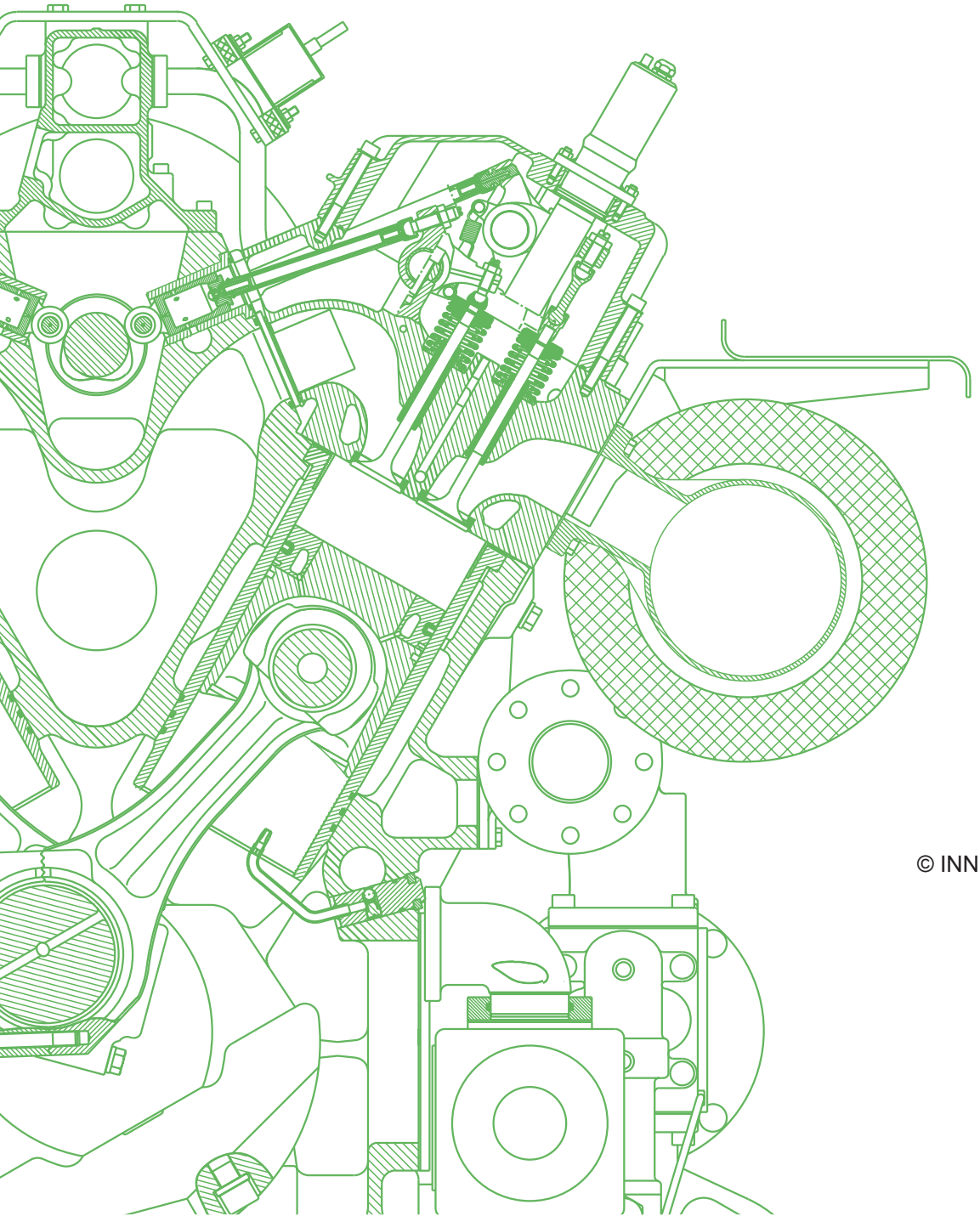
JENBACHER

TA 1501-0505

Technical Instruction

Thermal reactor - CL.AIR Design information type 2,3 & 4



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The target recipients of this document are:

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1 Description of operation of the thermal reactor

Fuel gases obtained from the decay processes of waste materials or biomass often contain impurities which have an impact on the lifetime of exhaust gas after-treatment technologies. Catalysts can become completely poisoned after a few operating hours, and thereby rendered ineffective.

The Cl.air© thermal reactor is a robust solution to reduce oxidisable exhaust gas emissions. Developed and optimised by INNIO Jenbacher GmbH & Co OG, the technology features a regenerative heat exchanger concept to minimise the energy requirements for thermal afterburning.

The use of CL.Air offers the following advantages:

- low emissions in combination with the patented INNIO Jenbacher GmbH & Co OG LEANOX system:

CO < 200 mg/Nm3 at 5%O2 – dry NOx < 500 mg/Nm3 at 5%O2 – dry THS < 133 mg/Nm3 at 5%O2 – dry COT < 100 mg C1/Nm3 at 5%O2 – dry HCOH < 20 mg/Nm3 at 5%O2 – dry	-> Typical values

- resistant to catalyst poisoning and therefore a non-deteriorating aftertreatment concept
- increased heat yield due to the utilisation of the chemical energy in the pollutants
- minimal periodic maintenance and therefore minimal fixed costs
- a design lifetime of 120,000 operating hours, which represents around 15 years without extensive equipment replacement

The thermal reactor unit includes 2 packed bed vessels connected by a reaction chamber. The reaction chamber is where the pollutant reduction takes place. The engine exhaust gases are passed through the two reservoirs in the opposite flow directions alternately. Untreated exhaust gas briefly escapes straight into the chimney during the flow reversal. See Figure 2.1. Generally, the reversal process takes less than 3 seconds. However, over time the CL.Air on average achieves the above-mentioned emission values (30-minute average values measured after termination of the heating phase).

The reduction of the oxidisable exhaust components is mainly driven and maintained by the chemical energy content remaining in the exhaust gas.

The CL.Air needs the following auxiliary energy sources for its operation:

- Electrical power for the heating cartridges during the heating phase and electrical equipment such as compressors, valves and the control cabinet
- Compressed air to operate the 4-way valve (for the periodic reversal of the exhaust gas flow direction through the thermal reactor)
- A small quantity of supplementary firing gas if necessary (landfill gas, biogas or natural gas) to maintain the reactor temperature

The thermal reactor is the best alternative to treating exhaust gases with catalytic converters where the composition of the fuel gas (e.g. sulphur or siloxanes) is such that the catalytic converters often have to be deactivated but where the emission limits still need to be guaranteed on a permanent basis.

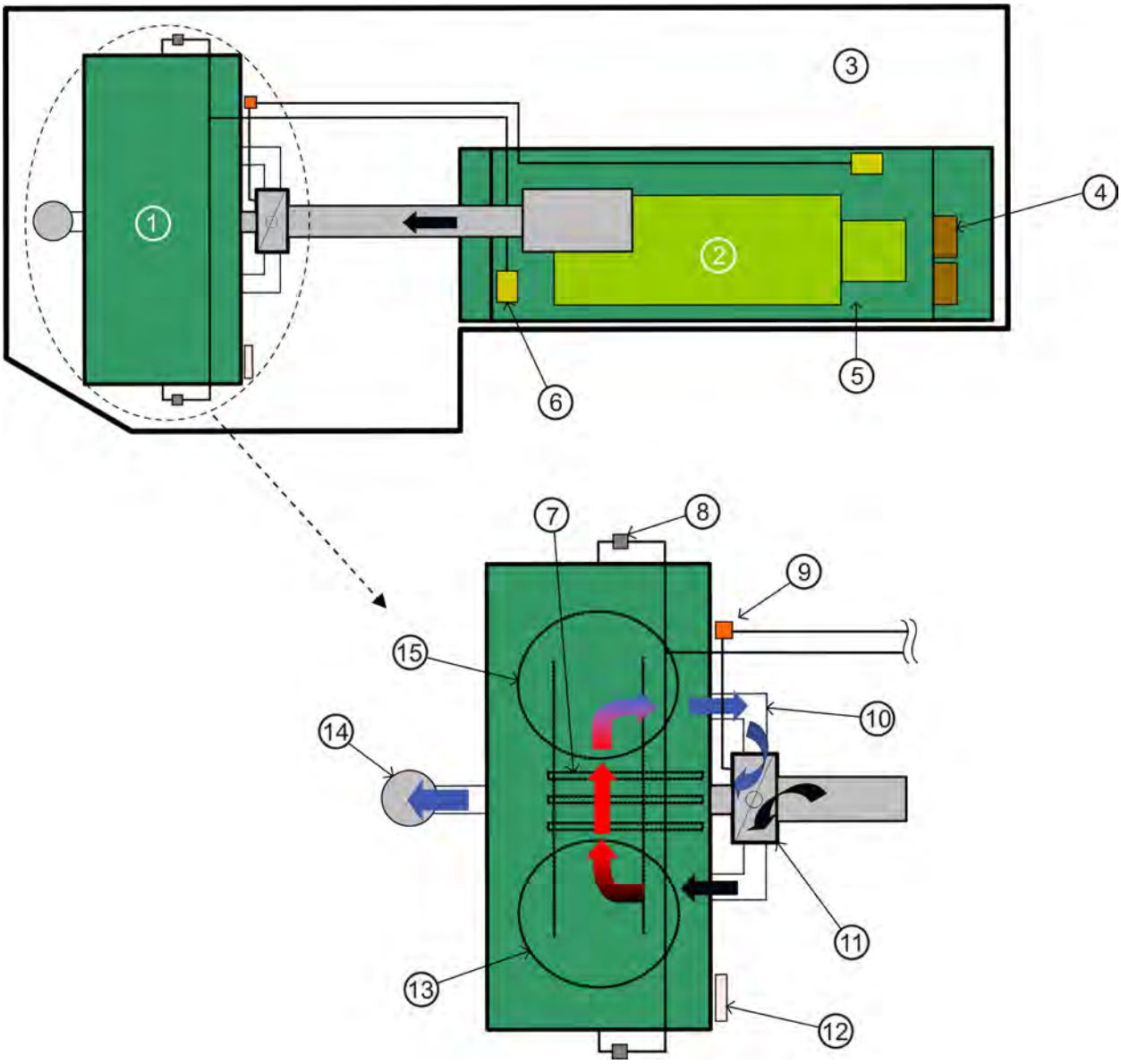
2 CL.Air system assemblies and components

The thermal reactor system consists of four main assemblies:

- the thermal reactor housing
- the gas injection system
- the compressed air system
- the control cabinet

Each reactor system is specifically designed to operate with only one particular engine version. This means that operating two engines with one CL.Air or fitting a smaller/larger CL.Air version may affect the exhaust treatment efficiency. This is why every system is equipped with the above-mentioned categories which must be used with the appropriate unit.

