Provincia di Fermo

Comune di Fermo

PROCEDIMENTO DI VALUTAZIONE D'IMPATTO AMBIENTALE

D.Lgs. n. 152/2006 e s.m.i. – L.R. n. 3/2012 e s.m.i.

Scheda tecnica post combustore

All. 12

Fermo ASITE S.r.l.u.

Sede Legale in Via Mazzini num.4 del Comune di Fermo 63900 (FM)
Unità Operativa in C.da San Biagio del Comune di Fermo 63900 (FM)

Data: Maggio 2015

Per presa visione:

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1. Description of the functionality of the thermal reactor

Fuel gases coming from degradation processes of waste materials or biomass often contains impurities which have an impact to the lifetime of exhaust after-treatment technologies. Catalysts can become completely contaminated after a few operating hours and therefore ineffective.

The CL.Air© thermal reactor is a robust solution for reducing oxidisable exhaust gas emissions. The technology, which was developed by GE Jenbacher, was optimised and features a regenerative heat exchanger concept to minimise the energy requirement for thermal afterburning.

The use of CL.Air offers the following advantages:

- Low emissions in combination with the patented GE Jenbacher LEANOX system:

CO < 200 mg/Nm^3 @ 5%O_2 – dry NO_X < 500 mg/Nm^3 @ 5%O_2 – dry THC < 133 mg/Nm^3 @ 5%O_2 – dry COT < 100 mg C1/Nm^3 @ 5%O_2 – dry HCOH < 20 mg/Nm^3 @ 5%O_2 – dry	**Typical values**

- Resistant to catalyst poisoning and therefore wear-free after-treatment 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 wide equipment replacement

The thermal reactor unit includes 2 reservoirs with packed material connected through a reaction chamber where the pollutant reduction takes place. The engine exhaust gases are guided through the two reservoirs in alternating flow directions. Untreated exhaust gas briefly escapes straight into the stack during the changeover. See Figure 2.1. Generally, the changeover process takes less than 3 seconds. Nevertheless, the CL.Air reaches the above-mentioned emission levels in an average time (30-minute average values measured following completion of the heating phase).

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

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

- Electrical, for the heating cartridges during start-heating phase and standard electrical equipment as compressors, valves and control cabinet
- Pneumatic, to switch the direction of incoming exhaust from engine to the two reservoirs
- Possibly a small quantity of pad gas (landfill gas, biogas or natural gas) to keep the reactor at the right 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) means that the catalytic converters often have to be deactivated and where the emission limits are to be guaranteed on a permanent basis.

2. CL.Air system assemblies and components

The thermal reactor system consists of four main assemblies:

- Thermal reactor housing
- Gas injection system
- Compressed air system
- Control cubicle

Each reactor system is SPECIFICALLY designed to operate only with an engine of a certain version. This means that connecting two engines to one CL.Air or operating a smaller/larger CL.Air version may affect the emission treatment efficiency. That is why every system is equipped with the above-mentioned categories to operate with a particular unit.

Figure 2.1 shows the four assemblies and the flow direction within the system:

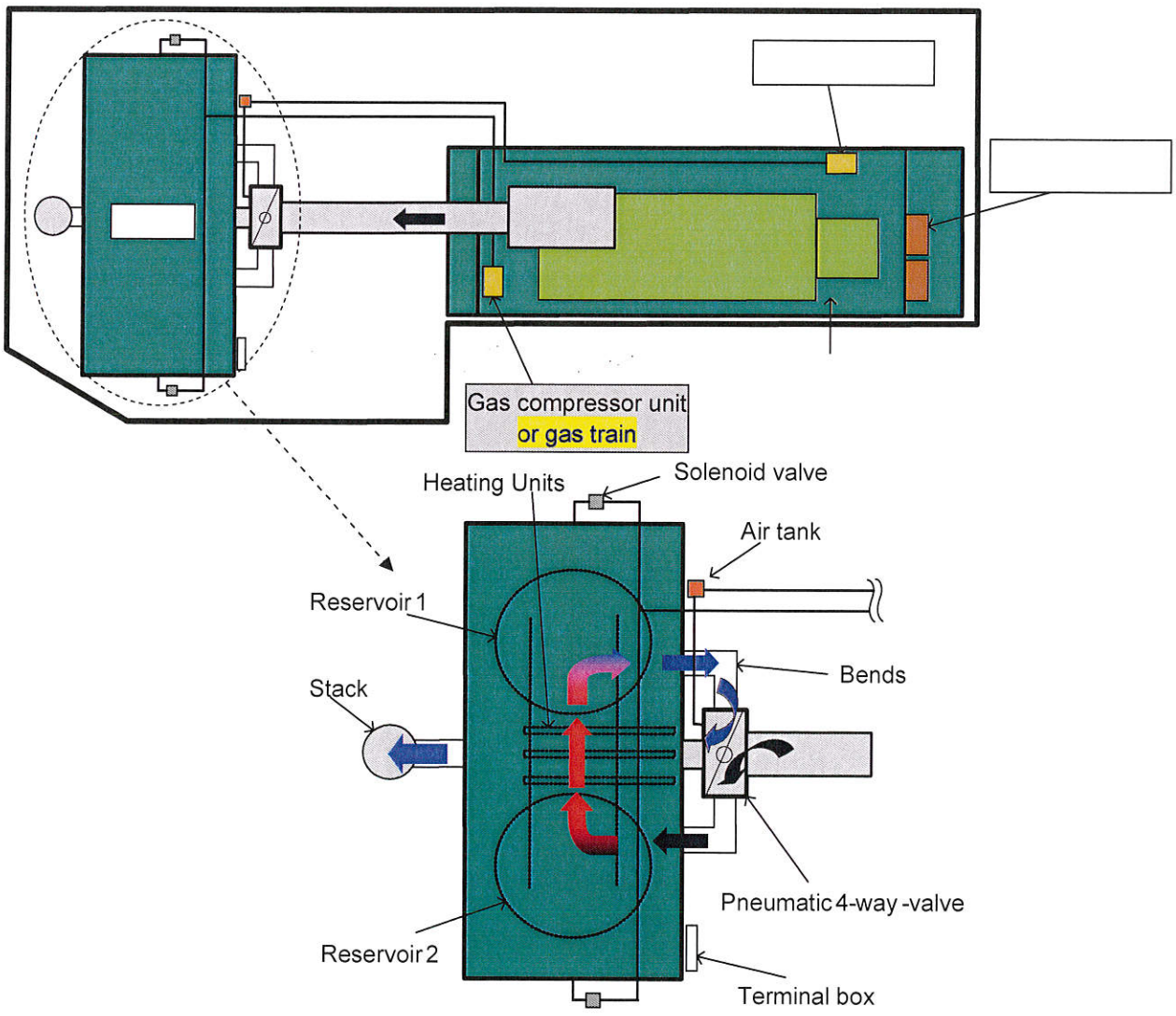


Figure 2.1. Concept diagram of the Thermal Reactor System

2.1 Components of the Thermal Reactor housing

- Two reservoirs
- One reaction chamber
- Internal insulation
- Electrical heating units (shipped loose)
- Ceramic packed material
- Pneumatic 4-way valve (shipped loose without Insulation)
- Bend pipelines (shipped loose without insulation)
- Base frame
- Casing
- Terminal box

2.2 Components of the gas injection system

- Gas compressor unit (shipped loose) or natural gas train* (shipped loose)
- Gas injection pipeline (not included in supply)
- Gas injection spuds (shipped loose)
- Solenoid valves (shipped loose)

* The pad 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 (control system required).

