short-term PCs with Headroom (EAL minus twice the long-term background concentration) for both operating scenarios.

The results of Air Impact Screening Test 1 and Test 2 are summarised in Table 6.

Table 6 Summary of Test 1 and Test 2 Screening results

Substance	Test 1	Test 2
Sulphur dioxide (15 min mean)	Fail	Fail
Sulphur dioxide (24 hr mean)	Fail	Fail
Sulphur dioxide (ecological-lichens and bryophytes)	Fail	Fail
Sulphur dioxide (ecological-other vegetation)	Fail	Fail
Nitrogen dioxide	Fail	Fail
Nitrogen oxides (as NO_2) (ecological)	Fail	Fail
Benzene	Fail	Fail
Carbon monoxide	Fail	Fail
Ammonia (ecological-lichens and bryophytes)	Fail	Fail
Ammonia (ecological-other vegetation)	Fail	Fail
Ammonia	Fail	Pass

For each operating scenario, the H1 assessment has determined the pollutants which 'fail' both Test 1 and Test 2 and require further assessment using detailed modelling. Those requiring further assessment are those which 'fail' in one or both scenarios and they are as follows.

EALs for human health:

- Nitrogen dioxide (annual and 1-hour mean)
- Carbon monoxide (8-hour mean)
- Benzene (annual and 24-hour mean)
- Sulphur dioxide (15-minute mean)
- Sulphur dioxide (24-hour mean)

EALs for potential impacts on the local and nationally designated ecological sites:

- Nitrogen dioxide (ecological - daily mean)

- Sulphur dioxide (ecological-other vegetation)
- Sulphur dioxide (ecological -lichens and bryophytes)
- Ammonia (ecological-other vegetation)
- Ammonia (ecological -lichens and bryophytes, lower critical level of 1µg/m^3)

3.2 Deposition to land

It is not possible to assess deposition to land from air using the current version of the H1 Risk Assessment Tool (version 9.2).[16] Deposition to land is therefore considered further in the supporting AQIA[17] for potential impact on ecological receptors.

3.3 Summary

Table 6 summarises which pollutant-EALs require further assessment using detailed modelling.

Deposition to land will be considered for potential impact on ecological sites within relevant screening distance criteria.

[16] Atmospheric Dispersion Modelling Liaison Committee (ADMLC) H1 Risk Assessment Tool (https://admlc.com/h1-tool/) Accessed 31/01/25).
[17] Earthcare Technical Ltd (June 2025) Air Quality Impact Assessment to Support a Bespoke Permit Application for Horse Close Anaerobic Digestion (AD) Plant, Courteenhall, Northamptonshire, NN7 2QF. Doc ref: ETL747_HRCL_AQIA_V1.1_Jun25.

4 Conclusion

This H1 Assessment has been completed to assess whether the air quality impact of point source emissions to air at the proposed operation of the Horse Close AD Plant, Courteenhall, Northamptonshire, NN7 2QF.

The H1 Assessment Tool spreadsheet v.9.2 has been used for quantitative assessment of combustion sources including the CHPs (A1, A2), emergency flare (A3) and emergency boiler (A4). The emergency generator (A5) would be used for less than 50 hours per year and as such has not been part of the quantitative screening assessment.

Emissions were assumed to meet the MCP ELVs for NOx and SO_2, and, for the CHPs, EALs for CO and TVOC. The emergency backup boiler will meet the MCP Directive ELVs for new plant fired by biogas although it is not an MCP as its thermal input is less than 1MW. The emergency generator will be a new MCP operating less than 500 hours per year as a 3-year rolling average and exempt from meeting MCPD ELVs.

Additional point sources to air evaluated within the screening assessment included: the Manure Reception Building odour abatement plant stack (A6), the underground leachate tank vent (A13), 1 No. Covered Digestate Storage Lagoon carbon filter outlet (A19), Liquid Feedstock Tank (A20) and emissions from the liquid Digestate Off-take point carbon filter (A21).

Test 1 of the assessment compared the long-term and short-term PCs calculated by the H1 Assessment Tool with the relevant EALs; all pollutant-EAL combinations were found to 'fail' Test 1.

Test 2 compared the long-term PECs are compared with the EALs and the short-term PCs with Headroom (EAL minus twice the long-term background concentration); all pollutant-EAL combinations, with the exception of long and short-term impacts from ammonia on human receptors, were found to 'fail' Test 2.

Three pollutant's EALs for ecological receptors, namely NO_2, NH_3 and SO_2 need to be considered further for the local and nationally designated ecological sites. Deposition to land will be considered for potential impact on these sites.

The pollutant-EALs which require further assessment using detailed modelling, within an Air Quality Impact Assessment include the following.

EALs for human health:

- Nitrogen dioxide (annual and 1-hour mean)
- Carbon monoxide (8-hour mean)
- Benzene (annual and 24-hour mean)
- Sulphur dioxide (15-minute mean)
- Sulphur dioxide (24-hour mean)

EALs for potential impacts on the local and nationally designated ecological sites:

- Nitrogen dioxide (ecological - daily mean)

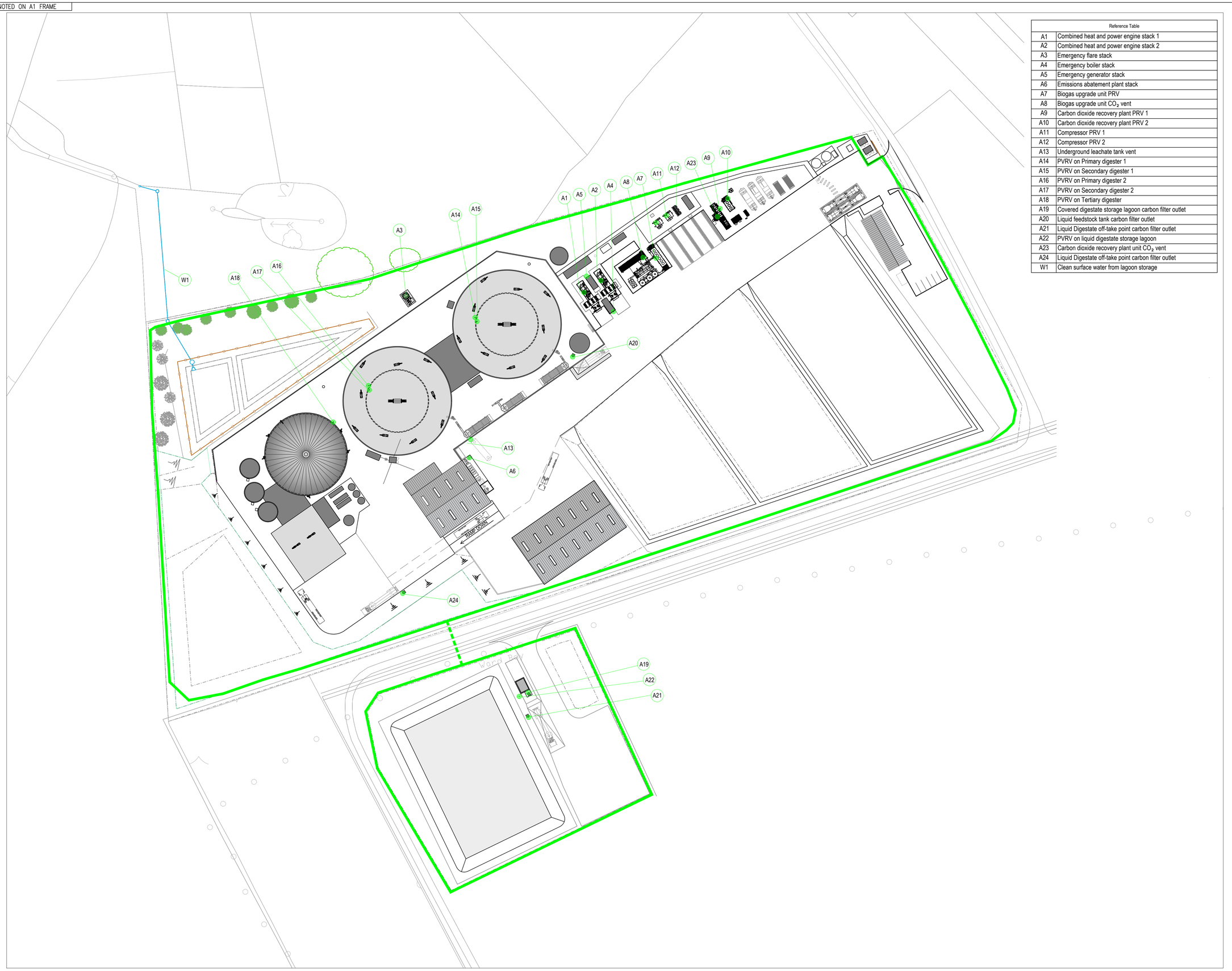
- Sulphur dioxide (ecological-other vegetation)
- Sulphur dioxide (ecological -lichens and bryophytes)
- Ammonia (ecological-other vegetation)
- Ammonia (ecological -lichens and bryophytes, lower critical level of 1µg/m^3)

An Air Quality Impact Assessment has been prepared to support this application.