The following Figure shows the four assemblies and the flow direction within the system:



Concept diagram of the thermal reactor system

①	CL.Air	⑨	Compressed air tank
②	Engine	⑩	Exhaust bends
③	Air compressor	⑪	Pneumatic 4-way valve
④	Thermal reactor control cabinet	⑫	Terminal boxes
⑤	Container	⑬	Vessel 2
⑥	Gas compressor unit or natural gas train	⑭	Chimney
⑦	Heating units	⑮	Vessel 2
⑧	Solenoid valve		

2.1 Components of the thermal reactor housing

- two vessels
- one reaction chamber

- internal insulation
- electrical heating units (supplied separately)
- Ceramic packed bed material
- pneumatic 4-way valve (supplied separately without Insulation)
- exhaust bends (supplied separately without insulation)
- Four base legs
- Housing
- terminal boxes

2.2 Components of the gas injection system

- Gas compressor unit (supplied separately) or natural gas train* (supplied separately)
- Gas injection pipelines (not included in supply)
- Gas injection lances (supplied separately)
- Solenoid valves (supplied separately)

* The supplementary firing gas required to maintain the reactor temperature can be taken either from the engine fuel gas pipe (gas compressor unit required) or from a natural gas pipe, if fitted (gas train required).

2.3 Components of the compressed air system

- Air compressor unit (supplied separately)
- Compressed air pipeline (not included in supply)
- Air tank (supplied separately)
- Air tank pipeline (supplied separately)

2.4 Components of the control cabinet

- The control cabinet includes all the electrical components for the control and monitoring systems.

3 Scope of supply

The components of the thermal reactor included in the scope of supply are listed in the table below:

Category group	Component	Supplied by
Thermal reactor housing	Thermal reactor unit	INNIO Jenbacher GmbH & Co OG
	Electrical heating units NHW2	INNIO Jenbacher GmbH & Co OG
	Ceramic packed bed material	INNIO Jenbacher GmbH & Co OG
	Pneumatic 4-way valve NVC4	INNIO Jenbacher GmbH & Co OG
	Exhaust bends	INNIO Jenbacher GmbH & Co OG

Category group	Component	Supplied by
	Four base legs	INNIO Jenbacher GmbH & Co OG
	Control and monitoring systems	INNIO Jenbacher GmbH & Co OG
	Terminal box	INNIO Jenbacher GmbH & Co OG
Gas injection	Gas compressor unit or natural gas train	INNIO Jenbacher GmbH & Co OG
	Gas injection pipeline including ball valves or SOV39-42	Client (if necessary supplied by INNIO Jenbacher GmbH & Co OG)
	Supplementary measures depending on the quality of the fuel gas injection	Client (if necessary supplied by INNIO Jenbacher GmbH & Co OG)
	Solenoid valves SOV9	INNIO Jenbacher GmbH & Co OG
	Gas-injection lances	INNIO Jenbacher GmbH & Co OG
Compressed air system	Air compressor	INNIO Jenbacher GmbH & Co OG
	Compressed air pipeline (from air compressor to air tank (NTD))	Client (if necessary supplied by INNIO Jenbacher GmbH & Co OG)
	Compressed air tank NTD (mounted on thermal reactor)	INNIO Jenbacher GmbH & Co OG
	Compressed-air line from 4-way valve to compressed air tank	INNIO Jenbacher GmbH & Co OG
Control cubicle	Control cabinet unit	INNIO Jenbacher GmbH & Co OG
Exhaust-gas system	Chimney	Customer INNIO Jenbacher GmbH & Co OG
	Piping to chimney	Customer INNIO Jenbacher GmbH & Co OG
	Piping from engine to CL.Air	Customer INNIO Jenbacher GmbH & Co OG
	Insulation of 4-way valve and bends	Customer INNIO Jenbacher GmbH & Co OG
Foundation	-	Customer INNIO Jenbacher GmbH & Co OG

Category group	Component	Supplied by
Cabling	between main grid / control cabinet / terminal box	Client (if necessary supplied by INNIO Jenbacher GmbH & Co OG)
	between control cabinet and Diane XT	Client (if necessary supplied by INNIO Jenbacher GmbH & Co OG)
Service platform	-	Client (if necessary supplied by INNIO Jenbacher GmbH & Co OG)

4 Installation conditions

4.1 General requirements regarding ambient conditions

The thermal reactor housing is designed for installation outdoors at temperatures between -20 and +40°C and may not be operated in potentially explosive atmospheres.

The gas injection and air compressor units must be installed indoors (temperatures between +5 and +40°C) in a location free of potentially explosive atmospheres. These units are generally installed inside the engine container or the engine room. See the cross reference for details.

If a natural gas train is installed instead of the gas compressor unit, the system is approved for indoor use and for temperatures between -10°C and +60°C. See the cross reference for details.

The installation site for the thermal reactor and all its components must be determined by the plant operator in accordance with the danger zone plan. The applicable directives and standards must be observed, e.g. ATEX Directive 94/9/EC, IEC 60079-10 or NFPA 497 (USA).

If local conditions so require, the customer must install a lightning protection system in accordance with the applicable local regulations.

See also

- Gas injection

4.2 Foundation and dimensions of the CL.Air unit

The CL.Air unit must be erected on a flat base surface. The minimum weights on the foundation as listed in the table below (not including pipework) must be considered:

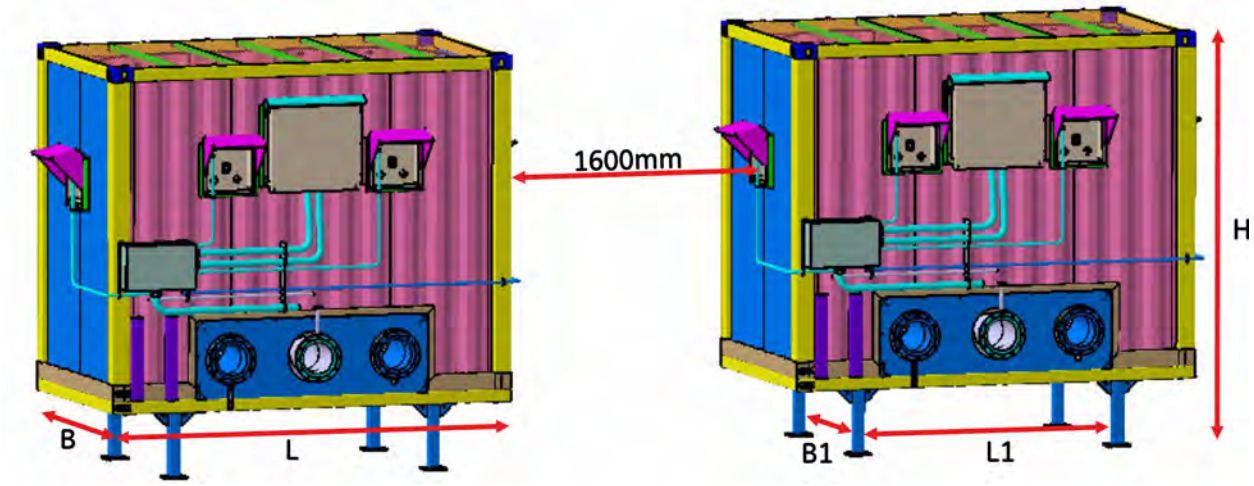
Engine/CL.Air - version	Minimum weight for foundation [kg]	weight of pneumatic 4-way valve * [kg]
J208	5600	260
J312	5600	260
J316 & J412	7200	330
J320 & J416	7900	420
J420	10600	800

* Approximate weight including insulation

The design must allow for a minimum clear distance around the thermal reactor. On the side where maintenance work is carried out, this distance must be 1.6 m for Type 2, 3, 412 & 416 engines, and 2.0 m for Type 420 engines. The following figures illustrate an example of CLAIR unit installation.

The table below contains the dimensions of the CL.Air unit without the 4-way valve. More detailed information can be found in the module drawing and the foundation plan in the Appendix.