2.3 Components of compressed air system

- Air compressor unit (shipped loose)
- Compressed air pipeline (not included in supply)
- Air tank (shipped loose)
- Air tank pipeline (shipped loose)

2.4 Components of control cubicle

- Control cubicle includes all electrical parts for 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	GE Jenbacher
	Electrical heating units NHW2	GE Jenbacher
	Ceramic packed material	GE Jenbacher
	Pneumatic 4-Way-Flap NVC4	GE Jenbacher
	Bend pipelines	GE Jenbacher
	Base frame	GE Jenbacher
	Control and monitoring systems	GE Jenbacher
	Terminal box	GE Jenbacher
Gas injection system	Gas compressor unit or natural gas train	GE Jenbacher
	Gas injection pipeline including ball valves or SOV39-42	Customer (if necessary delivered by GE Jenbacher)
	Additional measures according to quality of fuel gas injection	Customer (if necessary delivered by GE Jenbacher)
	Solenoid valves SOV9	GE Jenbacher
	Gas injection spuds	GE Jenbacher
Compressed air system	Air compressor unit	GE Jenbacher
	Compressed air pipeline (from air compressor to air tank NTD)	Customer (if necessary delivered by GE Jenbacher)
	Air tank NTD (mounted on thermal reactor)	GE Jenbacher
	Compressed air pipeline from 4-way flap to air tank	GE Jenbacher
Control cubicle	Control cubicle unit	GE Jenbacher
Exhaust system	Stack	Customer
	Piping to stack	Customer
	Piping from engine to CL.Air	Customer
	Insulation of 4-way valve and bends	Customer
Foundation	-	Customer
Wiring	Between main grid, control cubicle and terminal box	Customer (if necessary delivered by GE Jenbacher)
	Between control cubicle and Diane XT	Customer (if necessary delivered by GE Jenbacher)
Service Platform	-	Customer (if necessary delivered by GE Jenbacher)

4. Installation conditions

4.1 General considerations of 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 und +40°C) in a location free of potentially explosive atmospheres. These units are generally installed inside the engine container or the engine room. For details, see 6.2.
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 und +60°C. For details, see 6.2.

The installation site for the thermal reactor and all of 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.

4.2 Foundation and dimensions of the CL.Air unit

The customer is required to place the CL.Air unit on even ground and must consider the minimum weights for the foundation, which are listed in the table below (pipework is not included):

Engine/CL.Air version	Minimum weights for foundation [kg]	Weight of pneumatic 4-way valve* [kg]
J208	5,600	260
J312	5,600	260
J316 and J412	7,200	330
J320 and J416	7,900	420
J420	10,600	800

* Rough weight including insulation

A minimum distance around the thermal reactor has to be planned. On the side for maintenance purposes, a distance of 1.6 m is required for type 2, 3, 412 and 416 engines and 2.0 m for type 420 engines. Figures 4.1 and 4.2 provide an example of a J320 and J420 unit.

The table below contains the dimensions of the CL.Air unit without the 4-way valve. You will find detailed information in the module drawing and the foundation plan in the appendix.

Values [mm]	J208	J312	J316 and J412	J320 and J416	J420
Length of casing	3390	3500	4180	4390	5138
Width	1990	2040	2140	2320	2740
Height	3470	3470	3470	3610	3710
Frame length	2179	2272	2904	3042	2x1497
Frame width	1321	1359	1441	1589	1697

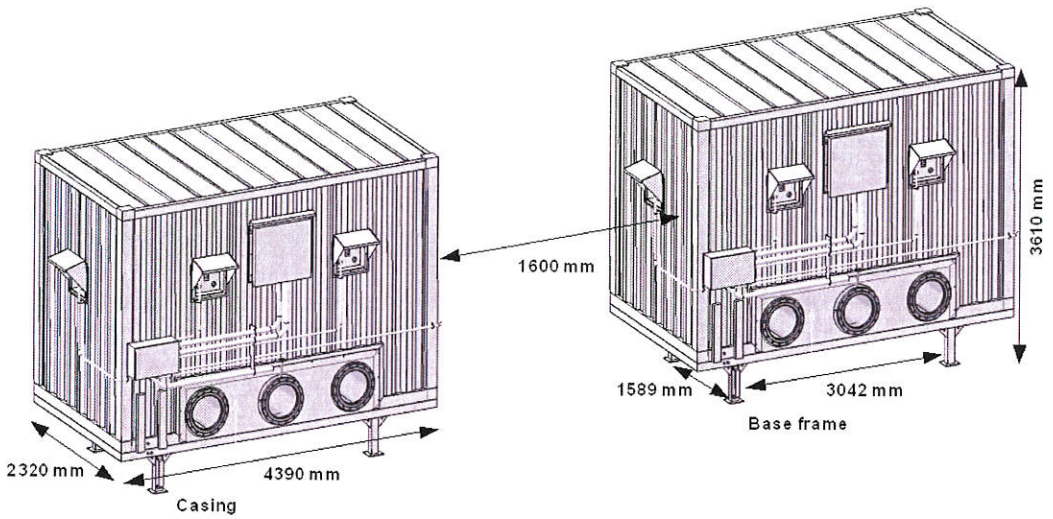


Figure 4.1 Dimensions of CL.Air unit J320

4.3 Surface for maintenance and assembly around the thermal reactor housing

The following table summarises the maintenance and assembly work to be done on the equipment. For detailed information according to engine type, please refer to the information in the appendix.

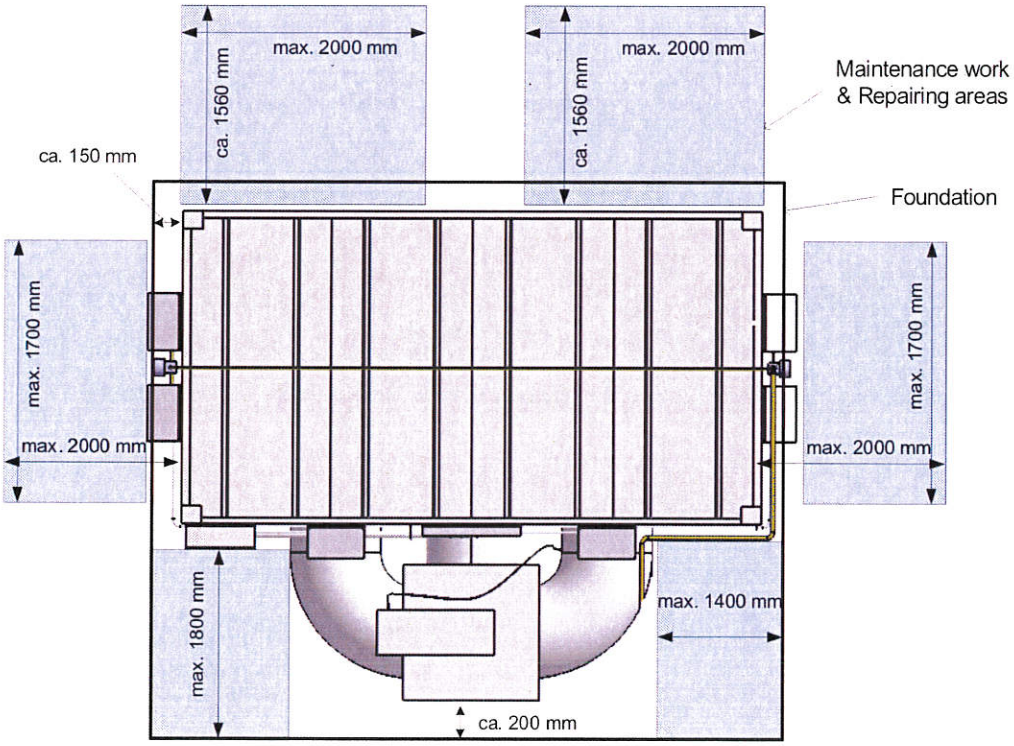


Figure 4.2 Typical dimension surfaces for the thermal reactor

4.4 Distance from the engine

The housing including the 4WV is to be installed at a maximum distance of 10 m from the engine container or engine room. (assuming the engine is installed close to the room walls). See figure 4.3.