Figures

Figure 1 - AD Plant permit boundary with emission point locations

AS NOTED ON A1 FRAME



Reference Table	
A1	Combined heat and power engine stack 1
A2	Combined heat and power engine stack 2
A3	Emergency flare stack
A4	Emergency boiler stack
A5	Emergency generator stack
A6	Emissions abatement plant stack
A7	Biogas upgrade unit PRV
A8	Biogas upgrade unit CO_2 vent
A9	Carbon dioxide recovery plant PRV 1
A10	Carbon dioxide recovery plant PRV 2
A11	Compressor PRV 1
A12	Compressor PRV 2
A13	Underground leachate tank vent
A14	PVRV on Primary digester 1
A15	PVRV on Secondary digester 1
A16	PVRV on Primary digester 2
A17	PVRV on Secondary digester 2
A18	PVRV on Tertiary digester
A19	Covered digestate storage lagoon carbon filter outlet
A20	Liquid feedstock tank carbon filter outlet
A21	Liquid Digestate off-take point carbon filter outlet
A22	PVRV on liquid digestate storage lagoon
A23	Carbon dioxide recovery plant unit CO_2 vent
A24	Liquid Digestate off-take point carbon filter outlet
W1	Clean surface water from lagoon storage

SITE PLAN
Scale: 1:750 @ A1

NOT FOR CONSTRUCTION

NOTES:-

Permitted Area Boundary (5.89ha)

Emission Release Location

Underground pipe conduit with leak detection

Rev	Date	Description	DR	CH
C	15/05/25	Issued For Approval	SJC	-
B	27/01/25	Issued For Approval	SJC	-
A	21/11/24	Issued For Approval	SJC	-

acorn BIOENERGY

Job Title
AD Plant.
Horse Close

Drawing Title
Site Emissions Plan.

Status
Approval

Scale
As Shown

Date
Nov '24

Drawn By
SJC

Checked
–

Approved
–

Drg. No.
HRCL-LAY-ABE-010

Rev
C

Appendix A H1 Assessment Tool Input and Output

Table 7 Input: Air release points

Release point code	Location or grid reference	Activity/Activities	Effective height (metres)	Dispersion factor (Long term)	Dispersion factor (short term)	Dispersion factor (monthly)	Efflux velocity (m/s)	Total flow (m3/h)
A1 CHP 1 (BG)	477444, 252701	CHP 1 BG combustion	0	148	3900	529	17.6	3752
A2 CHP 2 (NG)	477451, 252706	CHP 2 NG combustion	0	148	3900	529	20	4268
A3 Emergency flare	477369, 252700	Combustion	2.5	119	3070	405.175	21.1	16046
A4 Boiler	477456, 252693	Combustion	0	148	3900	529	6.01	504
A6 Abatement plant	477369, 252632	Emissions abatement	2.6	117.84	3036.8	400.222	13.4	18500
A13 Ugrd leachate tank	477396, 252639	Vent	0	148	3900	529	0.1	32.4
A19 Lagoon CF	477421, 252533	Emissions abatement	3.3	109.72	2804.4	365.551	2.21	250
A20 Liq Feed tnkCF	477439, 252674	Emissions abatement	0	148	3900	529	0.05	3
A21 Offtake	477421, 252522	Vent	3.3	109.72	2804.4	365.551	1.01	64.2
A24 Offtake	477368, 252575	Vent	0	148	3900	529	1.01	64.2

Table 8 Input: Emissions inventory

Release Point	Substance	Measurement method	Operating mode(%)	Long term conc (mg/m3)	Release rate g/s (long term)	Measurement basis (Long term)	Short term conc (mg/m3)	Release rate g/s (short term)	Measurement basis (short term)	Annual rate (t/yr)	Long term PC (ug/m3)	Short term PC (ug/m3)	Total Flow (m3/h)
A1 CHP 1 (BG)	Sulphur dioxide (15 min mean)	Estimated	100%	107	0.11	MCPD ELV	107	0.11	MCPD ELV	3.52	16.50	582.79	3752.00
A1 CHP 1 (BG)	Sulphur dioxide (24 hr mean)	Estimated	100%	107	0.11	MCPD ELV	107	0.11	MCPD ELV	3.52	16.50	256.60	3752.00
A1 CHP 1 (BG)	Sulphur dioxide (ecological-lichens and bryophytes)	Estimated	100%	107	0.11	MCPD ELV	107	0.11	MCPD ELV	3.52	16.50	434.92	3752.00
A1 CHP 1 (BG)	Sulphur dioxide (ecological-other vegetation)	Estimated	100%	107	0.11	MCPD ELV	107	0.11	MCPD ELV	3.52	16.50	434.92	3752.00
A1 CHP 1 (BG)	Nitrogen dioxide	Estimated	100%	500	0.52	MCPD ELV	500	0.52	MCPD ELV	16.43	77.12	1016.17	3752.00
A1 CHP 1 (BG)	Nitrogen oxides (as NO2) (ecological)	Estimated	100%	500	0.52	MCPD ELV	500	0.52	MCPD ELV	16.43	77.12	1199.08	3752.00
A1 CHP 1 (BG)	Benzene	Estimated	100%	20	0.02	2% of MCPD ELV	20	0.02	2% of MCPD ELV	0.66	3.08	47.96	3752.00
A1 CHP 1 (BG)	Carbon monoxide	Estimated	100%	1400	1.46	LFTGN 08	1400	1.46	LFTGN 08	46.01	215.95	3983.37	3752.00
A2 CHP 2 (NG)	Nitrogen dioxide	Estimated	100%	250	0.30	MCPD ELV	250	0.30	MCPD ELV	9.35	43.87	577.96	4268.00
A2 CHP 2 (NG)	Nitrogen oxides (as NO2) (ecological)	Estimated	100%	250	0.30	MCPD ELV	250	0.30	MCPD ELV	9.35	43.87	681.99	4268.00
A2 CHP 2 (NG)	Benzene	Estimated	100%	20	0.02	2% of MCPD ELV	20	0.02	2% of MCPD ELV	0.75	3.51	54.56	4268.00
A2 CHP 2 (NG)	Carbon monoxide	Estimated	100%	1400	1.66	LFTGN 08	1400	1.66	LFTGN 08	52.34	245.65	4531.19	4268.00
A3 Emergency flare	Benzene	Estimated	10%	0.5	0.00	5% of LFTGN 05	0.5	0.00	5% of LFTGN 05	0.01	0.03	4.04	16046.00
A3 Emergency flare	Nitrogen dioxide	Estimated	10%	150	0.67	LFTGN 05	150	0.67	LFTGN 05	2.11	7.96	1026.28	16046.00
A3 Emergency flare	Nitrogen oxides (as NO2) (ecological)	Estimated	10%	150	0.67	LFTGN 05	150	0.67	LFTGN 05	2.11	7.96	1211.00	16046.00
A3 Emergency flare	Carbon monoxide	Estimated	10%	50	0.22	LFTGN 05	50	0.22	LFTGN 05	0.70	2.65	478.93	16046.00
A4 Boiler	Sulphur dioxide (15 min mean)	Estimated	15%	100	0.01	MCPD ELV	100	0.01	MCPD ELV	0.07	0.31	73.16	504.00
A4 Boiler	Sulphur dioxide (24 hr mean)	Estimated	15%	100	0.01	MCPD ELV	100	0.01	MCPD ELV	0.07	0.31	32.21	504.00
A4 Boiler	Sulphur dioxide (ecological-lichens and bryophytes)	Estimated	15%	100	0.01	MCPD ELV	100	0.01	MCPD ELV	0.07	0.31	54.60	504.00
A4 Boiler	Sulphur dioxide (ecological-other vegetation)	Estimated	15%	100	0.01	MCPD ELV	100	0.01	MCPD ELV	0.07	0.31	54.60	504.00
A4 Boiler	Nitrogen dioxide	Estimated	15%	200	0.03	MCPD ELV	200	0.03	MCPD ELV	0.13	0.62	54.60	504.00

A4 Boiler	Nitrogen oxides (as NO2) (ecological)	Estimated	15%	200	0.03	MCPD ELV	200	0.03	MCPD ELV	0.13	0.62	64.43	504.00
A6 Abatement plant	Ammonia (ecological-lichens and bryophytes)	Estimated	100%	20	0.10	BAT-AEL	20	0.10	BAT-AEL	3.24	12.11	312.12	18500.00
A6 Abatement plant	Ammonia (ecological-other vegetation)	Estimated	100%	20	0.10	BAT-AEL	20	0.10	BAT-AEL	3.24	12.11	312.12	18500.00
A6 Abatement plant	Ammonia	Estimated	100%	20	0.10	BAT-AEL	20	0.10	BAT-AEL	3.24	12.11	312.12	18500.00
A13 Ugrd leachate tank	Ammonia (ecological-lichens and bryophytes)	Estimated	100%	2.9	0.00	Estimated	2.9	0.00	Estimated	0.00	0.00	0.10	32.40
A13 Ugrd leachate tank	Ammonia (ecological-other vegetation)	Estimated	100%	2.9	0.00	Estimated	2.9	0.00	Estimated	0.00	0.00	0.10	32.40
A13 Ugrd leachate tank	Ammonia	Estimated	100%	2.9	0.00	Estimated	2.9	0.00	Estimated	0.00	0.00	0.10	32.40
A19 Lagoon CF	Ammonia (ecological-lichens and bryophytes)	Estimated	100%	19	0.00	Estimated	19	0.00	Estimated	0.04	0.14	3.70	250.00
A19 Lagoon CF	Ammonia (ecological-other vegetation)	Estimated	100%	19	0.00	Estimated	19	0.00	Estimated	0.04	0.14	3.70	250.00
A19 Lagoon CF	Ammonia	Estimated	100%	19	0.00	Estimated	19	0.00	Estimated	0.04	0.14	3.70	250.00
A20 Liq Feed tnkCF	Ammonia (ecological-lichens and bryophytes)	Estimated	100%	20	0.00	Estimated	20	0.00	Estimated	0.00	0.00	0.07	3.00
A20 Liq Feed tnkCF	Ammonia (ecological-other vegetation)	Estimated	100%	20	0.00	Estimated	20	0.00	Estimated	0.00	0.00	0.07	3.00
A20 Liq Feed tnkCF	Ammonia	Estimated	100%	20	0.00	Estimated	20	0.00	Estimated	0.00	0.00	0.07	3.00
A21 Offtake	Ammonia (ecological-lichens and bryophytes)	Estimated	100%	0.06	0.00	Estimated	0.06	0.00	Estimated	0.00	0.00	0.00	64.20
A21 Offtake	Ammonia (ecological-other vegetation)	Estimated	100%	0.06	0.00	Estimated	0.06	0.00	Estimated	0.00	0.00	0.00	64.20
A21 Offtake	Ammonia	Estimated	100%	0.06	0.00	Estimated	0.06	0.00	Estimated	0.00	0.00	0.00	64.20
A24 Offtake	Ammonia (ecological-lichens and bryophytes)	Estimated	100%	0.18	0.00	Estimated	0.18	0.00	Estimated	0.00	0.00	0.01	64.20
A24 Offtake	Ammonia (ecological-other vegetation)	Estimated	100%	0.18	0.00	Estimated	0.18	0.00	Estimated	0.00	0.00	0.01	64.20
A24 Offtake	Ammonia	Estimated	100%	0.18	0.00	Estimated	0.18	0.00	Estimated	0.00	0.00	0.01	64.20