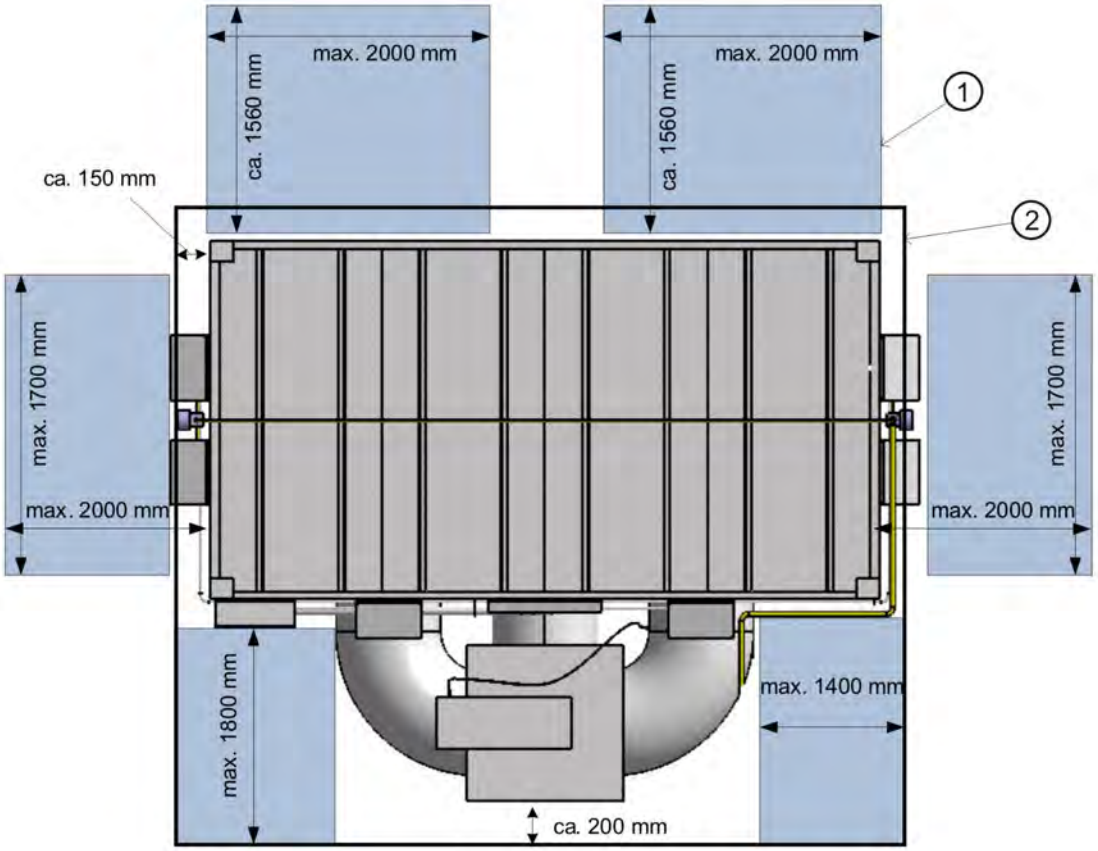
Values [mm]	J 208	J312	J316 & J412	J320 & J416	J420
Housing length (L)	3390	3500	4180	4390	5138
Width (B)	1990	2040	2140	2320	2740
Height (H)	3470	3470	3470	3610	3710
Leg offset lengthwise (L1)	2179	2272	2904	3042	2 x 1497
Leg offset widthwise (B1)	1321	1359	1441	1589	1697



Dimensions of the CL.Air unit

4.3 Maintenance and assembly space around the thermal reactor housing

The following Figure shows the space required for maintenance and assembly on the plant. See the Appendix for more detailed information on the individual engine types.

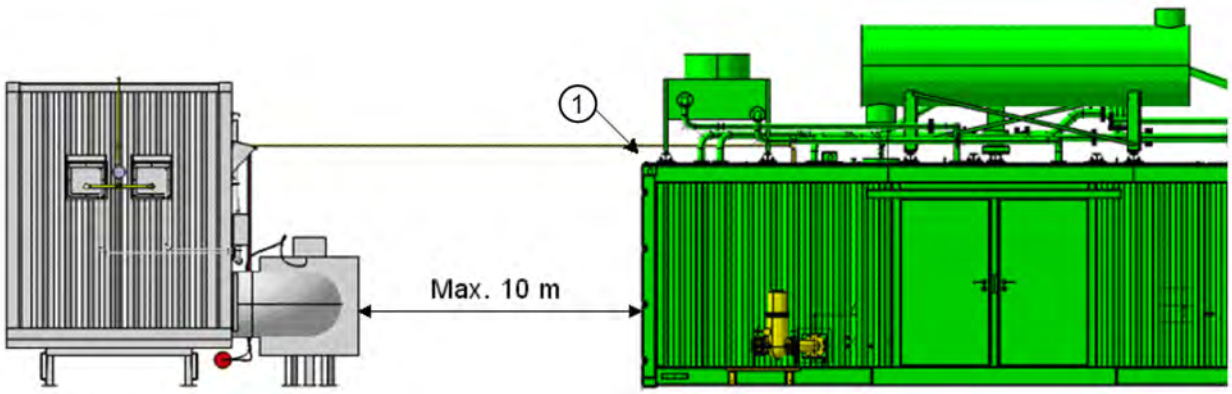


Required area for the thermal reactor

①	Space for maintenance and repair work	②	Foundation

4.4 Distance from the engine

The housing including the 4-way valve must be installed no more than 10 m away from the engine container or engine room (assuming the engine is installed close to the wall). See the Figure.



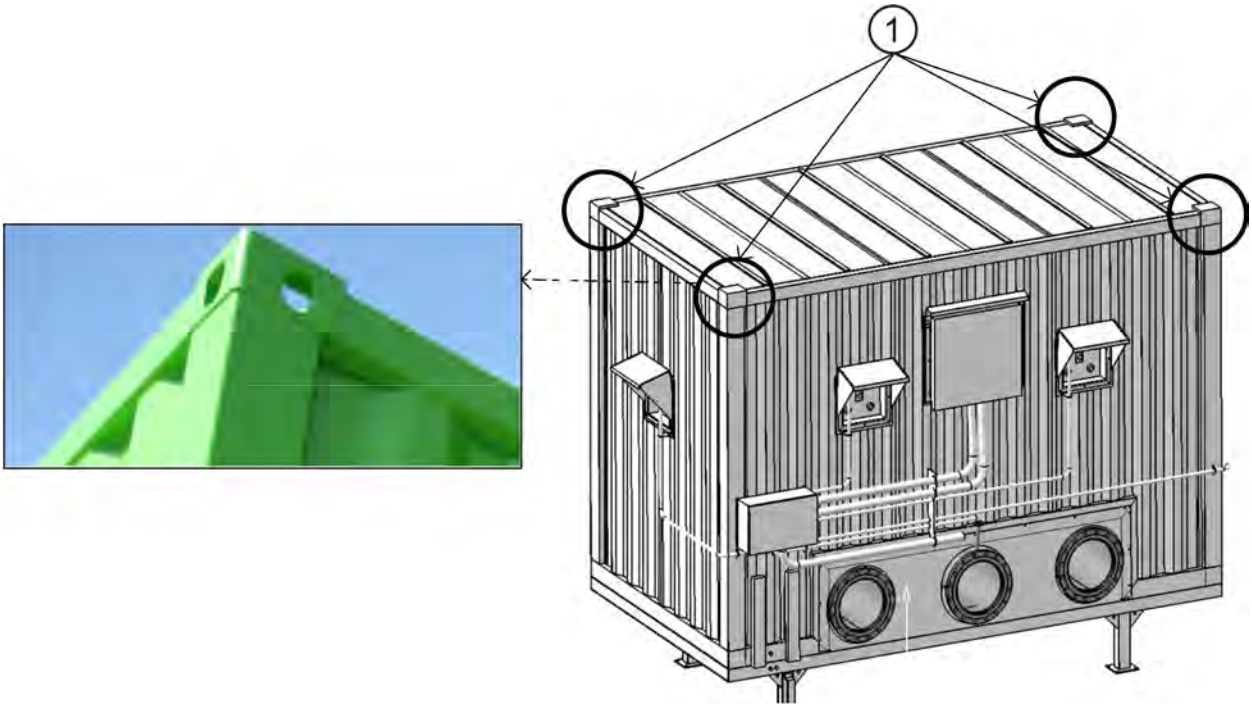
Distance between CI.Air housing and engine room for piping (Figure as an example only)

①	Engine container

4.5 Lifting the CL.Air system

A crane is required for positioning the CL.Air system on the prepared foundation. After the thermal reactor housing is lowered in place, install the 4 way valve. Refer to section 4.2 for the weights.

Use the corner fittings on the housing roof to lift the thermal reactor housing.