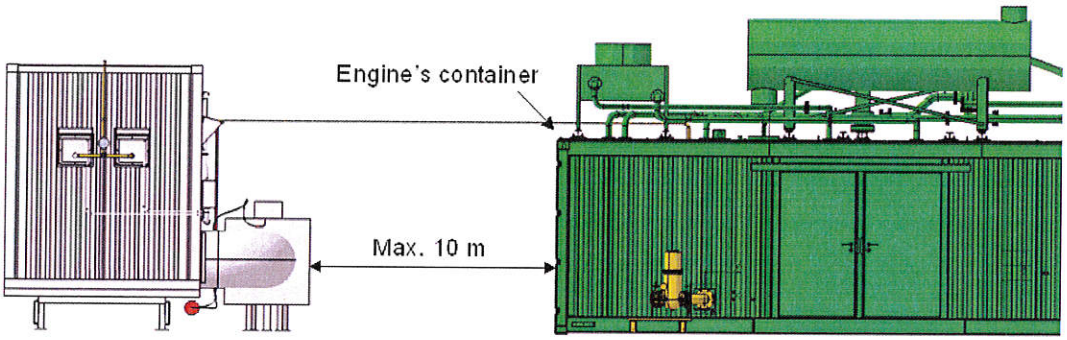


Figure 4.3 Distance between CL.Air housing and engine container for pipework (illustration for reference only)

4.5 Lifting of the CL.Air system

To mount the CL.Air system on the prepared foundation, it is necessary to place the equipment by using a crane. The 4-way valve is installed once the thermal reactor housing is in place. Please refer to Section 4.2 for details of weights.

The clevises on the housing are to be used to lift the thermal reactor housing. See Figure 4.4.

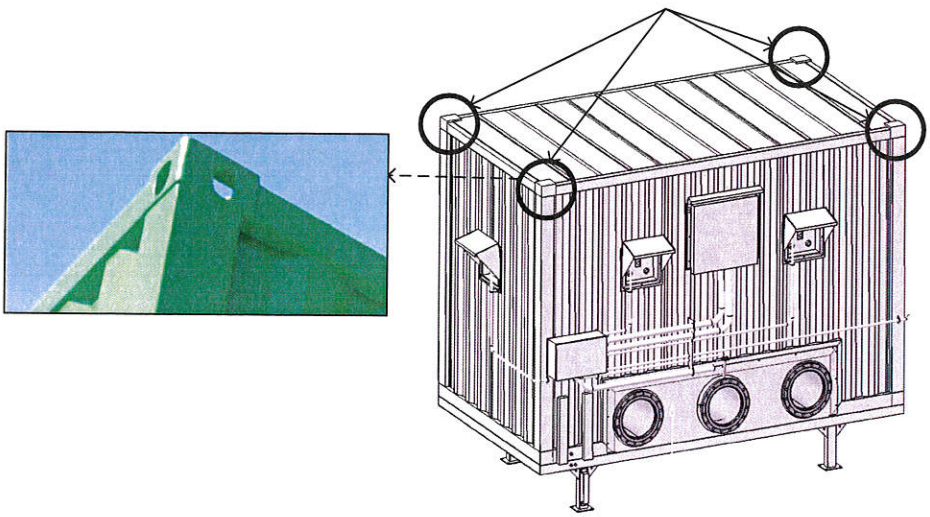


Figure 4.4 Lifting clevises on thermal reactor housing

4.6 Foundation for electrical installation

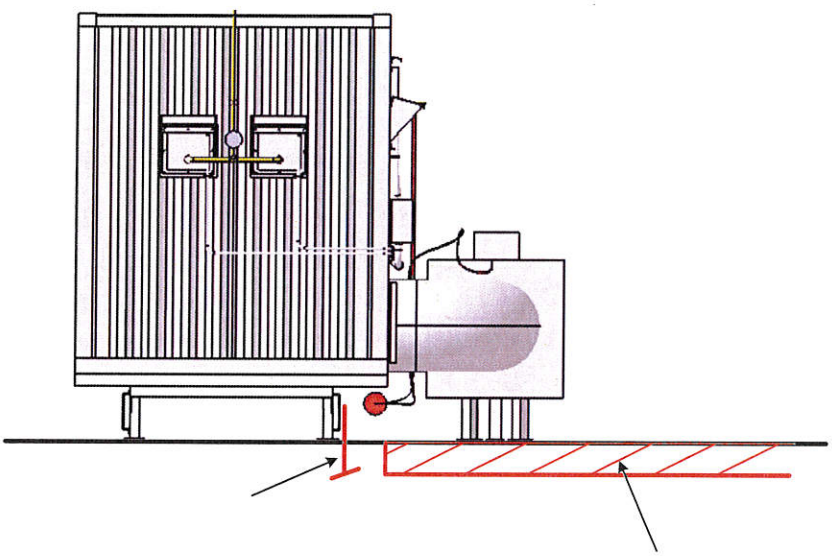


Figure 4.5 Electrical requirements for the foundation

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 increases by an average of 30-40°C (typically 30° in type 3 engines and 40°C in type 4 engines). See Figure 5.1. This increase (minus conduction losses) can be tapped off as increased heat output at the downstream heat exchanger.

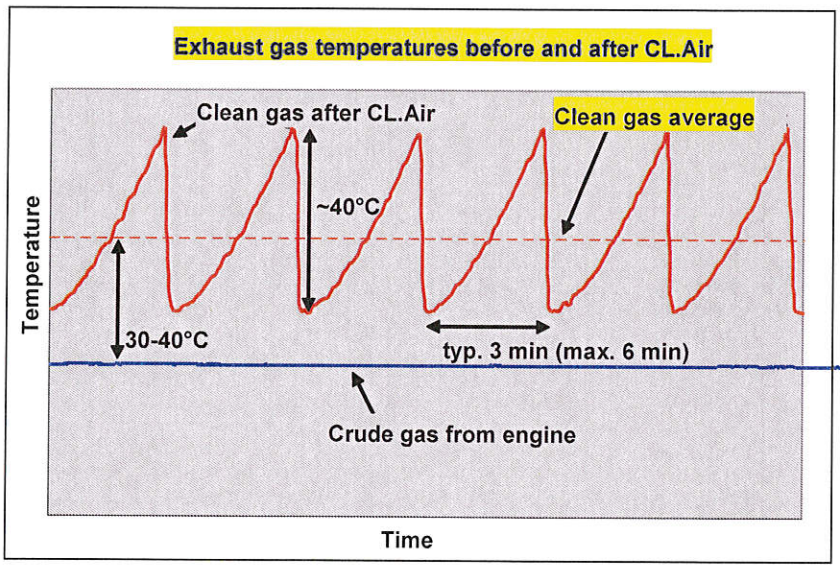


Figure 5.1 Exhaust gas temperatures before and after CL.Air

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 [Nm^3/h-wet]	Mass flow [kg/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 conduction losses. The values are for guidance only and have been determined based on $_{\Delta}T$=30°C for type 3 engines and $_{\Delta}T$=40°C for type 4 engines and c_p=1.11 kJ/kgK.