Table 9 Output: Air impacts – pollutants

Number	Substance	Long term EAL (ug/m3)	Long term PC (ug/m3)	Long term modelled PC	Short term EAL (ug/m3)	Short term PC (ug/m3)	Short term modelled PC
1	Sulphur dioxide (15 min mean)	0	16.81543111		266	655.9559067	
2	Sulphur dioxide (24 hr mean)	0	16.81543111		125	288.8164067	
3	Sulphur dioxide (ecological-lichens and bryop	10	16.82		0	489.52	
4	Sulphur dioxide (ecological-other vegetation)	20	16.82		0	489.52	
5	Nitrogen dioxide	40	129.57		200	2675.00	
6	Nitrogen oxides (as NO2) (ecological)	30	129.57		75	3156.50	
7	Benzene	5	6.62		30	106.56	
8	Carbon monoxide	0	464.25		10000	8993.50	
9	Ammonia (ecological-lichens and bryophytes)	1	12.26		0	316.00	
10	Ammonia (ecological-other vegetation)	3	12.26		0	316.00	
11	Ammonia	180	12.26		2500	316.00	

Table 10 Output: Air impacts – Test 1

Number	Substance	Long term EAL (ug/m3)	Long term PC (ug/m3)	%PC of EAL (long term)	>1% of EAL? (long term)	Short term EAL (ug/m3)	Short term PC (ug/m3)	%PC of EAL (short term)	>10% of EAL? (short term)
1	Sulphur dioxide (15 min mean)	0	16.81543111			266	655.9559067	246.60%	fail
2	Sulphur dioxide (24 hr mean)	0	16.81543111			125	288.8164067	231.05%	fail
3	Sulphur dioxide (ecological-lichens and bryophytes)	10	16.81543111	168.15%	fail	0	489.5193333		
4	Sulphur dioxide (ecological-other vegetation)	20	16.81543111	84.08%	fail	0	489.5193333		
5	Nitrogen dioxide	40	129.5677417	323.92%	fail	200	2675.000417	1337.50%	fail
6	Nitrogen oxides (as NO2) (ecological)	30	129.5677417	431.89%	fail	75	3156.500492	4208.67%	fail
7	Benzene	5	6.620742694	132.41%	fail	30	106.5590166	355.20%	fail
8	Carbon monoxide	0	464.2476028			10000	8993.495194	89.93%	fail
9	Ammonia (ecological-lichens and bryophytes)	1	12.26302472	1226.30%	fail	0	315.9981153		
10	Ammonia (ecological-other vegetation)	3	12.26302472	408.77%	fail	0	315.9981153		
11	Ammonia	180	12.26302472	6.81%	fail	2500	315.9981153	12.64%	fail

Table 11 Ouput: Air impacts – Test 2

Number	Substance	Long term EAL (ug/m3)	Long term PC (ug/m3)	Air Background conc (ug/m3)	%PC of headroom (long term)	PEC Long term (µg/m3)	%PEC of EAL% (Long term)	%PEC of EAL>70%? (long	Short term EAL (ug/m3)	Short term PC (ug/m3)	%PC of the EAL-2*background	%PC of headroom >=20%? (short term)
1	Sulphur dioxide (15 min mean)	0	16.81543111	3.49	100%	20.31			266	655.9559067	253.25%	fail
2	Sulphur dioxide (24 hr mean)	0	16.81543111	3.49	100%	20.31			125	288.8164067	244.72%	fail
3	Sulphur dioxide (ecological-lichens and br	10	16.81543111	1.36	100%	18.18	181.75%	fail	0	489.5193333		
4	Sulphur dioxide (ecological-other vegetati	20	16.81543111	1.36	90%	18.18	90.88%	fail	0	489.5193333		
5	Nitrogen dioxide	40	129.5677417	21.4	100%	150.97	377.42%	fail	200	2675.000417	1701.65%	fail
6	Nitrogen oxides (as NO2) (ecological)	30	129.5677417	21.4	100%	150.97	503.23%	fail	75	3156.500492	9802.80%	fail
7	Benzene	5	6.620742694	0.41	100%	7.03	140.61%	fail	30	106.5590166	365.18%	fail
8	Carbon monoxide	0	464.2476028	3306	100%	3770.25			10000	8993.495194	265.45%	fail
9	Ammonia (ecological-lichens and bryophyt	1	12.26302472	1.45	100%	13.71	1371.30%	fail	0	315.9981153		
10	Ammonia (ecological-other vegetation)	3	12.26302472	1.45	100%	13.71	457.10%	fail	0	315.9981153		
11	Ammonia	180	12.26302472	1.45	7%	13.71	7.62%	pass	2500	315.9981153	12.65%	pass

Table 12 Results: Air Assessment

Option	Substance	Test 1	Test 2
1	Sulphur dioxide (15 min mean)	Fail	Fail
1	Sulphur dioxide (24 hr mean)	Fail	Fail
1	Sulphur dioxide (ecological-lichens and bryophytes)	Fail	Fail
1	Sulphur dioxide (ecological-other vegetation)	Fail	Fail
1	Nitrogen dioxide	Fail	Fail
1	Nitrogen oxides (as NO2) (ecological)	Fail	Fail
1	Benzene	Fail	Fail
1	Carbon monoxide	Fail	Fail
1	Ammonia (ecological-lichens and bryophytes)	Fail	Fail
1	Ammonia (ecological-other vegetation)	Fail	Fail
1	Ammonia	Fail	Pass

Appendix B Proposed CHP technical specification

TEDOM
Combined Heat & Power

Quanto 1200

Basic technical data

Electrical output	1200	kW	Voltage	400	V
Heat output nominal/max.	1238/-	kW	Frequency	50	Hz
electrical efficiency	42,4	%	secondary circuit temperature inlet/outlet	70/90	°C
heat efficiency nominal/max.	43,8/-	%	Service weight of complete CHPU		
total efficiency nominal/max.	86,2/-	%	- container (C)	38	t
fuel input	2828	kW			

Emission	lean mixture	
NOx emission at 5% O2 in exhaust gas standard/option	500/-	mg/Nm^3
CO emission at 5% O2 in exhaust gas standard/option	1100/-	mg/Nm^3

Noise parameters		standard	
C	- CHPU at 10m	66	dB(A)

Notes

The Basic Technical Data are applicable for the standard conditions pursuant to the "Technical instructions" document. The minimum permanent electrical output must not drop below 50 % of the nominal output. Gas consumption is expressed under the normal conditions (0°C, 101.325 kPa) and gas LHV according to the section Fuel. Gas consumption tolerance, or fuel input tolerance, at 100% load is +5%. Tolerances of other parameters are mentioned in "Technical Instructions-Validity of Technical Data" document.

The manufacturer reserves the right to change this document and related documents.

TEDOM
Combined Heat & Power

Quanto 1200

Extended technical data

Standard design	100%	75%	50%	
electrical output	1200	900	600	kW
heat output	1238	976	725	kW
gas consumption	569	439	310	m^3/h
fuel input	2828	2183	1543	kW
electrical efficiency	42,4	41,2	38,9	%
heat efficiency	43,8	44,7	47,0	%
total efficiency	86,2	85,9	85,9	%

1) Heat output is formed of a secondary circuit heat output with exhaust gas cooled to 150°C.

Guaranteed parameters		
electrical output	1200	kW
electrical efficiency	40,4	%
heat efficiency	45,8	%
total efficiency	86,2	%
fuel input	2969	kW
NOx emission at 5% O2 in exhaust gas	500	mg/Nm^3
CO emission at 5% O2 in exhaust gas	1100	mg/Nm^3
CHPU at 10m	70	dB(A)

Electrical parameters

voltage	400	V
frequency	50	Hz
nominal current	2000	A
nominal power factor (GCB settings)	0,87	

operational current at cos φ=0,9	1925	A
short circuit resistance of the switchboard	40	kA
contribution of the actual source to the short-circuit current	< 20	kA
cos φ regulation range (underexcited/overexcited) [1)]	0,9÷1÷0,9	

1) Operation of generator with power factor lower than 0,98 decreaes generator efficiency, what can cause reduction of the CHPU active power.