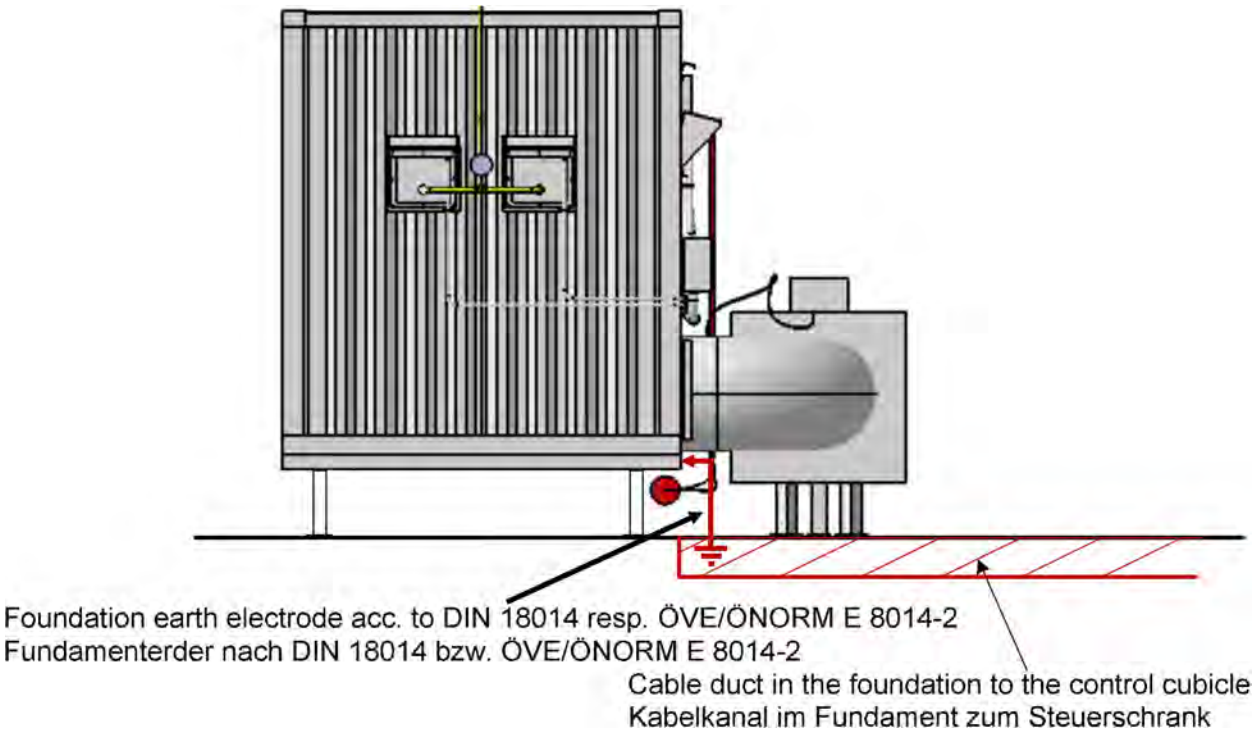
Thermal reactor housing corner fittings

①	Corner fitting

See also

- Foundation and dimensions of the CL.Air unit

4.6 Foundation for electrical installation



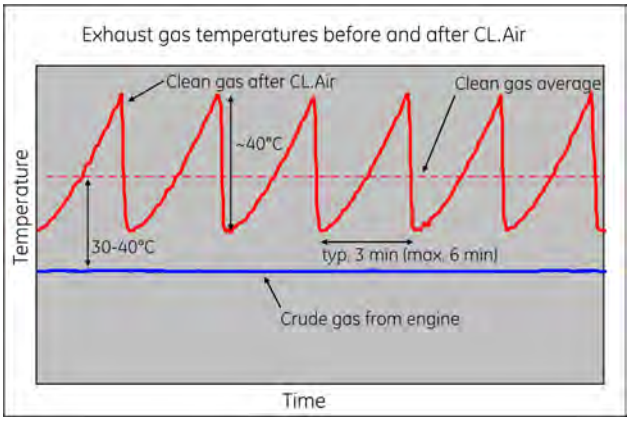
Electrical engineering requirements for the foundation

5 Operating data and resources needed

5.1 Exhaust gas

Exhaust gas temperatures

Another advantage of the thermal reactor is that the thermal efficiency of the system as a whole is increased by using the chemical energy contained in the pollutants. In this process, the exhaust gas temperature is increased by an average of 30-40°C (typically 30° in type 3 engines and 40°C in type 4 engines). See the Figure below: This increase (minus piping losses) can be tapped off as increased heat output at the downstream heat exchanger.



Exhaust gas temperatures before and after CL.Air

Exhaust gas volumetric flow/mass flow/heat output

The table below contains details of the typical exhaust gas flows and guide values for the increase in heat output expected for the various engine types:

Type	Volumetric flow [Nm3/h-wet]	Mass flow [Nm3/h-wet]	Increase in heat output* [kW]
J208	1500	1930	18
J312	2750	3550	33
J316	3650	4700	43
J320	4600	5930	55
J412	3650	4700	58
J416	4850	6250	77
J420	6100	7807	97

* Minus line losses. These should be regarded as guideline values and were

determined with $\Delta T = 30°C$ for a type 3 engine and $\Delta T = 40°C$ for a type 4 engine, where cp=1.11 kJ/kgK.

5.2 Gas injection

A small quantity of supplementary firing gas (approx. 1.5% of the fuel gas quantity required by the engine) from the engine gas train or from a natural gas train is injected into the CL.Air unit to maintain the required temperature in the reactor.

Supplementary firing gas requirement

The supplementary firing gas requirement depends on a number of parameters specific to the engine and system (engine type, engine settings, engine operating hours, atmospheric conditions, etc.). It is therefore only possible to provide guide values for the supplementary firing gas requirement in the table below.

Type*	Guide value for supplementary firing gas requirement [Nm3/h-CH4]***
J208	1.5
J312**	2.5
J316	3.0
J320	4.0
J412	4.0
J416	5.0
J420	6.0

* The guideline values relate to 50 Hz, 500 NOx engines

** Because of specific conditions, the CL.Air runs autothermally with a J312-C225 engine, i.e. no supplementary firing gas is required.

*** The quantities refer to the amount of pure CH4, i.e. when the CH4 content is 50%, the quantity injected is doubled. The quantities relate to an engine at full load.

Requirements when a gas compressor unit is used (engine fuel gas):

The gas quality must be as specified in TI 1000-0300. The following requirements also apply:

- Methane content in gas ≥ 40% by volume - dry
- Pressure in the gas train 50 - 80 mbar – standard gas compressor unit required

Gas dew point [°C]	Ambient temperature [°C]	Additional measure required for	Type of additional measure
T_T < 18	10 ≤ T ≤ 40	-	None
	-20 ≤ T < 10	Gas pipe to CL.Air (outer piping only)	Trace heating + insulation

Gas dew point [°C]	Ambient temperature [°C]	Additional measure required for	Type of additional measure
18 < τ ≤ 25	10 ≤ T ≤ 40	Inner gas pipes	Insulation
		Gas pipes to CL.Air (outer piping only)	-
	-20 ≤ T < 10	Inner gas pipes	Insulation
		Gas pipes to CL.Air (outer piping only)	Trace heating + insulation

Requirements when using a gas train (natural gas):

Only gases of gas families 1, 2 and 3 as specified in DVGW Work Sheet G260/I

See also

- Foundation and dimensions of the CL.Air unit

5.3 Compressed air

Compressed air is required for operating the pneumatic cylinder on the 4-way valve. It is produced by the compressor unit, which is integrated into the control system for safety reasons. In the event of a malfunction, the system is shut down. The air pressure should be between 4.5 – 8 bar. The air quality must comply with DIN ISO 8573-1. This lays down the following values:

Ambient temperature [°C]	Parameter	Class / Max. Value
+5 ≤ T < +40	Max. particle size	5 / 40 µm
	Pressure dew point	4 / +3°C
	Max. oil concentration	5 / 25 mg/m3
-20 ≤ T < +5	Max. particle size	5 / 40 µm
	Pressure dew point	3 / -20°C
	Max. oil concentration	5 / 25 mg/m3

5.4 Power supply and power consumption

The power supply supplies the gas compressor unit and gas pressure control system, the air compressor units, the heating elements and the control cabinet. The component requirements at 50 Hz are:

Component	Requirements
Air compressor	400 V, 1.7 kW
Gas compressor, type 2 & 3 engines	230 V, 0.95 kW
Gas compressor, type 4 engines	400 V, 0.75 kW
Solenoid valves (SOV 39, 40, 41, 42)	24V DC (only if two gas trains)
Ball valves	manual (only if 1 gas train)
Solenoid valves SOV1 type 2 & 3 engines	230 V
Solenoid valves SOV9	230 V
Gas flow control valve SOV11	24 V AC
Heating units, type 2 & 3 engines	230 V, 5 kW (6 - 9 units)
Heating units, type 4 engines	230 V, 7.5 kW (6 - 9 units)
Double solenoid valve for gas train (instead of gas compressor)	230 V, 35 VA
Optional valve test system for gas train (instead of gas compressor)	230 V

The power supply must comply with the following requirements:

- Three-phase four-line system
- Supply voltage range: rated voltage ±10%
- Frequency range: rated frequency ± 1% (continuous),± 2% (short-time)
- Mains configuration at generator connection point: TN system
- Direction of field rotation: right
- Earthing: TN system

Power supply for each engine type :

Power supply	J208 – J316	J320	J412	J416 – J420
TN system 3 x 400/230V at 50 Hz	63 A	80 A	80 A	125 A

* AC 500 V/ 120 kA / IEC 60269

The typical power consumption is as follows:

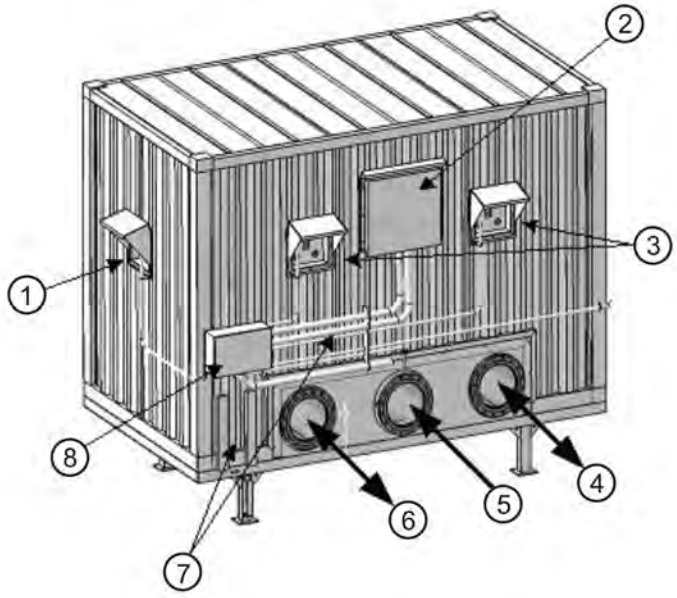
Values [kW]	J208 – J316	J320	J412	J416 – J420
Continuous operation	< 1.2	< 1.2	< 1.2	< 1.2
Heating units at 100% (only in heating phase)	27.0	40.5	40.5	60.7
gas compressor	~1.0	~1.0	~ 0.75	~ 0.75
Air compressor*	0.2	0.2	0.2	~ 0.2