5.2 Gas spray injection

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

Pad gas requirement

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

Type*	Guide value for pad gas requirement [Nm^3/h-CH4]***
J208	1.5
J312**	2.5
J316	3.0
J320	4.0
J412	4.0
J416	5.0
J420	6.0

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

** Because of specific conditions, the CL.Air runs autothermically with engineJ312-C225, i.e. no pad gas is required.

*** The quantities are quantities of pure CH4, i.e. when the CH4 content is 50%, the quantity injected is double. 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 of gas ≥ 40% Vol. - dry
- Pressure in the controlled gas system 50 - 80 mbar – standard gas compressor unit required

Dew point of gas °C	Ambient temperature °C	Additional measure required for	Class / Max. Value
$\tau < 18$	10 = T = 40	-	none
	-20 = T < 10	Gas pipe to CL.Air (outer piping only)	Heat tracing + Insulation
$18 < \tau = 25$	10 = T = 40	Inner gas pipes	Insulation
		Gas pipe to CL.Air (outer piping only)	-
	-20 = T < 10	Inner gas pipes	Insulation
		Gas pipe to CL.Air (outer piping only)	Heat tracing + Insulation

Requirements when a gas pressure control system is used (natural gas):

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

5.3 Compressed air

The compressed air is used to operate the pneumatic cylinder of the 4-way valve and it is supplied by the air compressor unit, which is integrated into the control system for safety reasons. In the event of failure, the system is shut down. Air pressure should lie between 4.5 and 8 bar. The air quality has to conform to DIN ISO 8573-1, which states the following values:

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

5.4 Power supply and power consumption

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

Component	Requirement
Air compressor	400 V, 1.7 kW
Gas compressor for types 2and3	230V, 0.95 kW
Gas compressor for type 4	400V, 0.75 kW
Solenoid valves (SOV 39, 40, 41, 42)	24V DC (only for two gas trains)
Ball valves	manual (only for 1 gas train)
Solenoid valves SOV1 for types 2 and 3	230V
Solenoid valves SOV9	230V
Gas flow regulating valve SOV11	24V AC
Heating units for types 2 and 3	230V, 5kW (6-9 units)
Heating units for type 4	230V, 7,5kW (6-9 units)
Double solenoid valve for gas pressure control system (instead of gas compressor)	230 V, 35VA
Optional valve test system for gas pressure control system (instead of gas compressor)	230 V

The power supply must comply with the following requirements:

- Three-phase, four-wire system
- Range for supply voltage is +/-10% of the nominal voltage
- Frequency range of +/- 1% of the nominal frequency (continuous),+/-2% short term
- Grid configuration at generator connection point: TN-system
- Rotating field direction: right
- Grounding: TN-system

The power supply for each the engine type is:

Power supply	J208 – J316	J320	J412	J416 – J420
TN-System 3x 400/230V at 50Hz	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 different components integrated into one unit. Please refer to Section 2.1. Gas injection and compressed air pipelines are all connected to the housing and to the 4-way valve respectively. Furthermore, all components of the control and monitoring system (shipped separately) are to be mounted on to the unit and connected to the terminal box. Figure 6.1 illustrates the cutting locations and Figure 6.2 the complete housing after installation.

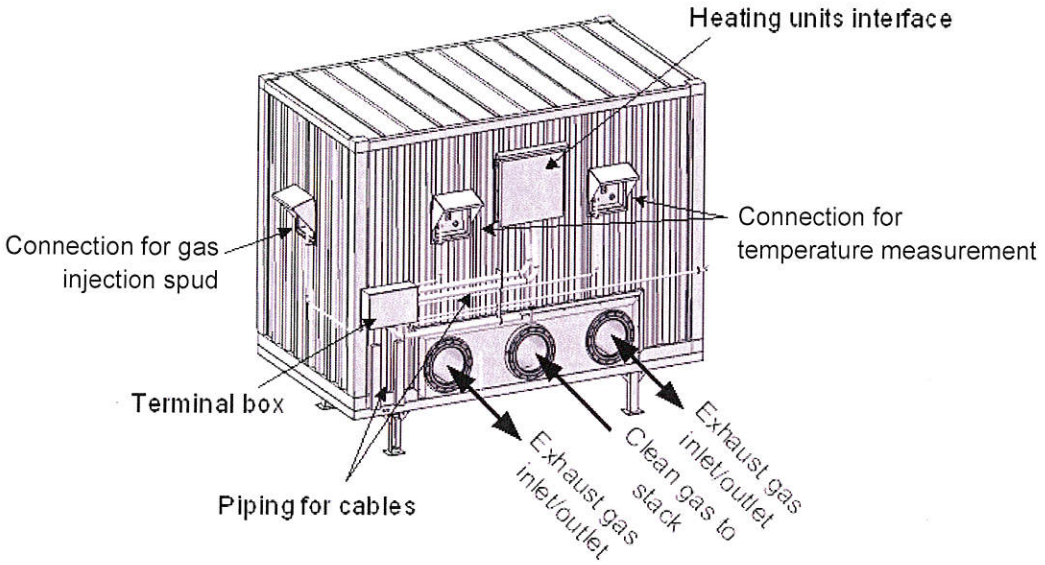


Figure 6.1 Cutting sites of the thermal reactor with other components (e.g. with J320 front view)

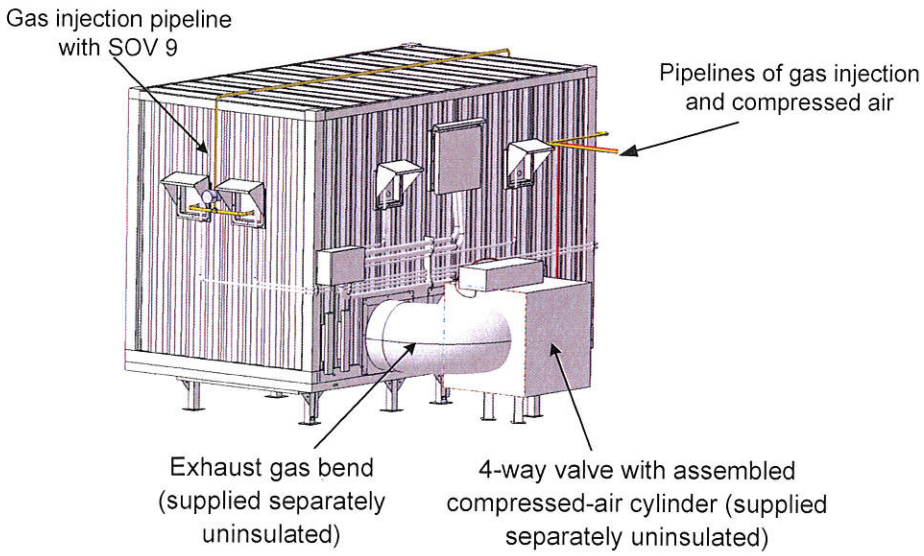
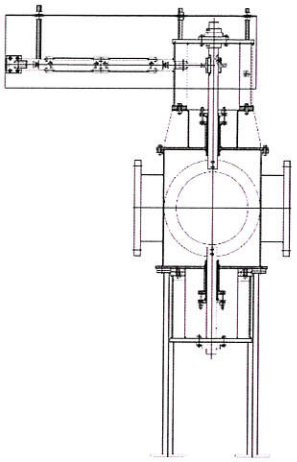


Figure 6.2 Thermal reactor housing after complete installation (e.g. J420 front view)

6.1.1 4-way valve (4WV or 4WD)

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

The 4-way valve (4-way diverter) conducts the engine's exhaust to CL.Air and the clean gas to the stack. It includes the pneumatic cylinder, which switches the valve every 3 – 6 minutes. It is connected to the compressed air system.