Engine / Generator

Engine	TCG2020V12	
manufacturer	MWM	
oil consumption	0,15	g/kWh
quantity of oil in the engine	715	dm^3
volume of oil tank for refilling	350	dm^3

Generator	MJB 500 MB4
manufacturer	MARELLI

TEDOM
Combined Heat & Power

Quanto 1200

Heat system

Secondary circuit

heat carrier: water		
heat output	1238	kW
inlet/outlet temperature	70/90	°C
min./max. inlet temperature	50/70	°C
nominal flow	14,8	kg/s
max. allowed pressure in circuit	600	kPa
volume (OM/SE/C)	-/-/145	dm^3
pressure drop at nominal flow (OM/SE/C)	-/-/45	kPa

Aftercooler circuit

heat carrier: antifreeze		
ethylene glycol concentration	35	%
heat output	91	kW
max. coolant inlet temperature into CHPU	50	°C
nominal flow	7,7	kg/s
expansion vessel volume (OM/SE/C)	/-/35	dm^3
min. inlet pressure into CHPU	100	kPa
max. inlet pressure into CHPU	300	kPa
max. outlet pressure from CHPU	450	kPa
volume (OM/SE/C)	-/-/45	dm^3
dry cooler volume	*tbd	dm^3

Primary circuit

heat carrier: antifreeze		
ethylene glycol concentration	35	%
heat output (OM, C)	1238	kW
max. allowed pressure in circuit	300	kPa
volume (OM/SE/C)	-/-/980	dm^3
dry cooler volume	*tbd	dm^3

**tbd - to be defined*

Exhaust gas

quantity	6254	kg/h	temperature at the CHPU outlet nominal/max.	150/180	°C
temperature at the engine outet	466	°C	max. allowed back-pressure	1	kPa

Fuel

biogas			nominal methane content	50	%
low heat value	17,9	MJ/m^3	pressure (C)	10 - 15	kPa
min. methane content	45	%	max. temperature	35	°C

Combustion and ventilation air

Combustion air

ambient temperature min./max. (C)	-20/35	°C
combustion air temperature min./max.	10/35	°C
quantity	5490	kg/h

Ventilation

	C	
unused heat removed by the ventilation	76	kW

Quanto 1200

Related documents

dimensional drawing C	R0550

TEDOM
Combined Heat & Power

Quanto 1200

Basic technical data

Electrical output	1200	kW	Voltage	400	V
Heat output nominal/max.	1220/-	kW	Frequency	50	Hz
electrical efficiency	42,0	%	secondary circuit temperature inlet/outlet	70/90	°C
heat efficiency nominal/max.	42,7/-	%	Service weight of complete CHPU		
total efficiency nominal/max.	84,7/-	%	- container (C)	38	t
fuel input	2854	kW			

Emission	lean mixture	
NOx emission at 5% O2 in exhaust gas standard/option	250/-	mg/Nm^3
CO emission at 5% O2 in exhaust gas standard/option	1100/-	mg/Nm^3

Noise parameters		standard	
C	- CHPU at 10m	66	dB(A)

Notes

The Basic Technical Data are applicable for the standard conditions pursuant to the "Technical instructions" document. The minimum permanent electrical output must not drop below 50 % of the nominal output. Gas consumption is expressed under the invoicing conditions (15°C, 101.325 kPa) and gas LHV according to the section Fuel. Gas consumption tolerance, or fuel input tolerance, at 100% load is +5%. Tolerances of other parameters are mentioned in "Technical Instructions-Validity of Technical Data" document.

The manufacturer reserves the right to change this document and related documents.

TEDOM
Combined Heat & Power

Quanto 1200

Extended technical data

Standard design	100%	75%	50%	
electrical output	1200	900	600	kW
heat output	1220	962	714	kW
gas consumption	302	233	165	m^3/h
fuel input	2854	2203	1558	kW
electrical efficiency	42,0	40,8	38,5	%
heat efficiency	42,7	43,7	45,8	%
total efficiency	84,7	84,5	84,3	%

1) Heat output is formed of a secondary circuit heat output with exhaust gas cooled to 150°C.

Guaranteed parameters		
electrical output	1200	kW
electrical efficiency	40,0	%
heat efficiency	44,7	%
total efficiency	84,7	%
fuel input	2997	kW
NOx emission at 5% O2 in exhaust gas	250	mg/Nm^3
CO emission at 5% O2 in exhaust gas	1100	mg/Nm^3
CHPU at 10m	70	dB(A)

Electrical parameters

voltage	400	V
frequency	50	Hz
nominal current	2000	A
nominal power factor (GCB settings)	0,87	

operational current at cos φ=0,9	1925	A
short circuit resistance of the switchboard	40	kA
contribution of the actual source to the short-circuit current	< 20	kA
cos φ regulation range (underexcited/overexcited) [1)]	0,9÷1÷0,9	

1) Operation of generator with power factor lower than 0,98 decreaes generator efficiency, what can cause reduction of the CHPU active power.

Engine / Generator

Engine	TCG2020V12	
manufacturer	MWM	
oil consumption	0,15	g/kWh
quantity of oil in the engine	715	dm^3
volume of oil tank for refilling	350	dm^3

Generator	MJB 500 MB4
manufacturer	MARELLI

TEDOM
Combined Heat & Power

Quanto 1200

Heat system

Secondary circuit

heat carrier: water		
heat output	1220	kW
inlet/outlet temperature	70/90	°C
min./max. inlet temperature	50/70	°C
nominal flow	14,6	kg/s
max. allowed pressure in circuit	600	kPa
volume (OM/SE/C)	-/-/145	dm^3
pressure drop at nominal flow (OM/SE/C)	-/-/45	kPa

Aftercooler circuit

heat carrier: antifreeze		
ethylene glycol concentration	35	%
heat output	95	kW
max. coolant inlet temperature into CHPU	47	°C
nominal flow	9,7	kg/s
expansion vessel volume (OM/SE/C)	/-/35	dm^3
min. inlet pressure into CHPU	100	kPa
max. inlet pressure into CHPU	300	kPa
max. outlet pressure from CHPU	450	kPa
volume (OM/SE/C)	-/-/45	dm^3
dry cooler volume	*tbd	dm^3

Primary circuit

heat carrier: antifreeze		
ethylene glycol concentration	35	%
heat output (OM, C)	1220	kW
max. allowed pressure in circuit	300	kPa
volume (OM/SE/C)	-/-/980	dm^3
dry cooler volume	*tbd	dm^3

**tbd - to be defined*

Exhaust gas

quantity	7114	kg/h
temperature at the engine outet	402	°C
temperature at the CHPU outlet nominal/max.	150/180	°C
max. allowed back-pressure	1	kPa

Fuel

natural gas		
low heat value	34	MJ/m^3
min. methane number	101	
pressure (C)	10 - 15	kPa
max. temperature	35	°C

Combustion and ventilation air

Combustion air

ambient temperature min./max. (C)	-20/35	°C
combustion air temperature min./max.	10/35	°C
quantity	6896	kg/h

Ventilation

	C	
unused heat removed by the ventilation	77	kW

Quanto 1200

Related documents

dimensional drawing C	R0550

Appendix C Emergency flare technical specification

Datasheet for MTU 3000-HT-GVD

Gasflare MTU 3000-HT-GVD (full automatic type)

High temperature gas flare with hidden flame according to TA-Luft Pt. 5.4.8.1.3a. Designed for thermic disposing of Biogas with **100mm** flame tube insulation.

All gas-bearing parts of the flare are made of stainless steel, welded, stained and passivated.

Specifications:

gas flow step 1/2/3:	1300 / 1950 / 2600 Nm³/h
max. thermal Power:	16000kW
Gas:	Biogas filtered and drained
CH4 concentration:	45-65 % CH_4
Flame Temperature:	**> 1000°C** above 1300m³/h
Residence time:	0,3 seconds
Gas pressure:	max. -5mbar with integrated gas blower
Gas Flange:	DN 300
Ignition:	Ignition burner biogas
Flame detection:	UV-Cell, heat resistant type
Sound level:	~ 75 dB(A) in 15 m at 2600 Nm3/h
Dimensions (LxWxH):	220 x 220 x 1050cm

Controls and Instruments (mounted ready to start)

20 Biogas burner
4 Flame Arrestor DN100, Insert SS, ATEX approved
4 Shut off gas valve DN100, EN 161 certified
2 Pressure switch (p-min, p-max)
1 Gas blower GVD652-15kW with FI, Atex approved
1 Suction pressure switch, set to -7mbar
1 Manual flap inlet DN300

7,5m Flame tube 1.4301

- 100mm heat resistant insulation up to 1400°C
- 2x Thermocouple for monitoring and control of the
- Combustion temperature, t-max. protection at 1150°C.
- 2pcs. sampling port`s DN80, 90 degrees offset

3,5m base frame 1.4301

- Enclosed base frame with air control flap`s.
- temperature regulation to > 1000°C

E-cabinet IP 54 mounted on flare body

Operating voltage 3x400V with blower. Flame detecting with UV-Sensor, including EN approved Flame Controller IFD 258 for flame, ignition and valve control.