* With 3 min. switching interval

6 Technical details of components

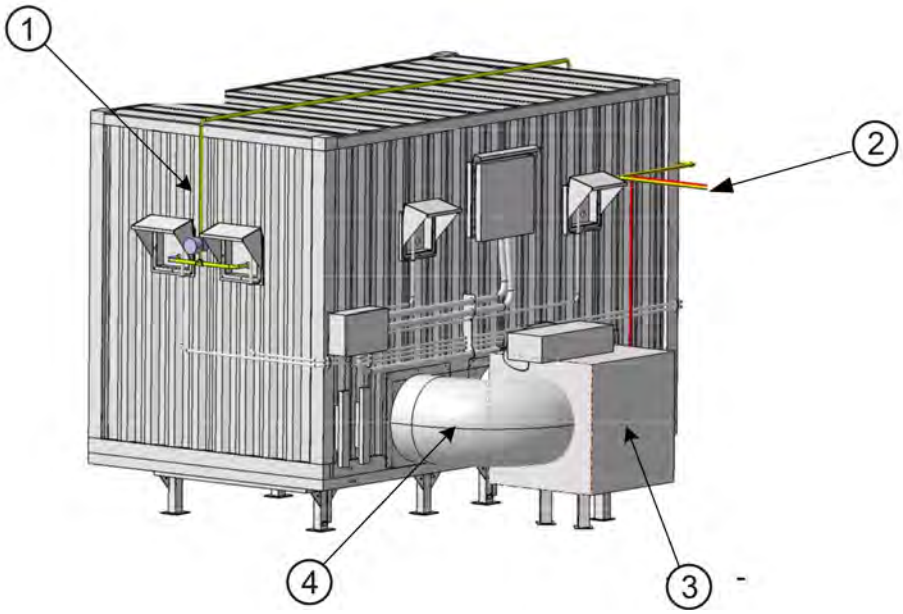
6.1 Thermal reactor housing

The housing is made up of a number of different components integrated into one unit. See ⇨ Section. The gas injection and compressed air pipelines are connected to the housing and to the 4-way valve respectively. Furthermore, all the components of the control and monitoring system (shipped separately) must be assembled onto the unit and connected to the terminal box. The first Figure shows the interfaces, while the second shows the completed housing after installation.



Thermal reactor interfaces with other components (Example: J320 front view)

①	Connection for gas injection lance	⑤	Cleaned gas
②	Heating units interface	⑥	Exhaust gas inlet/outlet
③	Temperature-measurement connections	⑦	Cable ducts
④	Exhaust gas inlet/outlet	⑧	Terminal boxes



Thermal reactor housing after completion of installation (example: J320 front view)

①	Gas injection line with SOV9.	③	Assembled 4-way valve with compressed-air cylinder (supplied separately & not insulated)
②	Gas injection and compressed air lines	④	Exhaust bends (supplied separately and not insulated)

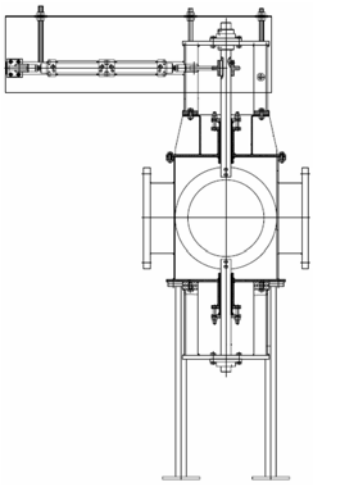
See also

- Components of the thermal reactor housing

6.1.1 4-way valve

4-way valve	DN	PN	DIN	Working pressure
J208	250	10	2576	50 mbar
J312	250			
J316 & J412	300			
J320 & J416	350			
J420	500			

The 4-way valve (4-way diverter) sends the engine exhaust to the CL.Air and the cleaned gas to the chimney. It includes a pneumatic cylinder, which switches the valve every 3 to 6 minutes. It is connected to the compressed air system.



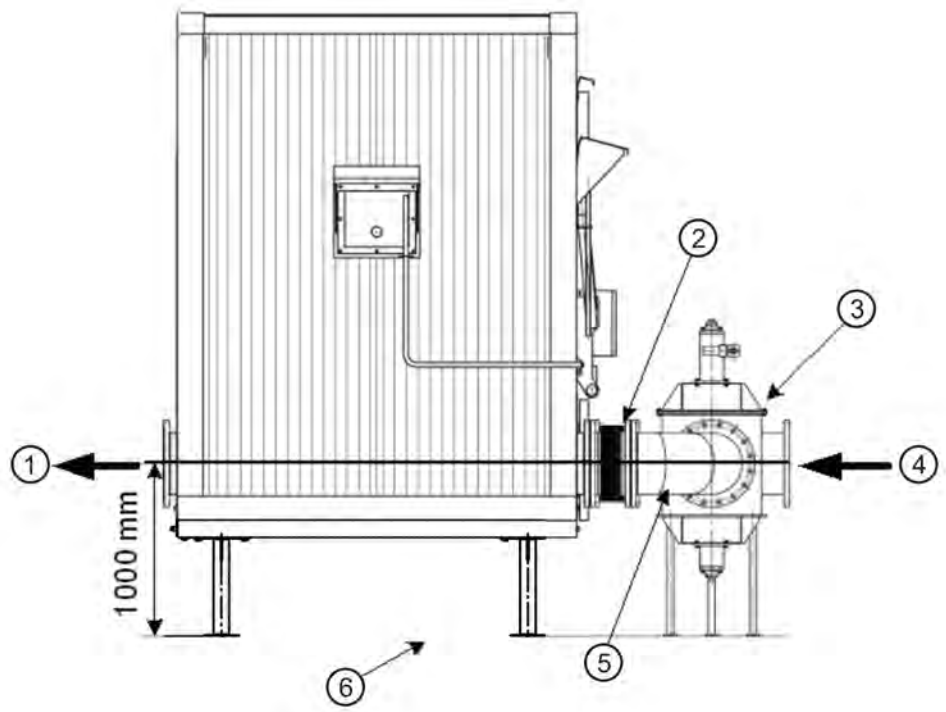
Note: The 4-way valve is not designed for static loads from the pipe. A compensator should therefore be installed in the exhaust line just before the 4-way valve. Note the following ⇨ Section as well.

See also

- Exhaust system (not included in supply)

6.1.2 Exhaust bends

The exhaust bends connect the thermal reactor housing with the 4-way valve. They must be mounted in line with the centreline of the CL.Air housing exhaust piping, 1000 mm above the foundation. Compensators are integrated in the exhaust bends. For more detailed information, see the Figure below and the plant layout drawing.



Thermal reactor housing after completion of installation (example: J320 front view)

①	Cleaned exhaust gas	④	Engine exhaust gas
②	Compensators	⑤	Exhaust bends
③	4-way valve	⑥	Foundation

6.2 Gas injection

Depending on whether engine fuel gas or natural gas is used for supplementary firing to maintain the thermal reactor temperature, the gas injection system consists of the following components: gas compressor unit or gas train, gas injection pipeline, solenoid valves (SOV9) and gas injection lances. The gas quality for the gas injection system must satisfy the requirements set out in the following ⇨ Section.

See also

- Gas injection

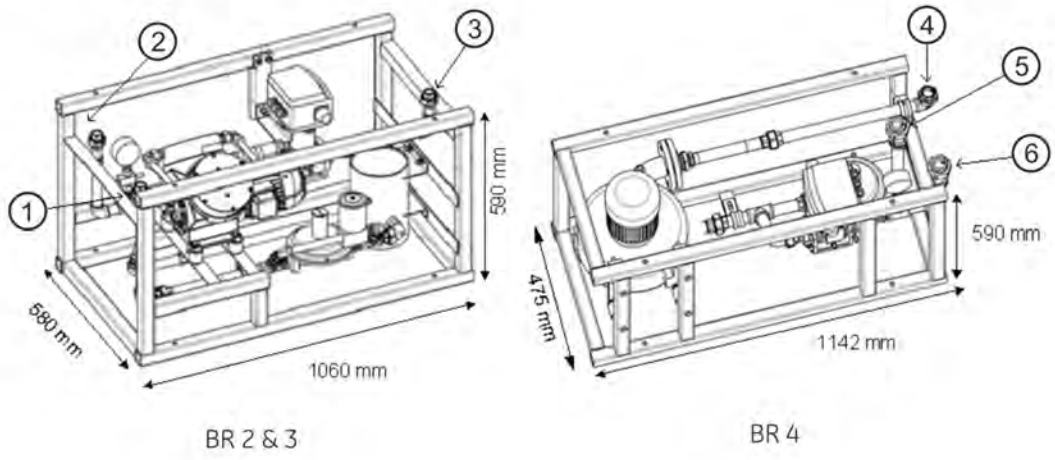
6.2.1 Gas compressor unit for biogas or landfill gas injection

The unit must be installed and operated indoors in a location free of potentially explosive atmospheres at temperatures between +5°C and +40°C. The applicable directives and standards must be observed (e.g. ATEX Directive 94/9/EC, IEC 60079-10 or NFPA 497 (USA)). It is recommended that the unit be installed inside the engine container or in the engine room close to the gas sensor in the engine gas train. The ventilation system in these locations must be in accordance to the INNIO Jenbacher GmbH & Co OG engines' requirements. The unit is painted with RAL 1023 in order to be identified as a gas carrier. See the Figures below.