Warning: The 4-way valve is not designed for static loads from the pipe. A compensator should therefore be installed in the exhaust manifold just before the 4-way valve. See also Section 6.5.

6.1.2 Bend pipelines

The bends connects the thermal reactor housing with the 4WV. They have to be assembled following the centre line of the CL.Air housing's exhaust piping 1000 mm above the foundation. Compensators are part of the bends. See figure 6.4 and the site of installation diagram for more references.

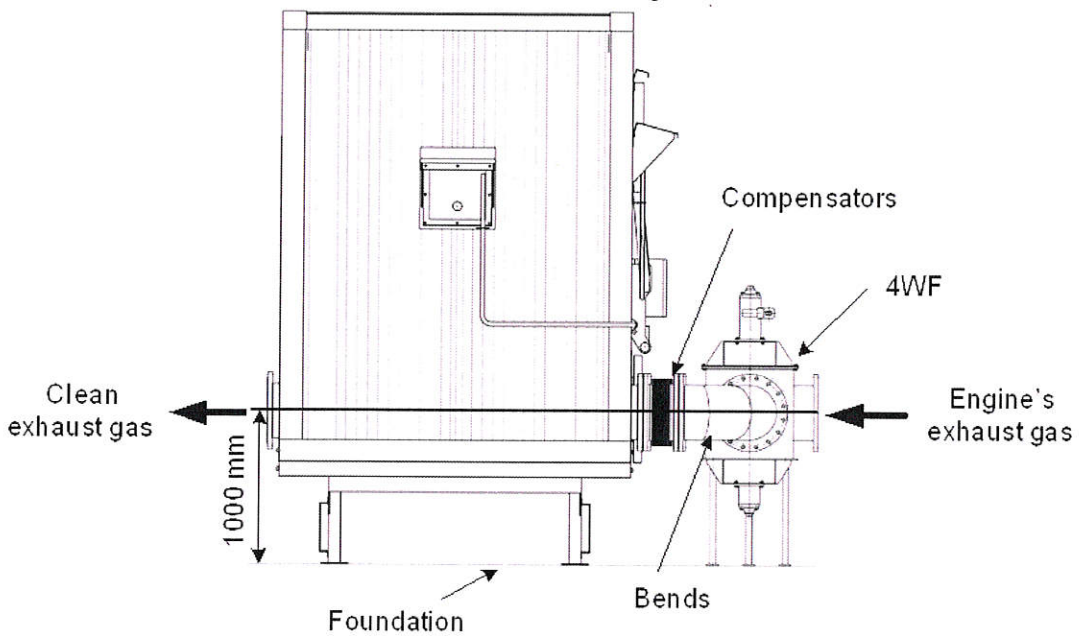


Figure 6.4 Thermal reactor housing after complete installation (e.g. J420 front view)

6.2 Gas injection system

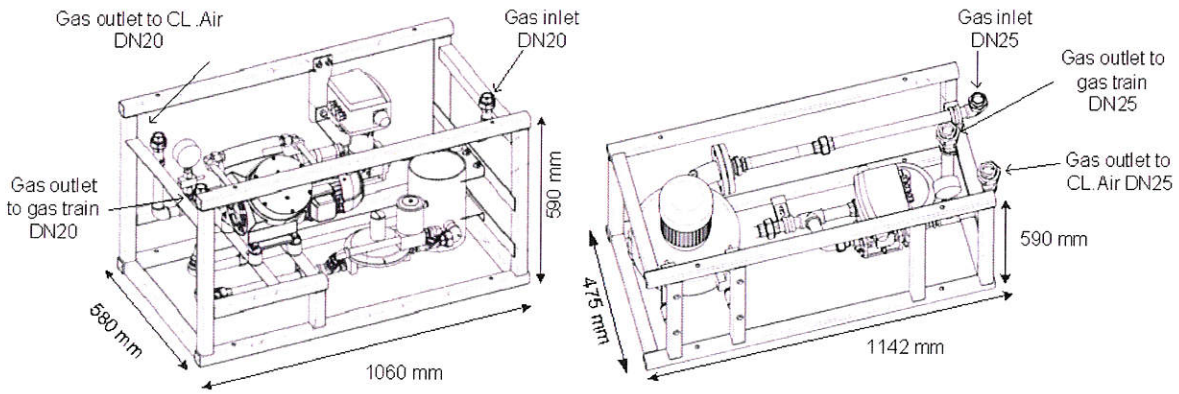
Depending on whether the thermal reactor temperature is padded with engine fuel gas or natural gas, the gas injection system consists of the following components: gas compressor unit or gas pressure control system, gas injection pipeline, solenoid valves (SOV9) and gas injection spuds. The gas quality for the gas injection system must satisfy the requirements set out in Section 5.2.

6.2.1 Gas injection unit

The unit must be installed and operated indoors in a location free of potentially explosive atmospheres at temperatures between +5°C und +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's controlled gas system. The ventilation system at the installation site must conform to the specifications for the GE Jenbacher gas engine concerned. The unit is painted in RAL colour 1023, which marks it as a gas-carrying unit. See Figures 6.6 a/b/c.

The gas injection unit includes:

- Gas compressor
- Gas flow control valve SOV11
- Safety relief valve Svalve
- Solenoid valve SOV1 (only for type 2 and 3 engines)
- Solenoid valve SOV12 (only for versions before manufacturing year 2009)
- Reservoir of gas compressor unit (only for type 2 and 3 engines)



Type 2 & 3 **Type 4**

Figure 6.5 Gas injection unit for type 2 and 3 engines (left) and type 4 engines (right)