- PLC with touch display for 1000°C control
- Manual operation or automatic operation
- 5 automatic re-cycling attempts
- Start with an external signal (on/off)
- Extended data exchange and data storage
- 4-20mA output for external temperature monitoring

Options

E-cabinet made of Stainless steel, 1.4301

Standard is carbon steel stove-enamelled. IP 54

Separated E-Cabinet

For external mounting, according to some national safety regulations. We lead all cables in a IP65 Junction Box on the flare. (7 meter cable)

Frost protection

Heating and housing of the instruments

Flame arrester SS

Housing stainless steel DN100

Anchor Set

16 pcs. Anchor Bolts SS, M20

Appendix D Emergency boiler technical specification

VIESMANN

VITOPLEX 200

Low temperature oil/gas boiler
90 to 560 kW

Datasheet

Part no. and prices: See pricelist

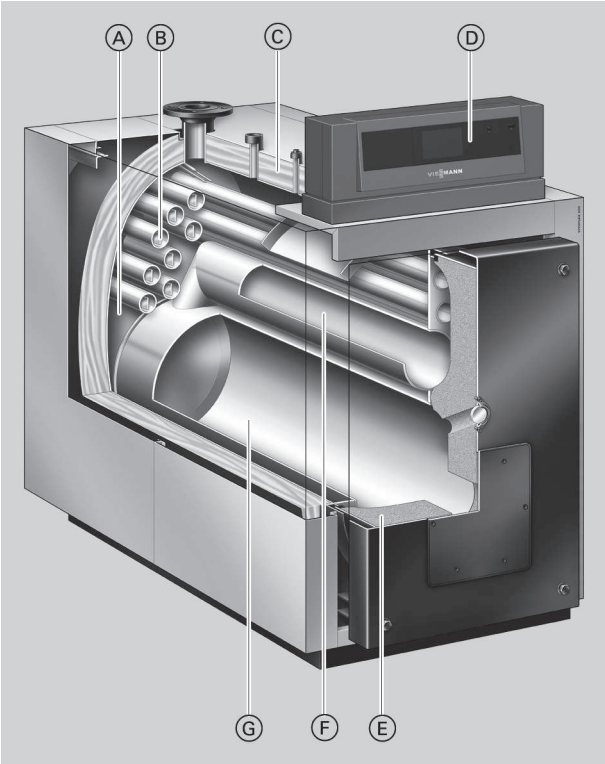
VITOPLEX 200 Type SX2A

Low temperature oil/gas boiler
- Three-pass boiler
- For operation with modulating boiler water temperature
- With Vitotrans 300 as condensing unit

Information for type SX2A, 90 to 350 kW:
In accordance with the Ecodesign Directive for Heating Appliances and Water Heaters (Dir. 2009/125/EC), Implementing Regulation (EU) No. 813/2013 and (EU) No. 814/2013, these boilers may not be sold and used within the EU for the purpose of generating space heating and domestic hot water. A sale is subject to the proviso of exclusive use for purposes not included in the regulations stated above.

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 content provide excellent natural circulation and reliable heat transfer.
- Integral Therm-Control start-up system for easy hydraulic connection – no shunt pump or return temperature raising facility are required.
- Boilers up to 300 kW do not require a low water indicator
- Compact design for easy transportation into boiler rooms and economical use of space – important for modernisation projects
- Fastfix installation system for control unit and thermal insulation
- Easy to use Vitotronic control unit with colour touchscreen
- 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.



Ⓐ Wide water galleries and large water content ensure excellent natural circulation and easy hydraulic connection
Ⓑ Third hot gas flue
Ⓒ Highly effective thermal insulation
Ⓓ Vitotronic control unit with colour touchscreen
Ⓔ Thermal insulation on boiler door
Ⓕ Hot gas flue (second pass)
Ⓖ Combustion chamber

5797332

Boiler specification

Specification

Rated heating output	**kW**	**90**	**120**	**150**	**200**	**270**	**350**	**440**	**560**
Rated heat input	kW	98	130	163	217	293	380	478	609
CE designation									
– According to Efficiency Directive					CE-0085BQ0020			—	—
– 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				4				
	kPa				400				
Pressure drop on the hot gas side	Pa	60	80	100	200	180	310	280	400
	mbar	0.6	0.8	1.0	2.0	1.8	3.1	2.8	4.0
Boiler body dimensions									
Length (dim. q)*1	mm	1195	1400	1385	1580	1600	1800	1825	1970
Width (dim. d)	mm	575	575	650	650	730	730	865	865
Height (incl. connectors) (dim. t)	mm	1145	1145	1180	1180	1285	1285	1455	1455
Total dimensions									
Total length (dim. r)	mm	1260	1460	1445	1640	1660	1860	1885	2030
Total length incl. burner and hood, depending on burner make (dim. s)	mm	1660	1860	1865	2060	2085	–	–	–
Total width (dim. e)	mm	755	755	825	825	905	905	1040	1040
Total height (dim. b)	mm	1315	1315	1350	1350	1460	1460	1625	1625
Service height (control unit) (dim. a)	mm	1485	1485	1520	1520	1630	1630	1795	1795
Height									
– Adjustable anti-vibration feet	mm	28	28	28	28	28	28	28	28
– Anti-vibration boiler supports (under load)	mm	–	–	–	–	–	37	37	37
Foundation									
Length	mm	1000	1200	1200	1400	1400	1650	1650	1800
Width	mm	760	760	830	830	900	900	1040	1040
Combustion chamber diameter	mm	380	380	400	400	480	480	570	570
Combustion chamber length	mm	800	1000	1000	1200	1200	1400	1400	1550
Weight boiler body	kg	315	365	415	460	585	700	895	1100
Total weight Boiler incl. thermal insulation and boiler control unit	kg	360	410	465	510	635	760	960	1170
Total weight Boiler incl. thermal insulation, burner and boiler control unit	kg	390	440	495	540	665	–	–	–
Capacity boiler water	litres	180	210	255	300	400	445	600	635
Boiler connections									
Boiler flow and return	PN 6 DN	65	65	65	65	65	80	100	100
Safety connection (safety valve) (male thread)	R	1¼	1¼	1¼	1¼	1¼	1¼	1½	1½
Drain (male thread)	R				1¼				
Flue gas parameters*2									
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									
– For natural gas	kg/h				1.5225 x combustion output in kW				
– For fuel oil EL	kg/h				1.5 x combustion output in kW				
Required draught	Pa/mbar				0				
Flue gas connection	Ø mm	180	180	200	200	200	200	250	250
Standard seasonal efficiency [to DIN] (for operation with fuel oil) For heating system temperature 75/60 °C	%				89 (H_s) [gross cv]				

*1 *Boiler door removed.*

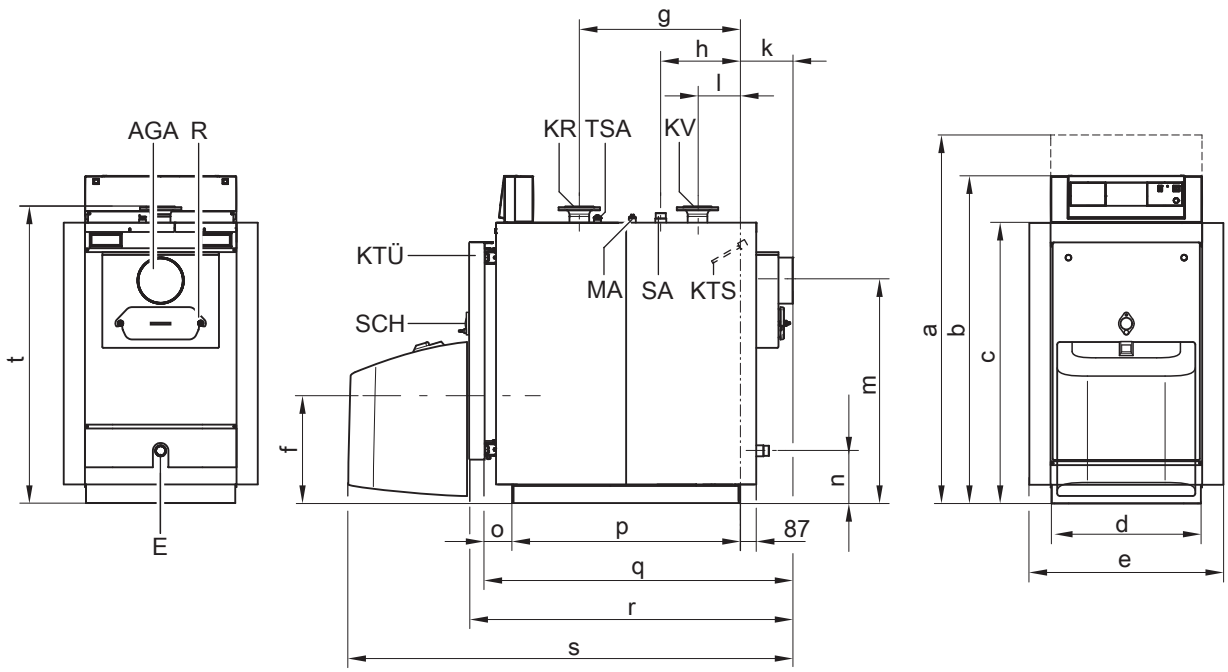
*2 *Values for calculating the size of the flue system to EN 13384, relative to 13.2 % CO_2 for fuel oil EL and 10 % CO_2 for natural gas. Flue gas temperatures as actual gross values at 20 °C combustion air temperature. The details for partial load refer to an output of 60 % of rated heating output.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

5797332

Boiler specification (cont.)