The gas compressor injection unit includes the following components:

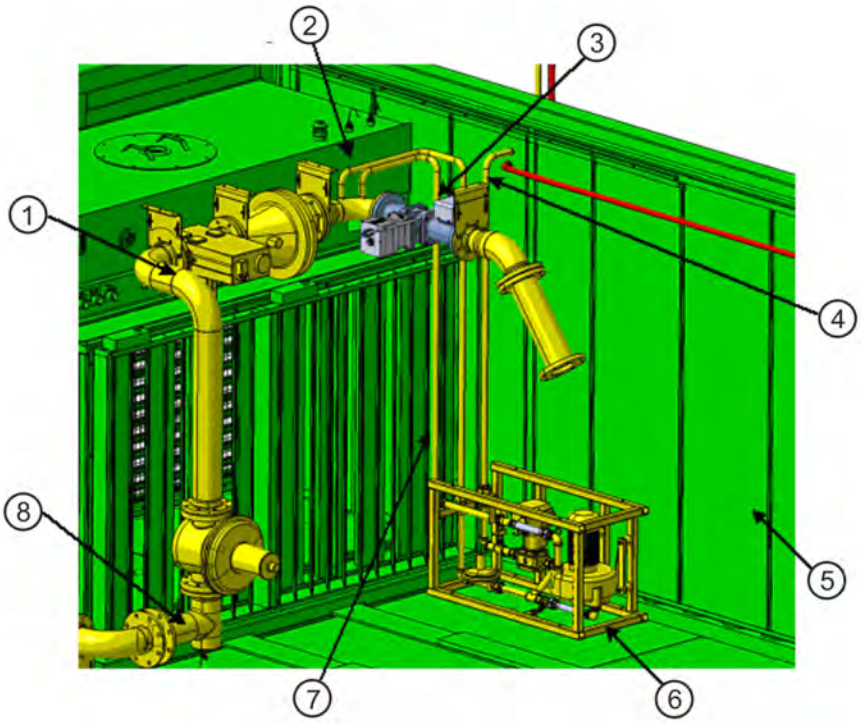
- Gas compressor
- Gas flow control valve SOV11
- Safety valve

- Solenoid valve SOV1 (only for type 2 & 3 engines)
- Solenoid valve SOV12 (only for versions manufactured before 2009)
- Gas compressor unit tank (only for type 2 & 3 engines)



Gas injection unit for type 2 &3 engines (left) and type 4 engines (right)

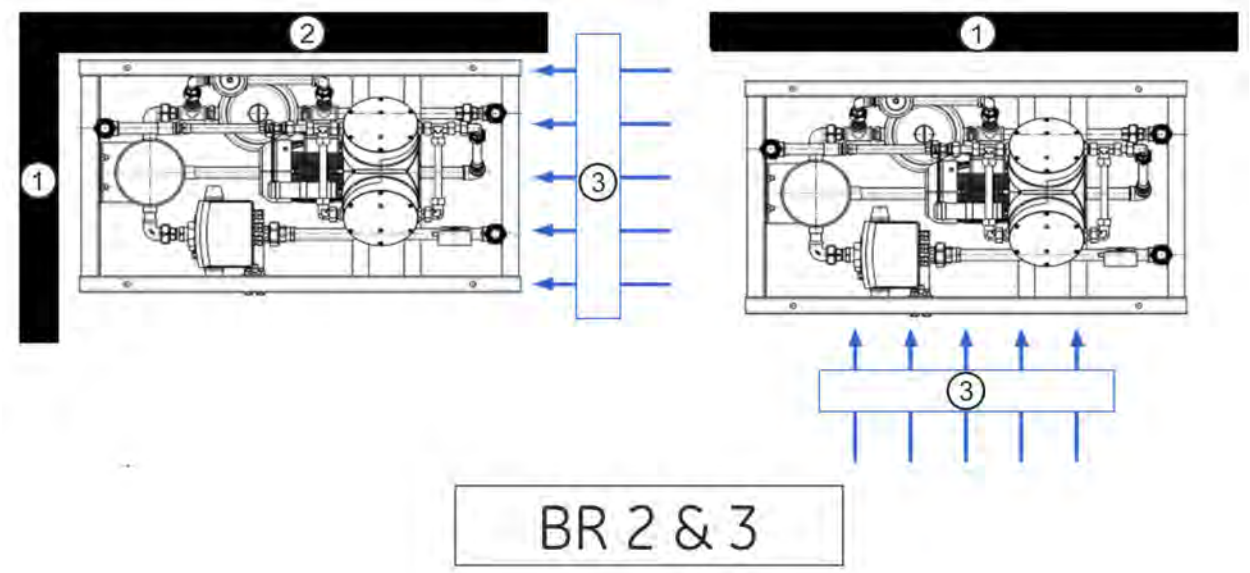
①	Gas outlet to gas train, DN 20	④	Gas inlet, DN 25
②	Gas outlet to CL.Air unit, DN 20	⑤	Gas outlet to gas train, DN 25
③	Gas inlet, DN 20	⑥	Gas outlet to CL.Air unit, DN 25



Installation site for the gas compressor unit in the engine container (except for type 4 engines)

①	Gas train	⑤	Engine container
②	Gas injection line to gas train	⑥	Gas injection unit
③	TecJet	⑦	Gas injection pipeline to gas compressor
④	Gas injection pipeline to container wall	⑧	Position of CH_4 sensor

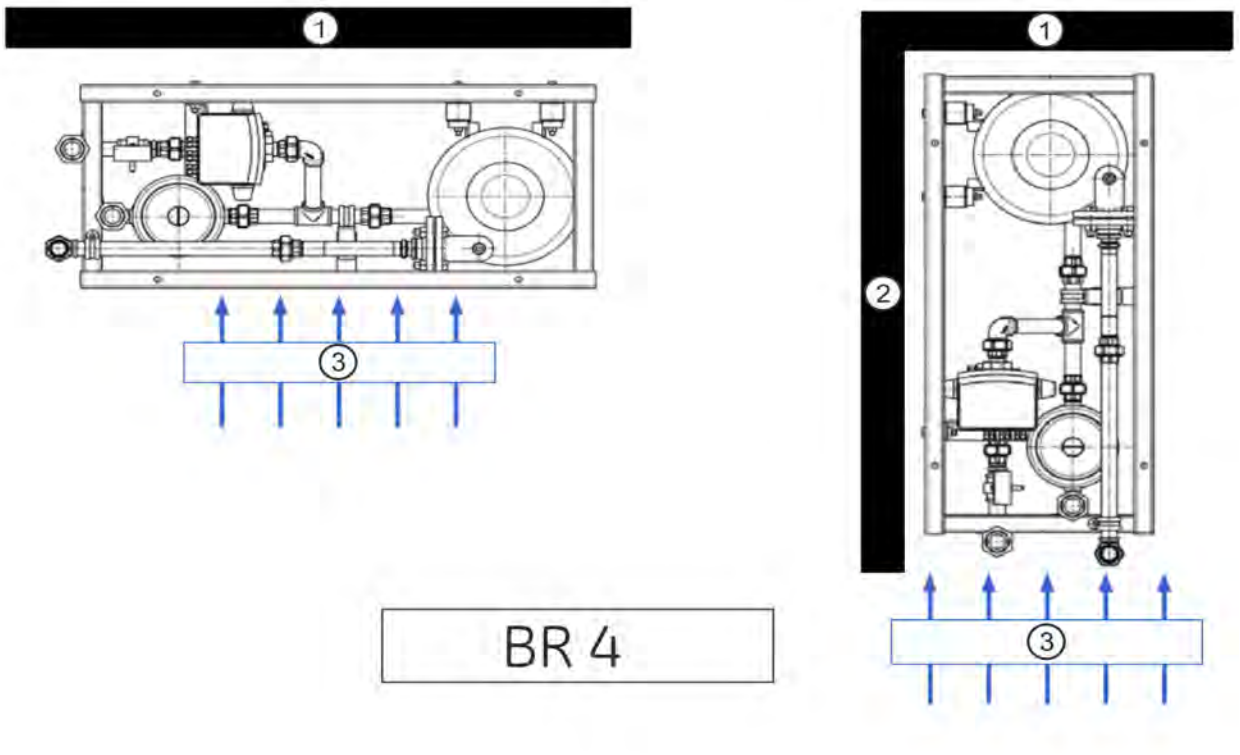
The following figures illustrate the most common installation of the unit depending on the engine type. The unit must be installed so that it allows safe access to the gas compressor unit and safe removal of the components for maintenance purposes.



Gas compressor unit tank installed depending on the ventilation direction (only for type 2 & 3 engines)

- If installed in the engine room:
  ventilation direction parallel to the wall
- Min. fresh air intake flow: 0.12 l/s (only for the unit)

①	Louvre	③	Direction of ventilation
②	Wall		



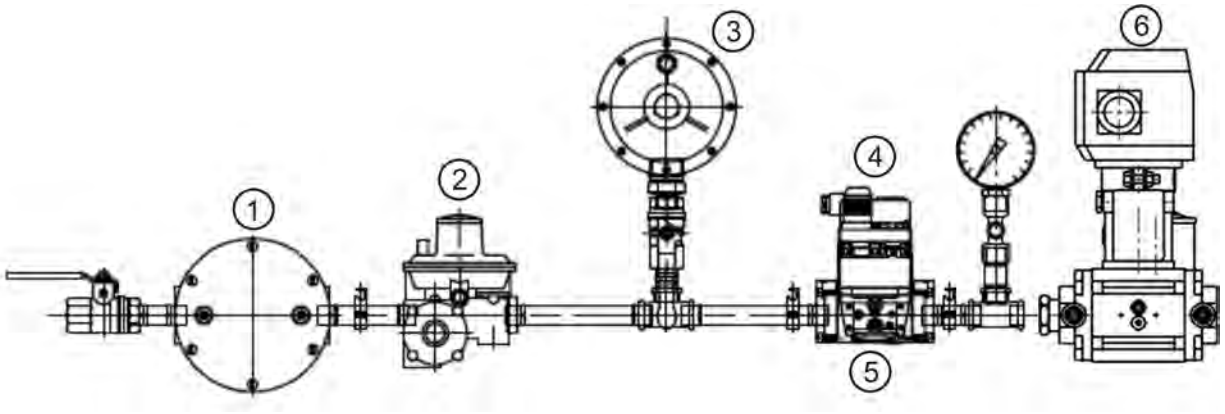
Gas compressor unit tank installed depending on the ventilation direction (only for type 4 engines)

- If installed in the engine room:
  ventilation direction parallel to the wall
- Min. fresh air intake flow: 0.12 l/s (only for the unit)

①	Louvre	③	Direction of ventilation
②	Wall		

6.2.2 Gas train for natural gas injection

The gas train includes the following components:



Front view of gas train for the CL.Air supplementary gas firing

①	Gas filter	⑤	Double solenoid valve
②	Gas train with integrated safety shut-off valve	⑥	Gas flow control valve
③	Safety blow-off valve	Exhaust and air bleed lines to atmosphere (to be supplied by customer)	
④	Optional: Valve testing system		

Installation site

The unit must be installed indoors in a location free of potentially explosive atmospheres. The applicable directives and standards must be observed (e.g. ATEX Directive 94/9/EC, IEC 60079-10 or NFPA 497 (USA)). The gas train is only permitted for indoor use and for temperatures between -10°C and +60°C and must be considered permanently technically sealed if properly maintained. As an additional safety measure, it is advisable to install the gas train in a well-ventilated space (engine container or engine room) as described in TI 1100-0110 and/or to provide a gas sensor (with a suitable connection to the engine control system).