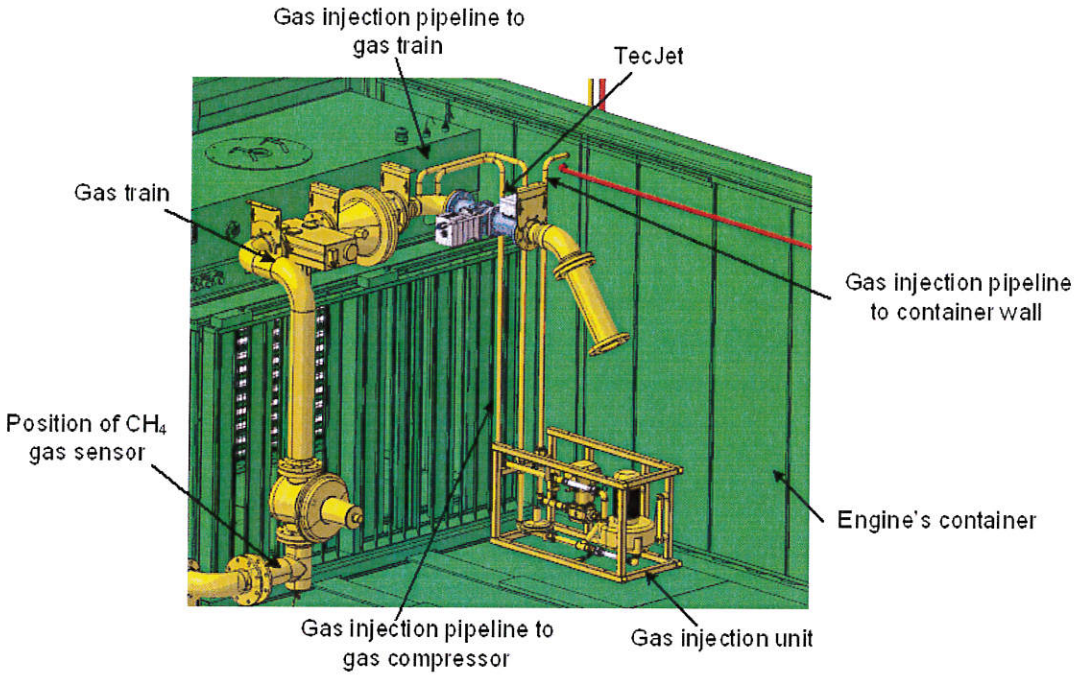
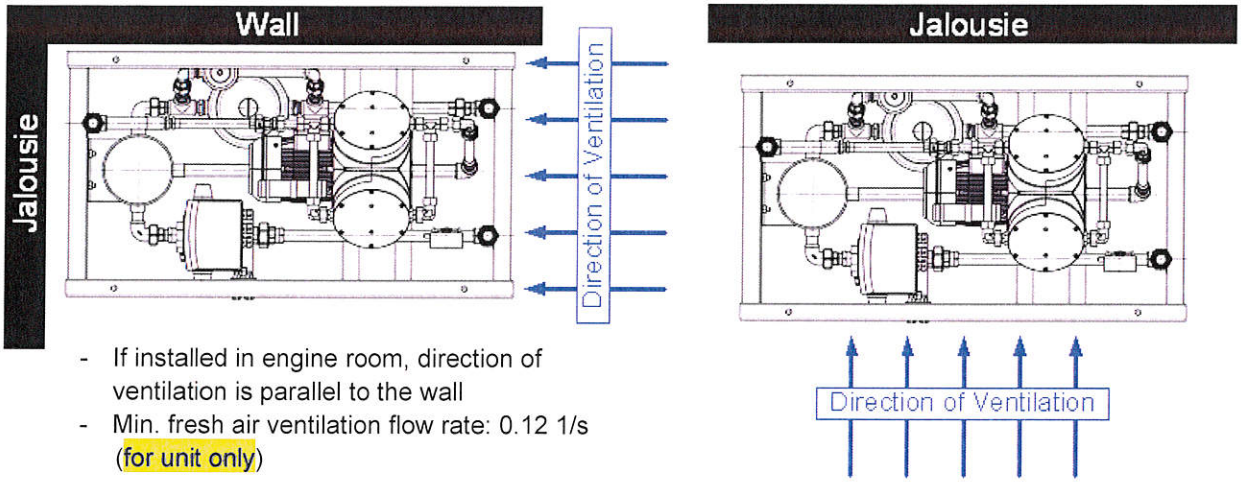


Figure 6.6a Installation site for the gas compressor unit in the engine container (except type 4 engine)

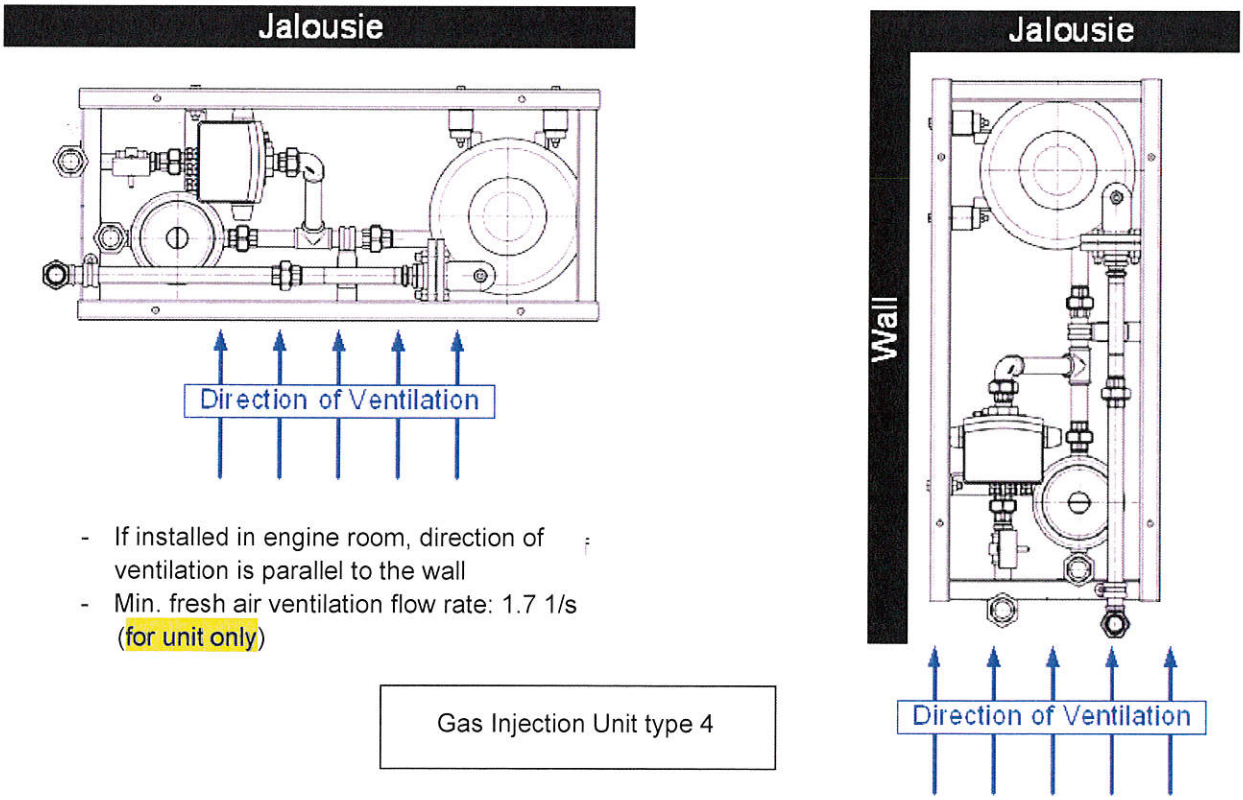
Figures 6.6b and 6.6c illustrate the most common installation of the unit depending on the engine type. The unit must be installed so that it allows safe access to the gas compressor unit and safe removal of the components for maintenance purposes.



- If installed in engine room, direction of ventilation is parallel to the wall
- Min. fresh air ventilation flow rate: 0.12 1/s (for unit only)

Gas Injection Unit type 2 & 3

Figure 6.6b Installation site for the gas injection unit according to direction of ventilation for type 2 and 3 engines



- If installed in engine room, direction of ventilation is parallel to the wall
- Min. fresh air ventilation flow rate: 1.7 1/s (for unit only)

Gas Injection Unit type 4

Figure 6.6c Installation site for gas injection unit according to direction of ventilation for type 4 engine

6.2.2 Gas train for natural gas injection

The gas train includes the following components:

- Gas filter (GF)
- Gas pressure controller (DR) with integrated safety shut-off valve (SAV)
- Safety blow-off valve (SBV)
- Double solenoid valve (DMV)
- Optional: valve test system (VPS)
- Gas-flow control valve (SOV11)
- Exhaust and air bleed lines to the open air (to be supplied by customer)