Rated heating output	**kW**	**90**	**120**	**150**	**200**	**270**	**350**	**440**	**560**
Standby loss $q_{B,70}$	%	0.40	0.35	0.30	0.30	0.25	0.25	0.22	0.20
Sound pressure level*3									
1 m in front of the boiler (1st/2nd stage)	dB(A)	<68/<69						–	
In the flue pipe (1st/2nd stage)	dB(A)	<96/<103						–	
Matching Vitotrans 300									
– Gas operation	Part no.	Z010326		Z010327		Z010328		Z010329	
– Oil operation	Part no.	Z010330		Z010331		Z010332		Z010333	
Rated heating output									
Boiler with Vitotrans 300									
– Gas operation	kW	98.7	131.4	164.3	219.0	295.6	383.3	478.7	608.9
– Oil operation	kW	95.8	127.8	159.8	213.0	287.5	372.7	466.4	593.5
CE designation		CE-0085BS0287							
Vitotrans 300 in conjunction with boiler as a condensing unit									
Pressure drop on the hot gas side	Pa	125	145	185	285	280	410	385	505
Boiler with Vitotrans 300	mbar	1.25	1.45	1.85	2.85	2.80	4.10	3.85	5.05
Total length	mm	1990		2290		2570		2950	
Boiler with Vitotrans 300 excl. burner									

Dimensions



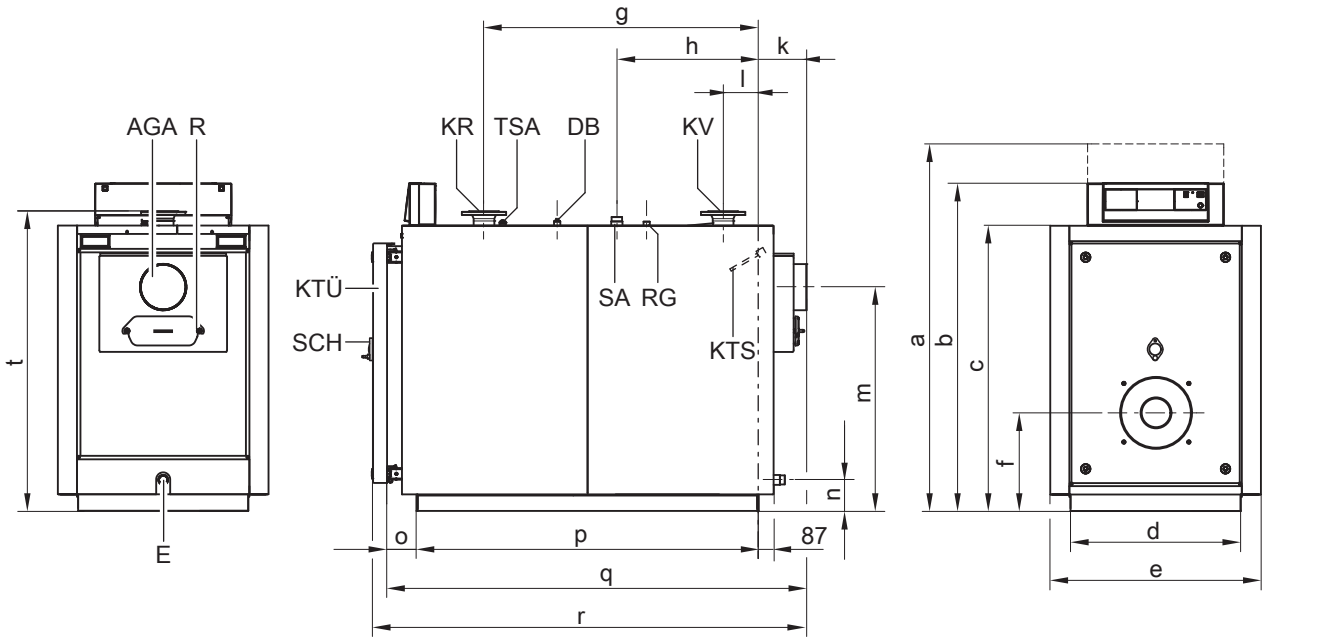
90 to 270 kW

AGA Flue outlet
E Drain
KR Boiler return
KTS Boiler water temperature sensor
KTÜ Boiler door
KV Boiler flow
MA Female connection R ½ (male thread) for pressure gauge
R Cleaning aperture
SA Safety connection (safety valve)
SCH Inspection port
TSA Female connection R ½ (male thread) for Therm-Control temperature sensor

*3 *Standard values resulting from sound pressure level testing cannot be guaranteed, as sound pressure level tests are always dependent on the specific system. The data provided here refers to Viessmann Vitoflame 100 pressure-jet oil/gas burners.*

5797332

Boiler specification (cont.)



350 to 560 kW

AGA Flue outlet
DB Female connection R ½ (male thread) for maximum pressure limiter
E Drain
KR Boiler return
KTS Boiler water temperature sensor
KTÜ Boiler door
KV Boiler flow
R Cleaning aperture
RG Female connection R ½ (male thread) for additional control equipment
SA Safety connection (safety valve)
SCH Inspection port
TSA Female connection R ½ (male thread) for Therm-Control temperature sensor

Dimensions

Rated heating output	kW	90	120	150	200	270	350	440	560
a	mm	1485	1485	1520	1520	1630	1630	1795	1795
b	mm	1315	1315	1350	1350	1460	1460	1625	1625
c	mm	1085	1085	1115	1115	1225	1225	1395	1395
d	mm	575	575	650	650	730	730	865	865
e	mm	755	755	825	825	905	905	1040	1040
f	mm	440	440	440	440	420	420	470	470
g	mm	622	825	811	1009	979	1179	1146	1292
h	mm	307	395	324	423	409	609	710	783
k	mm	203	203	203	203	203	203	224	224
l	mm	165	165	151	151	153	153	166	166
m	mm	860	860	885	885	960	960	1110	1110
n	mm	200	200	190	190	135	135	135	135
o	mm	110	110	110	110	130	130	130	130
p (length of base rails)	mm	882	1085	1071	1268	1269	1469	1471	1617
q (transport dimension)	mm	1195	1400	1385	1580	1600	1800	1825	1970
r	mm	1260	1460	1445	1640	1660	1860	1885	2030
s (depending on burner make)	mm	1670	1875	1880	2075	2095	–	–	–
t	mm	1145	1145	1180	1180	1285	1285	1455	1455

Where access to the boiler room is difficult the boiler door can be removed.
Dim. f: Observe the installed burner height.
Dim. q: With boiler door removed

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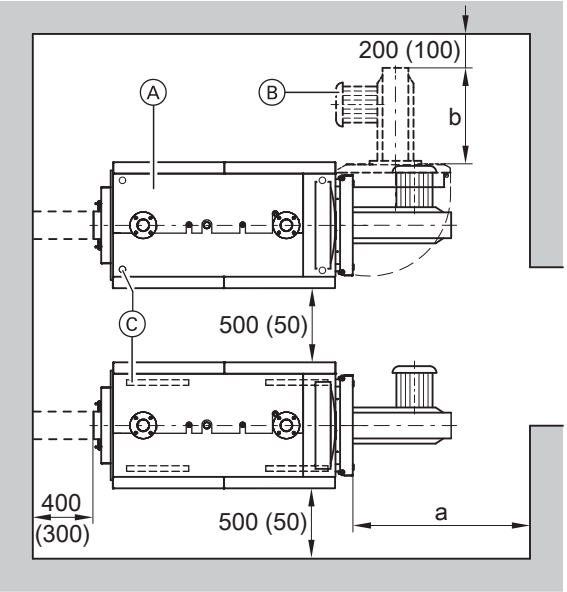
Boiler specification (cont.)

Siting

Minimum clearances



Observe the stated dimensions to ensure easy 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 left. The hinge pins can be repositioned so the door opens to the right.

Ⓐ Boiler
Ⓑ Burner
Ⓒ Adjustable anti-vibration feet (90 to 560 kW) or anti-vibration boiler supports (350 to 560 kW)

Rated heating output	kW	90	120	150	200	270	350	440	560
a	mm	1100			1400		1600		

Dim. a: Maintain this space in front of the boiler to enable removal of the turbulators and cleaning of the hot gas flues.
Dim. b: Observe the installed burner length.

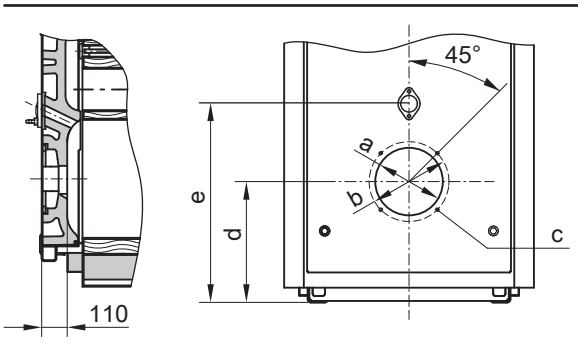
Siting conditions

- 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

Boilers up to 120 kW:
The burner fixing hole circle, burner fixing holes and flame tube aperture comply with EN 226.
Boilers from 150 kW:
The burner fixing hole circle, burner fixing holes and flame tube aperture are as detailed in the table below.
The burner may be mounted directly on the hinged boiler door. If the burner dimensions deviate from those stated in the table below, use the burner plate included in the standard delivery.
Burner tiles 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.