Sufficient space and safe access must be provided to allow staff to operate the unit (e.g. ball valves, reset button on the valve test system, etc.) or to carry out maintenance work (e.g. replacing filters, etc.).

Inadequately-protected frequency converters can result in failures in the valve test system when mains failures occur. It is essential to provide sufficient mains screening.

Exhaust and air bleed lines

The customer is responsible for ensuring that properly-designed exhaust and air bleed lines are routed from the pressure controller, the safety shut-off valve (SAV) and the safety blow-off valve (SBV) via the roof to atmosphere. The exhaust and air bleed lines must be kept separate and be designed at DN15 at least. To ensure better gas distribution, the open end of the lines should point downwards. The plant operator is responsible for drawing up a zone plan. The applicable directives and standards (e.g. ATEX Directive 94/9/EC, IEC 60079-10 or NFPA 497 (USA)) must be observed.

As a rough guide, a spherical zone (as described in ATEX) can be formed around the line opening with the following radii:

- Pressure controller: 0.5 m, Zone 2
- SAV: 0.5 m, Zone 2
- SBV breather line: 0.5 m, Zone 2
- SBV blow-off line: 0.5 m (Zone 1) and 1.2 m (Zone 2)

No potential ignition sources must be present around the line openings in these zones under any circumstances.

Installation position

The installation position is as shown in the previous Figure (front view).

6.2.3 Gas injection pipelines (not included in supply)

The gas injection pipelines are not part of the standard scope of supply for the thermal reactor and must therefore be installed by the customer. The applicable local regulations must be observed and the lines must be of a permanently technically sealed type. After installation, the customer must carry out a leak test before the system can be commissioned.

Depending on the type (gas compressor unit or natural gas train), the gas injection pipelines consist of at least the following components: The gas injection pipeline leads from the controlled gas system through the gas compressor unit to the thermal reactor. A bypass leads back to the gas train. Supplemental measures can be integrated into the pipeline, depending on the fuel gas dew point see ⇨ Section.

Section	DN	NS	Max. length	Recommended Material	Valves	Installation location	Possible SM
Type 2 and 3 engines							
To gas compressor	20	¾”	10 m	ST.35.8 or ST 37.0	Manual	After NDR	Insulation
to the gas train			10 m		Manual	After NDR	Insulation
To container wall			10 m		-	From gas unit to container wall	Insulation
To CL.Air			21 m		SOV 9	between container wall and CL.Air	Insulation and trace heating
Gas injection lances	-	-	-	-	-	inside the CL.Air	-
Type 4 engines							
To gas compressor	25	1”	10 m	ST 35.8 or ST.37.0	Manual	Before TecJet	Insulation
to the gas train		1”	10 m		Manual	Before TecJet	Insulation
To container wall		1”	10 m		-	between gas unit and container wall	Insulation
To CL.Air		1”	21 m		SOV 9	between container wall and CL.Air	Insulation and trace heating
Gas injection lances	-	-	-	-	-	inside the CL.Air	-

The valves installed along the gas injection pipelines are approved for pressures up to 1 bar. The gas piping must be designed for a working pressure 500 mbar.

On plants with two gas trains, the following valves are used instead of the (manual) valves referred to in the above table:

Section	Type / DN	Valves	Installation location	Supplemental Measures
to gas compressor	Type 2&3 / DN20	SOV 39	See table above.	Insulation
from gas compressor	Type 4 / DN25	SOV 40		Insulation
to gas compressor	Type 2&3 / DN20	SOV 41	See table above.	Insulation

Section	Type / DN	Valves	Installation location	Supplemental Measures
from gas compressor	Type 4 / DN25	SOV 42		Insulation

All gas piping must be identified as gas-carrying by proper labelling or by painting with RAL 1023. After installation, the customer must carry out a leak test before the system can be commissioned.

See also

- Gas injection

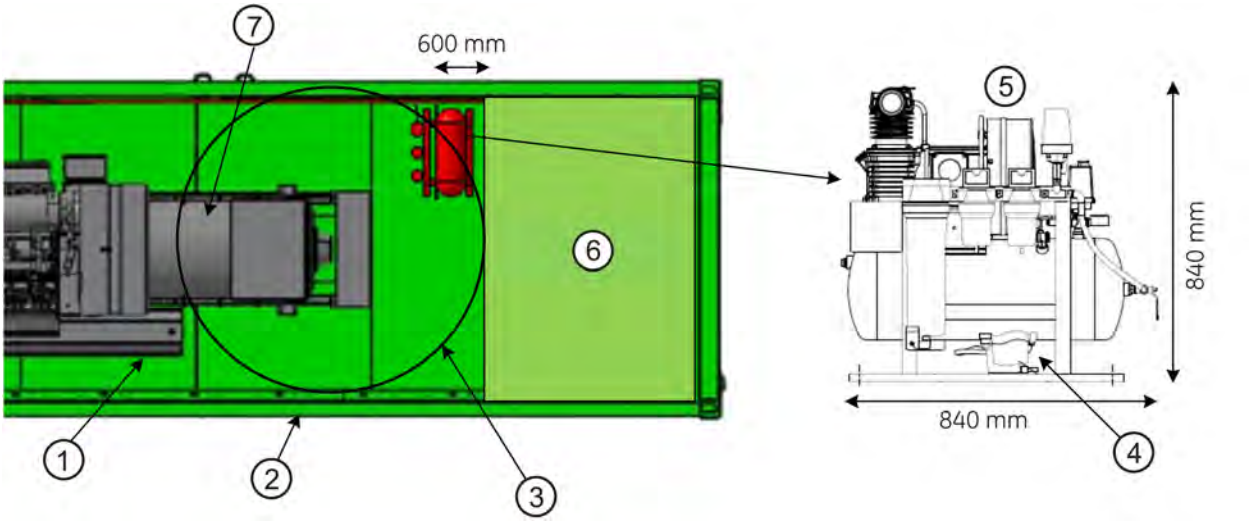
6.3 Compressed air system

The air system is divided into the following groups:

6.3.1 Air compressor unit

The unit provides the compressed air to operate the pneumatic cylinder of the 4-way valve. The unit must be installed indoors in a location free of potentially-explosive atmospheres. The applicable directives and standards must observed (e.g. ATEX Directive 94/9/EC, ICE 60079-10 or NFPA 497 (USA)). The following figure shows the recommended installation location, which ensures adequate temperature and ventilation. The customer is responsible for installing a condensate drain.

The unit must be installed so as to allow safe access for operational and maintenance work.

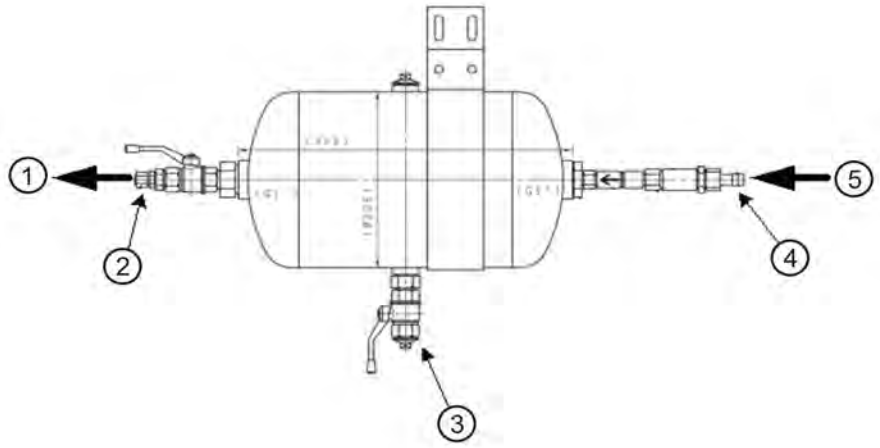


Installation location of air compressor unit in the engine container (Figure shows an example only)

①	Engine	⑤	Air compressor unit
②	Engine container	⑥	Control cabinet Room
③	Well-ventilated zone of container	⑦	Generator
④	Drain outlet dia. 8 x 23 (hose not included in delivery)		

6.3.2 Air tank NTD

The compressed air tank acts as a reservoir for compressed air. It is mounted on the thermal reactor housing between the compressed air unit and the pneumatic cylinder.