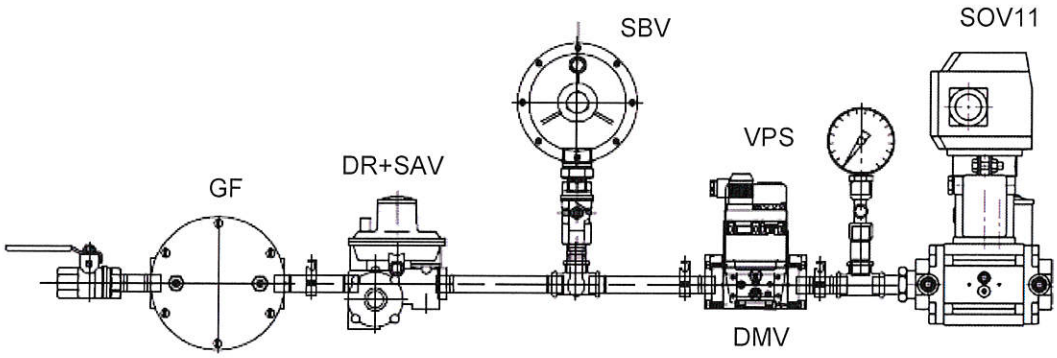


Figure 6.7 Front view of gas train for the CL.Air pad gas combustion unit

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 und +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 room (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 lead from the pressure controller, the safety shut-off valve (SAV) and the safety blow-off valve (SBV) over the roof to the open air. The exhaust and air bleed lines must be kept separate and be designed at least to DN15. 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 exhaust line: 0.5 m, Zone 1 and 1.2 m, Zone 2

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

Assembly position

The assembly position is as shown in Figure 6.7 (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 controlled gas system. Supplemental measures can be integrated into the pipeline, depending on the fuel gas dew point (see Section 5.2).

Section	DN	NS	Max. length	Recommended Material	Valves	Installation location	Possible supplemental measure
Types 2&3							
To gas compressor	20	¾"	10 m	ST.35.8 or ST.37.0	Manual	After NDR	Insulation
To 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	From container wall to CL.Air	Insulation & trace heating
Gas injection spuds	-	-	-	-	-	Inside CL.Air	-
Type 4							
To gas compressor	25	1"	10 m	ST.35.8 or ST.37.0	Manual	Before TecJet	Insulation
To gas train		1"	10 m		Manual	Before TecJet	Insulation
To container wall		1"	10 m		-	From gas unit to container wall	Insulation
To CL.Air		1"	21 m		SOV 9	From container wall to CL.Air	Insulation & trace heating
Gas injection spuds	-	-	-	-	-	Inside CL.Air	-

The valves installed in the gas injection pipelines are suitable up to 1 bar. The gas pipelines are designed for a 500 mbar working pressure.

In the case of systems with two controlled gas systems, 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	Insulation
From gas compressor	Type 4 / DN25	SOV 40	above	Insulation
To gas compressor	Type 2&3 / DN20	SOV 41	See table	Insulation
From gas compressor	Type 4 / DN25	SOV 42	above	Insulation

All gas piping must be identified as gas carriers by proper labelling or by painting it with RAL 1023. After installation the customer must carry out a leak test before commissioning can take place.

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 4WV. The unit is to be installed indoors at a location that is free of potentially explosive atmospheres. Refer to the applicable directives and standards, (e.g. ATEX-directive 94/9/EC, IEC 60079-10 or NFPA 497 (USA)). Figure 6.7 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 to allow safe access for operational and maintenance work.

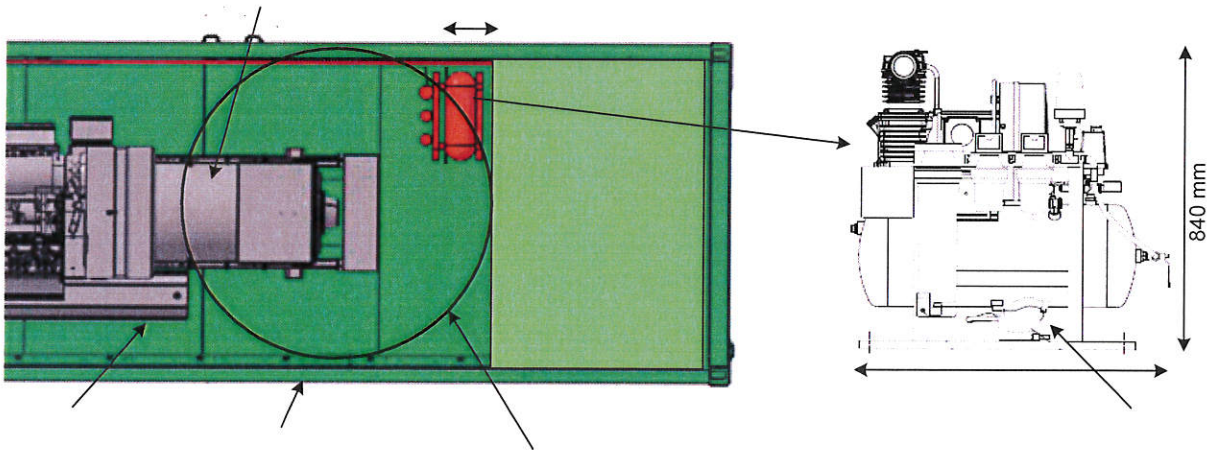


Figure 6.8 Installation location of air compressor unit in engines container (illustration for reference only)

6.3.2 Air tank NTD

The air tank is a buffer of the compressed air flow and it is installed on the thermal reactor housing. It is connected between the compressed air unit and the pneumatic cylinder.

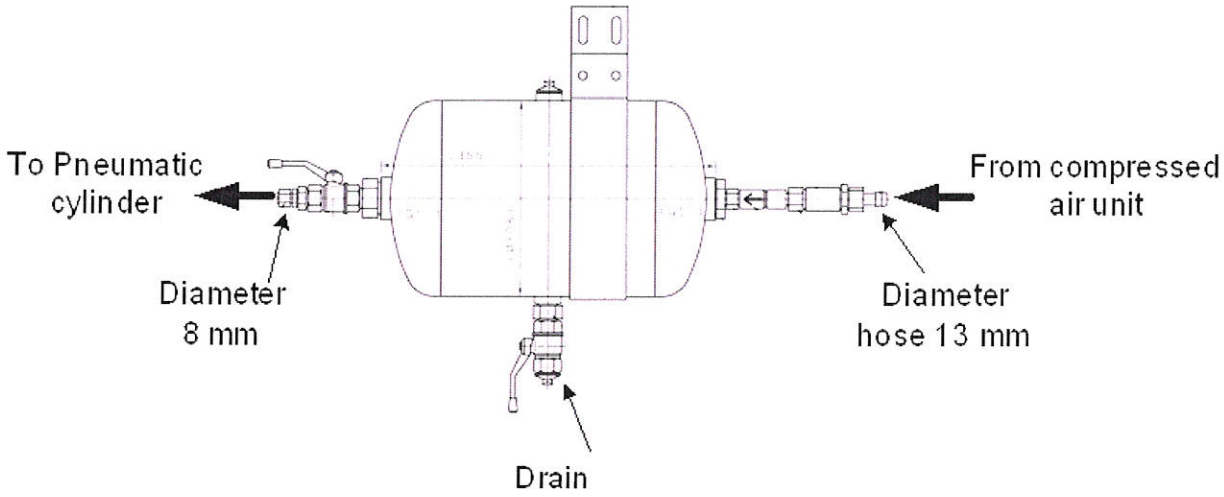


Figure 6.9 Air tank of thermal reactor

6.3.3 Compressed air pipeline (not included in supply)

The length of the pipeline is approx. 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 pipeline with material ST.37.0 and DN 15 (1/2"). The connection of the air compressor unit is DN 12 (3/8"). Figure 6.9 shows a typical arrangement of the pipeline.
All air piping must be identified as carrying air by proper labelling or by painting it in red.