Rated heating output	kW	90	120	150	200	270	350	440	560
a	Ø mm	135	135	240	240	240	240	290	290
b	Ø mm	170	170	270	270	270	270	330	330
c	Number/thread	4/M 8	4/M 8	4/M 10	4/M 10	4/M 10	4/M 10	4/M 12	4/M 12

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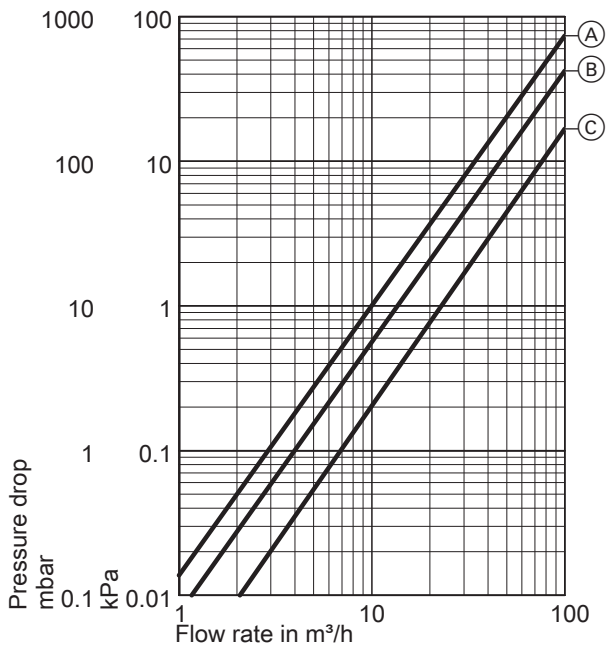
Boiler specification (cont.)

Rated heating output	kW	90	120	150	200	270	350	440	560
d	mm	440	440	440	440	420	420	470	470
e	mm	650	650	650	650	670	670	780	780

Pressure drop on the heating water side



Ⓐ Rated heating output 90 to 270 kW
Ⓑ Rated heating output 350 kW
Ⓒ Rated heating output 440 and 560 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.**	**Z010326** **Z010330**	**Z010327** **Z010331**	**Z010328** **Z010332**	**Z010329** **Z010333**
Rated boiler heating output	kW	90-125	140-200	230-350	380-560
Rated heating output range of the Vitotrans 300 for					
– Gas operation	from kW	8.7	12.7	21.8	33.3
	to kW	11.9	19.0	33.3	48.9
– Oil operation	from kW	5.8	8.8	14.9	22.9
	to kW	8.1	13.0	22.7	33.5
Permiss. operating pressure	bar	4	4	4	6
	MPa	0.4	0.4	0.4	0.6
Permiss. flow temperature (= safety temperature)	°C	110	110	110	110
Pressure drop on the hot gas side	mbar	0.65	0.85	1.00	1.05
	Pa	65	85	100	105
Flue gas temperature					
– Gas operation	°C	65	65	65	65
– Oil operation	°C	70	70	70	70
Flue gas mass flow rate	from kg/h	136	213	383	546
	to kg/h	213	341	596	954
Total dimensions					
Total length (dim. h) incl. mating flanges	mm	666	777	856	967
Total width (dim. b)	mm	714	760	837	928
Total height (dim. c)	mm	1037	1152	1167	1350
Transport dimensions					
Length excl. mating flanges	mm	648	760	837	928
Width (dim. a)	mm	618	636	706	839
Height (dim. d)	mm	1081	1098	1172	1296
Heat exchanger weight	kg	94	119	144	234
Total weight Heat exchanger incl. thermal insulation	kg	125	150	188	284
Capacity					
Heating water	litres	70	97	134	181
Flue gas	m^3	0.055	0.096	0.133	0.223
Connections					
Heating water flow and return	DN	40	50	50	65
Condensate drain (male thread)	R	½	½	½	½
Flue gas connection					
– To the boiler	DN	180	200	200	250
– To the flue system	DN	150	200	200	250

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 for gas operation and 200/70 °C for 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.

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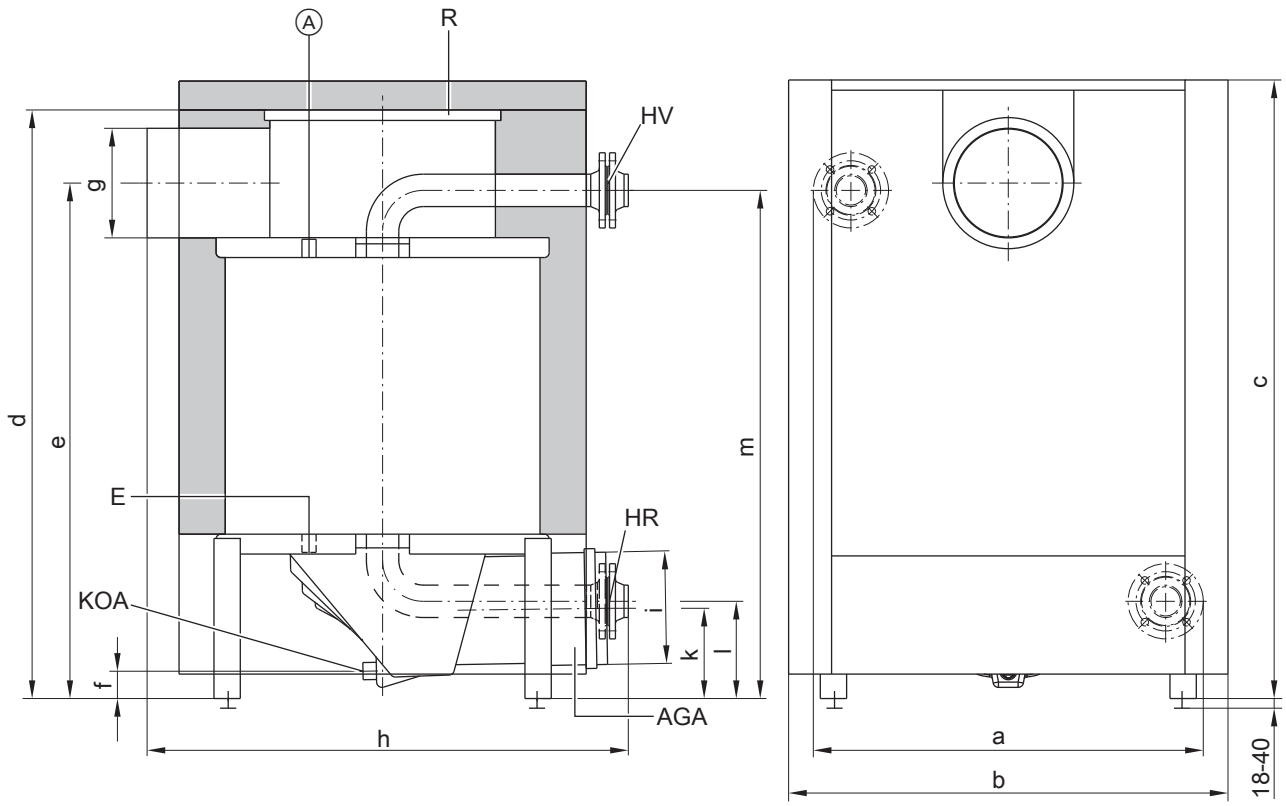
Vitotrans 300 specification (cont.)

Dimensions



Ⓐ Additional female connection R ½ (male thread)
AGA Flue outlet
E Drain R ½ (male thread)
HR Heating water return (inlet)
HV Heating water flow (outlet)
KOA Condensate drain ∅ 32
R Cleaning aperture

Dimensions

Part no.		Z010326 Z010330	Z010327 Z010331	Z010328 Z010332	Z010329 Z010333
a	mm	628	656	726	839
b	mm	714	746	818	912
c	mm	1022	1098	1151	1308
d	mm	965	1043	1096	1245
e	mm	851	907	960	1080
f	mm	73	53	51	88
g (internal)	∅ mm	181	201	201	251
h	mm	707	818	896	1015
i (internal)	∅ mm	151	201	201	251
k	mm	165	170	168	230
l	mm	170	172	181	232
m	mm	851	899	946	1075

Delivered condition

Heat exchanger body with fitted flue gas collector. Mating flanges are fitted to all connectors

1 box with thermal insulation

Connection on the flue gas side

Connect the boiler flue outlet and offset flue adaptor of the flue gas/water heat exchanger through a connection collar (accessories) (do not weld).

Height compensation:
- Vitoplex boiler through adjusting screws
- Vitorond boiler through on-site adaptor

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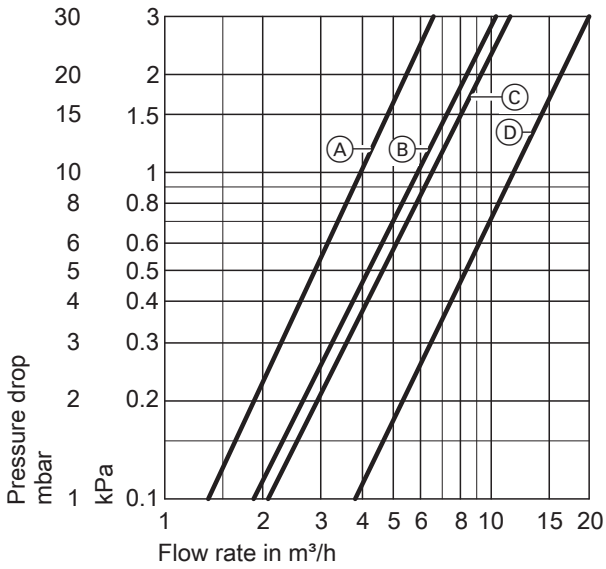
Vitotrans 300 specification (cont.)