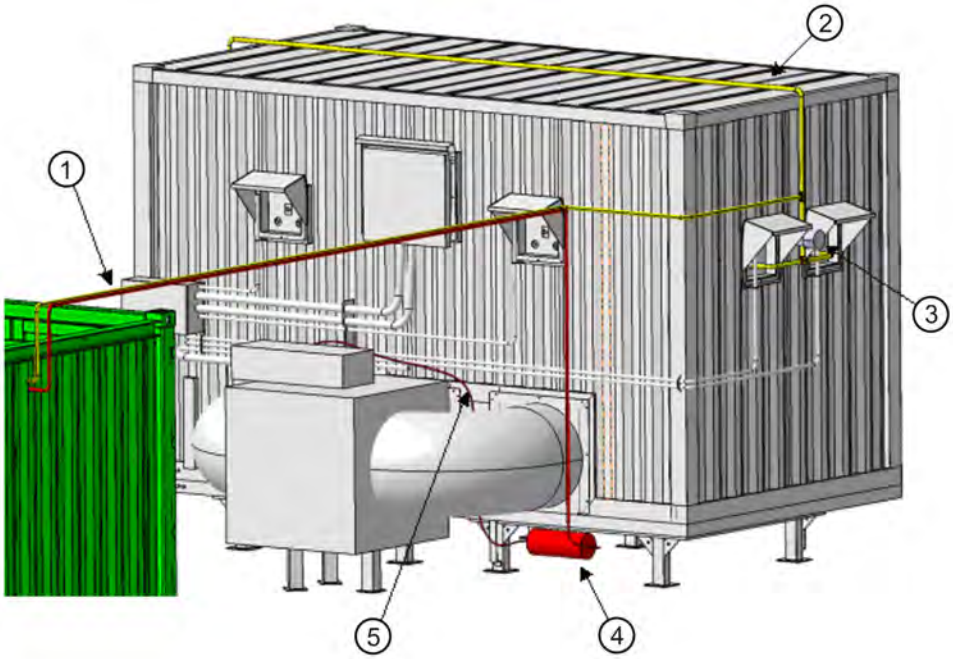
Thermal reactor compressed air reservoir

①	To pneumatic cylinder	④	Hose diameter 13 mm
②	Diameter 8mm	⑤	From compressed air unit
③	discharge		

6.3.3 Compressed air line (not included in supply)

The length of the line is 30 m. The recommended materials are high pressure hose for min. 10 bar suitable for an ambient temperature between -20 and +40°C with a diameter of 13 x 4.5 or a pipe of ST.37.0 material and DN 15 (1/2”). The connection of the air compressor unit is DN 12 (3/8”). Figure 6.10 shows a typical arrangement of the pipe.

All air piping must be identified as air-carrying by proper labelling or by painting it in red.



Typical assembly of the compressed air line and air tank

①	Compressed-air line	④	Compressed air tank
②	Gas injection line	⑤	Air tank pipeline
③	SOV9		

6.4 Control cabinet

A separately-arranged cabinet contains all the equipment for analysing signals and controlling the plant. The cabinet unit is designed for indoor installation. The cabinet must be positioned in accordance with local regulations.

The following table summarizes the properties of the unit:

Temperature parameters	**Indoor installation (naturally ventilated)**
Max. temperature	40°C
max. 24 hr. average	35°C
Min. temperature	5°C
Relative humidity	max. 50% at 40°C
Max. height of installation location	2,000 mm

Totally enclosed floor-mounted sheet steel cabinet with front door wired to terminals. It is ready for operation, with the cable inlet at the bottom. The cabinet must be sited no further than 50 m away from the thermal reactor.

Guard	IP 42 outdoors IP1X or IPXXA / IP2X or IPXXB indoors (protection against unintentional direct contact with hazardous live parts)

Design according to EN 60439-1 / IEC 60439-1 with the following dimensions:

Dimensions [mm]	
Height	2000
Width	800
Depth	600

The thermal reactor is operated and controlled from the engine control panel, where its operating mode visual display is situated. The power supply to the starter and control batteries is 24 V DC. The power supply to the auxiliaries (auxiliary power supply) is 3 x 400/230 V, 50 Hz.

An outdoor version of the control cabinet can be supplied on request. Contact INNIO for details.

6.5 Exhaust system (not included in supply)

The exhaust system consists of the following components:

chimney (clean gas temperature < 600°C) or heat exchanger with chimney (clean gas temperature approx. 250°C) The Figures in ⇨ Section shown a typical exhaust gas temperature curve.

Piping to chimney

Piping from engine to CL.Air (insulated)

Insulation of 4-way valve and bends (designed for an internal temperature of at least 600°C and outer surface temperature of < 60°C)

See also ⇨ Section and ⇨ Sectionon this.

Recommendation for exhaust line:

Depending on the characteristics and length, compensators should be provided in any case (about 1 compensator every 10 m).

See also

- 4-way valve
- Exhaust bends
- Exhaust gas

6.6 Foundation (not included in supply)

See Section and Section and circuit diagram number 616910 (type 2 and 3 engines) and 616911 (type 4 engines).

See also

- General requirements regarding ambient conditions
- Foundation and dimensions of the CL.Air unit

6.7 Cabling (not included in supply)

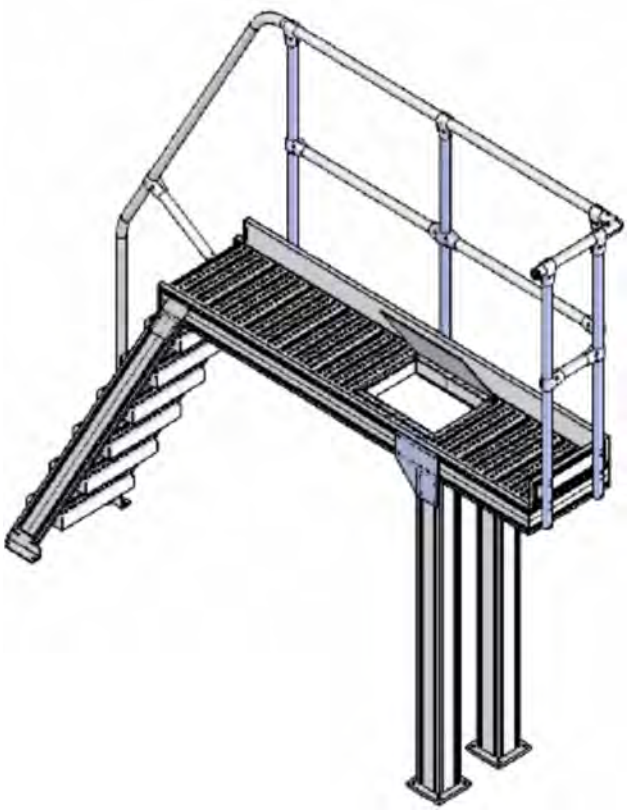
See thermal reactor circuit diagram, taking into account the distances referred to in Section and Section.

See also

- Thermal reactor housing
- Control cabinet

6.8 Service platform (not included in supply)

The customer must provide the necessary safety equipment for personnel when maintenance work is being carried out around the thermal reactor housing. This applies especially to elevated working areas. INNIO Jenbacher GmbH & Co OG can on request provide a service platform which is erected over the 4-way valve. If required by the client, the platform must be ordered additionally.



Service platform for maintenance work on the thermal reactor

7 Safety

7.1 General safety requirements

The customer shall inform INNIO Jenbacher GmbH & Co OG if different or additional safety regulations apply to a project. In addition, the installation site of the thermal reactor plant must be checked against the hazardous area plan. The plant must not be installed in an area subject to a potential explosive hazard.

Note: The thermal reactor is not designed for operation with explosive gas mixtures. The customer must therefore ensure that no ignitable gas mixture flows through the system and/or exists around under any circumstances whatsoever.

7.2 Operation and maintenance requirements

The system is designed to operate in “automatic mode”. The operator must react to malfunctions and irregularities in operation and carry out the necessary maintenance work. During operation the entire system must be inspected during a daily inspection round.

A distinguishing feature of INNIO Jenbacher GmbH & Co OG CL.Air is its low-maintenance design. However, it they still require inspection and maintenance to ensure their safe and successful operation and to able to preserve warranty rights.

All necessary inspection and maintenance work is specified in IW 8070 A0 and must be carried out at the specified intervals. Shorter intervals specified elsewhere must also be observed in addition, where appropriate. Work may only be carried out by staff having relevant electrical and mechanical training who have been familiarized with the hazards posed by gas-carrying components.

8 Appendix

The following documentation is available for the thermal reactor system:

Description

Included in customer information and available on the INNIO website

Foundation plan

Types J208, J312, J316, J320, J412, J416 with circuit diagram number 616910

Type J410 with circuit diagram number 616911

Plant layout drawing

Types J208 & J312 with circuit diagram 599375

Types J316 & J412 with circuit diagram 330615

Types J320 & J416 with circuit diagram 331023

Types J420 with circuit diagram 389160

General technical diagram

Types 2 & 3 with diagram 508646

Type 4 with diagram 631133

Wiring diagrams

project-specific

Inspection and maintenance work

Document IW 8070 A0

Documentation of the individual components

Data collection sheet E 8070

Weekly inspection plan E 8070A

Instructions for adjusting the 4-way valve position switches 1501-0503

Instructions for installation TA 1501-0504

9 Revision code

Revision history

Index	Date	Description / Revision summary	Expert *Auditor*
4	11.04.2019	GE durch INNIO ersetzt / GE replaced by INNIO	**Opoku** *Pichler R.*
3	31.10.2012	Änderungen am Rahmen/ Frame design changed	**Provin** *Häusl*
2	23.11.2010	Klassifizierung & Schutzvermerk hinzugefügt / Added Classification and Protection Notice Format Tabelle bei Gaseindüsungsleitungen angepasst / Changed Format from Table in Gasinjection pipeline	**Schartner** *Pichler*
1	28.06.2010	Umstellung auf CMS / Change to Content Management System ersetzt / replaced Index: c	**Schartner** *Schartner*