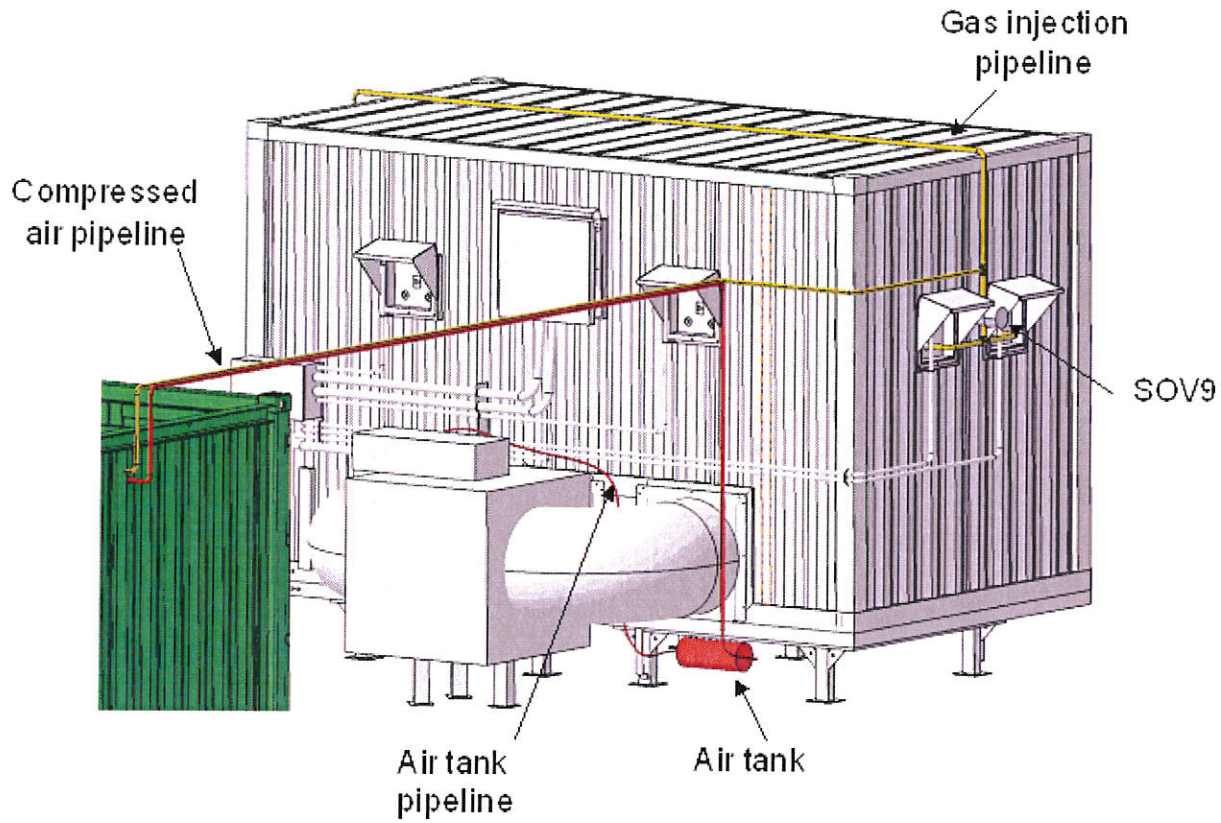


Figure 6.10 Typical assembly of compressed air pipeline with air tank

6.4 Control cubicle

A separately arranged cubicle contains all devices to analyse signals and control the installation. The cubicle unit is designed for indoor installation. The positioning of the cubicle has to be according to local regulations.

The next table summarizes the properties of the unit:

Temperature parameters	**Indoors 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. Altitude of site	2000 m

Totally enclosed floor-mounted sheet steel cubicle with front door wired to terminals. It is ready to operate with cable entry at the bottom. The location must be < 50m from the thermal reactor.

Protection: IP 42 external
IP1X or IPXXA / IP2X or IPXXB internal (protection against unintentional direct contact with hazardous live parts)

The design conforms to EN 60439-1 / IEC 60439-1 and has the following dimensions:

Dimensions [mm]	
Height	2,000
Width	800
Depth	600

The operation, control and visualisation of the operating mode of the thermal reactor are carried out at the engine control panel. The control supply voltage from starter and control panel batteries is 24V DC and the supply of power for auxiliaries from auxiliary power panel is 3 x 400/230 V, 50 Hz.
An outdoor version of the control cubicle can be supplied. Contact GEJ for details.

6.5 Exhaust system (not included in supply)

The exhaust system consists of the following components:

- Stack (clean gas temperature < 600°C) or Heat Exchanger with Stack (clean gas temperature of 250°C). Figure 5.1 shows a typical temperature profile after CL.Air.
- Piping to stack
- Piping from engine to CL.Air (insulated)
- Insulation of 4WV and bends (design suitable with a min. inner temperature of 600°C and outer safety temperature of < 60°C)

For more details refer to sections 6.1.1 & 6.1.2.

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

6.6 Foundation (not included in supply)

Refer to sections 4.1 and 4.2 and to diagram number 616910 (for types 2 & 3) and 616911 (for type 4).

6.7 Wiring (not included in supply)

Refer to wiring diagram of the thermal reactor containing details of the distances mentioned in Sections 6.1 and 6.4.

6.8 Service platform (not included in supply)

During maintenance work on the thermal reactor housing the customer must provide the necessary safety equipment for personnel, especially for high work areas. GE Jenbacher offers a service platform suitable for placing in front of the 4WV. The platform must be ordered separately.

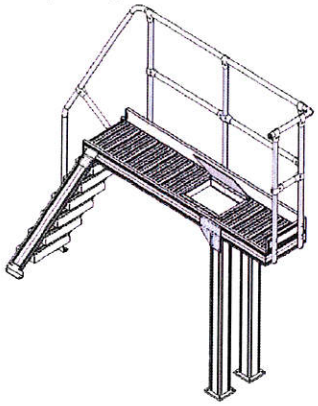


Figure 6.11 Service platform for maintenance work on the thermal reactor

7. Safety

7.1 General Safety Requirements

The customer must inform GE Jenbacher if there are other or additional regulations applicable to this project and must also check its hazardous area plan as regards the intended location of the thermal reactor system. The system must be installed in an area classified as EX free zone.

Note: The thermal reactor is not designed for operation with explosive gas mixtures. The customer must therefore ensure that no gas mixture that can be ignited flows through the system and/or exists around it.

7.2 Requirements for operation and maintenance

The system is designed to operate in "automatic mode". The operator has to respond to failures and irregularities and to carry out required maintenance work. During operation the entire system must be inspected during a daily inspection round.

A distinguishing feature of GE Jenbacher CL.Air units is their low-maintenance design. However, they still require inspection and maintenance to ensure their safe and successful operation and to be able to preserve warranty rights.

All necessary inspection and maintenance work is specified in "Maintenance Work 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 specialist staff having relevant electrical and mechanical training and who have also been familiarised with the hazards posed by gas-carrying components.

8. Appendices:

The following documentation is available for the thermal reactor system:

Description
Included in customer information and available in GEJ Home page

Foundation plan
Type J208, J312, J316, J320, J412, J416 engines with diagram number 616910
Type J410 engine with diagram number 616911

Site of installation diagram
Type J208 & J312 engines with diagram 599375
Type J316 & J412 engines with diagram 330615
Type J320 & J416 engines with diagram 331023
Type J420 with diagram 389160

General technical diagram
Type 2 & 3 engines with diagram 508646
Type 4 engine with diagram 631133

Wiring diagram
Specific to a project

Inspection and maintenance work
Document with ID-Number IW 8070 A0
Documentation of all relevant components
Collection of date sheet with ID – E 8070
Weekly inspection with ID – E 8070A
Instructions for adjusting the position switches of 4WV TI 1501-0503
Instructions for installation TI 1501-0504