Pressure drop on the heating water side

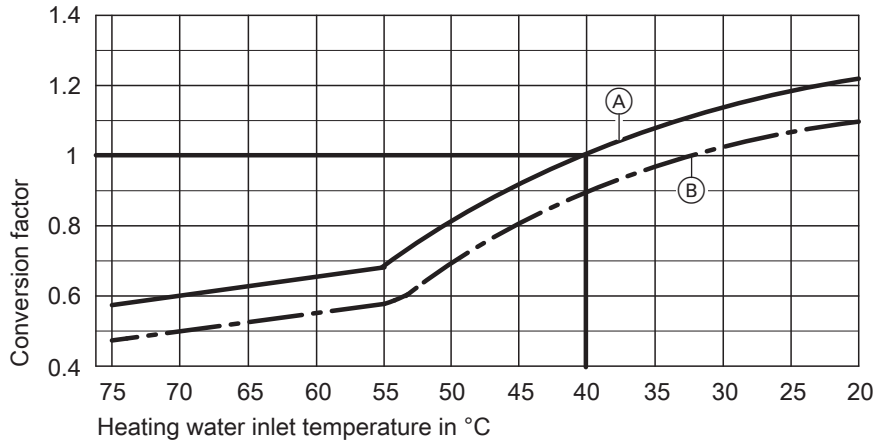
Part no. Z010326 to Z010333



Part no.	Curve
Z010326 Z010330	Ⓐ
Z010327 Z010331	Ⓑ
Z010328 Z010332	Ⓒ
Z010329 Z010333	Ⓓ

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 body with fitted boiler door and cleaning cover.
Mating flanges are fitted to all connectors.
The adjusting screws are supplied in the combustion chamber.
Cleaning equipment can be found on top of the boiler.

2 boxes with thermal insulation
1 box with boiler control unit and 1 bag with technical documentation
1 Therm-Control
1 coding card and technical documentation for Vitoplex 200
1 burner plate (from 150 kW)

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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.

Control panel

- Vitocontrol control panel with e.g. Vitotronic 200-H, type HK1B or HK3B for 1 or up to 3 heating circuits with mixer on request.

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 regulates the boiler water temperature of one boiler in 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 200-M multi mode system controller**
  For weather-compensated cascade control of boilers with a Vitotronic 100 control unit and a Vitobloc 200 CHP unit or other heat generators on request.

Control panel

- Vitocontrol control panel with e.g. Vitotronic 200-H, type HK1B or HK3B for 1 or up to 3 heating circuits with mixer on request.

Boiler accessories

See pricelist.

Operating conditions for systems with Vitotronic boiler protection

Vitotronic boiler protection, e.g. Therm-Control.

		Requirements	
Operation with burner load		**≥ 60 %**	**< 60 %**
1.	Heating water flow rate	None	
2.	Boiler return temperature (minimum value)*4	None*5	
3.	Lower boiler water temperature	– Oil operation 50 °C – Gas operation 60 °C	– Oil operation 60 °C – Gas operation 65 °C
4.	Two-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 the 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	

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

Operating conditions for systems with on-site boiler protection

		Requirements	
Operation with burner load		**≥ 60 %**	**< 60 %**
1.	Heating water flow rate	None	
2.	Boiler return temperature (minimum value)	– Oil operation 40 °C – Gas operation 53 °C	– Oil operation 53 °C – Gas operation 58 °C
3.	Lower boiler water temperature	– Oil operation 50 °C – Gas operation 60 °C	– Oil operation 60 °C – Gas operation 65 °C
4.	2-stage burner operation	1st stage 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

*4 *The technical guide "System examples" contains relevant sample systems for use of the Therm-Control start-up system.*

*5 *No requirements; only in conjunction with Therm-Control.*

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Operating conditions for systems with on-site boiler protection (cont.)

	Requirements	
Operation with burner load	**≥ 60 %**	**< 60 %**
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	

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

Design/engineering information

Mounting a suitable burner

The burner must be suitable for the relevant rated heating output and the pressure drop on the hot gas side of the boiler (see burner manufacturer's specification).
The material of the burner head must be suitable for operating temperatures of at least 500 °C.

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 CE-designated in accordance with Directive 2009/142/EC.

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

Low water indicator

If the standard boiler control unit is connected in accordance with the installation instructions, the Vitoplex 200 up to 300 kW (except in attic heating centres) does not require a low water indicator to EN 12828.

In the event of a water shortage due to a leak in the heating system and simultaneous burner operation, the control unit will automatically shut down the burner before the boiler and/or flue system reach impermissible high temperatures.

Permissible flow temperatures

Hot water boiler for permissible flow temperatures (= safety temperatures)

Up to 110 °C
- **CE designation:**
  CE-0085 (90 to 350 kW) compliant with Efficiency Directive
  and
  CE-0085 compliant with the Gas Appliances Directive

Above 110 °C (up to 120 °C) (with individual test certification 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** require supervision, according to the Health & Safety at Work Act [Germany]. In accordance with the conformity assessment diagram no. 5 of the EU Pressure Equipment Directive, these boilers must be classed as category III.
  The system must be tested prior to commissioning.
  – Annually: External inspection, inspection of the safety equipment and water quality.
  – Every 3 years: Internal inspection (or water pressure test as an alternative).
  – Every 9 years: Water pressure test (for max. test pressure see type plate).
  An approved inspection body (e.g. TÜV [in Germany]) must carry out the test.

Further information on design/engineering

See the technical guide to this boiler.

Tested quality

CE designation according to current EC Directives

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Subject to technical modifications.

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Appendix E Manure Reception Building emissions abatement system

Schedule 16: Performance tests and procedures

1. Schedule Summary

This schedule describes the performance tests, per Clause 35, that are to be carried out, their duration, the raw materials to be used, what product is to be made, the conditions under which they are to be carried out, how the Plant is to be operated and so on. The parameters that are actually to be guaranteed and their associated liquidated damages are then set out below and in Schedule 17.

Performance Test shall demonstrate:

- the Plant satisfies the Performance Guarantees; and
- the Plant complies with the Specification and the requirements of this Contract.

2. Pre-requisites to Performance Tests

These include but not limited to:

- Following completion & acceptance of Schedules 9, 10, 13, 14 & 15, the performance test period will commence.
- All values and figures are based on the fact that the Plant is operated in line with the operation and maintenance manuals supplied by the **Contractor** and with the feedstock supplied by the **Purchaser** under Schedule 3
- Steady state operation as stated in Schedule 15
- The **Purchaser** shall instruct the **Contractor** as to where and how noise and emissions shall be measured. In response, the **Contractor** shall prepare a method statement outlining the process for measuring noise and emissions, such method statement to be in accordance with all requirements set out in the **Purchaser's** planning permission.

3. Performance Test Parameters

The **Contractor** will provide to the **Purchaser** a Performance Test plan which will include all procedures to achieve a successful test. it will follow to demonstrate the Plant will meet the Performance Parameters listed below

The following table details the performance parameters, expected and guaranteed values that are to be demonstrated by the **Contractor** and are linked to the Performance Damages in Schedule 17:

Design and guaranteed process values

Parameter	Unit	Expected Value	Guarantee Value	Acceptability Criterion	Comments
Total Air flow	m^3/hour	18,500	18,500*	not less than	Equates to building dimension to give a minimum of 3 changes per hour
Ammonia concentration (from exhaust stack)	Mg/Nm ^{3}	0.3-20	0.3-20	not more than	Conform to BAT guidelines

Odour units (from exhaust stack)	Ou/Nm^3	<800	<1000	not more than	Conform to BAT guidelines

* The flow rate and changes will be sufficient to ensure a negative pressure within the building based on dimensions supplied by on Acorn, in normal operation.

The following table details the performance parameters with expected values and acceptability criteria that are to be demonstrated and are linked to the achieving an Acceptance Certificate under Clause 35 and 36:

Additional Performance Parameters				
Parameter	**Unit**	**Expected Value**	**Acceptability Criterion**	**Comments**
Power usage	kW	39.25- in normal operation	No more than	Total power of complete Works in normal operation
Air changes per hour	No. per hour	3*	No less than	
Water usage	Litres per day	1000- Based on expected ammonia concentrations	No more than	

* The flow rate and changes will be sufficient to ensure a negative pressure within the building in normal operation

4. Performance tests and procedures

The **Contractor** agrees to provide performance guarantees. Guarantees of performance measured by tests will establish how well the Plant is performing against the Contract requirements. The tests and criteria are set out above and the guaranteed values are in Schedule 17. The Performance test and procedures are defined in Clause 35 and set out below;

1. The **Contractor** is to confirm in writing to the **Purchaser** that the Plant has achieved steady state, i.e., it runs as per the requirements as defined in Schedule 15 for 48 hours prior to the commencement of the Performance Test. A 2-week notification period will be given prior to the commencement of the performance test.
2. Once the Performance Test window commences the window will last for a maximum of 6 weeks

3. Proof of performance is considered to have been achieved as soon as the Performance Parameters of the Plant over a rolling period of 28 days is on average within the parameters stated and their respective acceptability criteria in the Performance test parameters. Testing frequency and methodology to be agreed.
4. If any equipment reliability issues hinder the performance test, the 6-week testing period will reset, within the 18-week window.
5. There are a maximum of 3 resets during the 6-week performance testing window.
6. As a minimum to evidence the performance the following information will be recorded and logged:
   6.1. Parasitic power consumption
   6.2. Total air flow (Nm^3 per hour)_
   6.3. Odour (units) from exhaust stack
   6.4. Ammonia (units) from exhaust stack

   6.5. Any other non-air components (units) exiting the exhaust stack
   6.6. Consistent negative pressure within the building
7. The Contractor and Purchaser shall calibrate all instruments used in the Performance test in their respective scope prior to the Performance test.
8. If the performance of the Plant will be reduced or interrupted for any reasons not caused by the Contractor, the performance test duration as well as the performance test window will be extended by the same amount of time lost due to the disruption (including the time required to get back to steady state conditions, if applicable). In this case, the Contractor must notify the Purchaser within 5 working days of the disruption. Consequently, the output recorded due to the reduction and/or interruption shall be excluded from the dataset.
9. The plant will be operated by the **Purchaser** (Acorn Operations) staff during this period under the direction of the **Contractors'** experienced staff**.**