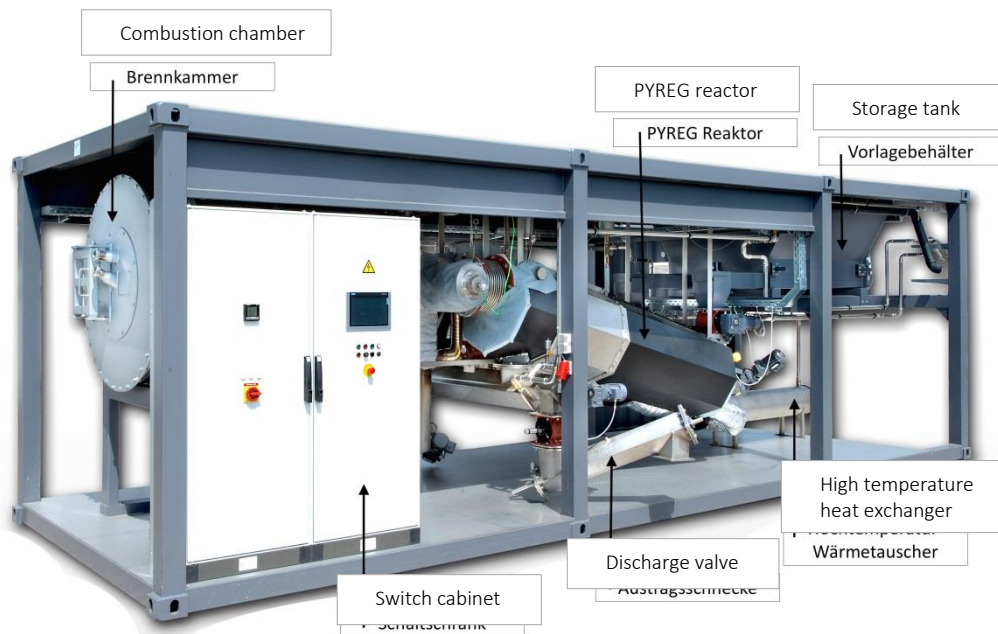




Operating manual for

PYREG - P 500

Unit for Biomass Processing



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2 General information

2.1 Preface

This operating manual is an essential aid for the assembly and successful and safe operation of the P500, and contains important information on all of its phases of life.

Compliance with the operating manual helps to prevent danger, minimise repair costs and downtime, and increase the P500's reliability and service life.

The operating manual must be available in the vicinity of the P500 at all times. It must be read and put into effect by all persons charged with:















- transportation
- assembly
- configuration
- troubleshooting
- maintenance and/or
- upkeep (maintenance, inspection, repair)
of the P500

This operating manual follows the formal structure of the content of annex I of the Machinery Directive 2006/42/EC, section 1.7.4.2., where applicable.

Table 1

2.2 Explanation of symbols - warning and prohibition signs

Warning and prohibition signs must be labelled with symbols in accordance with ASR 1.3 and DIN ISO 7010. The following symbols are used in this operating manual:

Symbol	Meaning
	General warning
	Danger from electric current
	Danger from hot surfaces
	Danger of crushing
	Danger from harmful vapours
	Danger of falling loads
	Danger from unexpected start-up of the handling system
	Danger of fire
	Danger of lacerations
	Danger from corrosive liquids
	Open flames and fire prohibited
	Smoking prohibited
	Eating and drinking prohibited
	General information

2.3 Explanation of symbols - mandatory signs

Table 2 Mandatory signs

Mandatory signs must be labelled with symbols in accordance with DIN ISO 7010 and BGV A8. The following symbols are used in this operating manual:

Symbol	Meaning
	Wear foot protection (safety shoes)
	Use protective eyewear
	Wear protective gloves
	Use hearing protection
	Use face protection
	Wear protective clothing
	Follow the instructions for use
	Disconnect before maintenance or repairs
	Use a mask
	General information

2.4 Warning information

The following warnings are used in this operating manual:



DANGER

Danger to Life

Consequences of failure to comply...

- Information regarding prevention

A warning notice with this danger level signifies an imminent dangerous situation. If this dangerous situation is not prevented, it will result in death or serious injury.

Follow the instructions provided in this warning notice in order to prevent the risk of death or serious personal injury.



WARNING

Risk of Injury

Consequences of failure to comply...

- Information regarding prevention

A warning notice with this danger level signifies a potentially dangerous situation. If this dangerous situation is not prevented, it can lead to death or serious personal injury.

Follow the instructions provided in this warning notice in order to prevent the risk of death or serious personal injury.



CAUTION

Bodily injury from...

Consequences of failure to comply...

- Information regarding prevention

A warning notice with this danger level signifies a potentially dangerous situation. If this dangerous situation is not prevented, it can lead to minor or moderate injury.

Follow the instructions provided in this warning notice in order to prevent the risk of personal injury.



CAUTION

Material damage from...

Consequences of failure to comply...

- Information regarding prevention

A warning notice with this danger level signifies potential material damage. If the situation is not prevented, it may result in material damage.

Follow the instructions provided in this warning notice in order to prevent material damage.



NOTE

Information...

A note signifies additional information provided to facilitate handling of the P500.

2.5 Limitation of liability

All of the information and instructions contained in this operating manual have been prepared with consideration to the applicable statutory standards and regulations and the current state of the art and technology, as well as our many years of knowledge and experience.

PYREG GmbH reserves the right to make technical modifications to the P500 treated in this operating manual within the framework of further development.

For damage or interruptions to operation resulting from operating error, failure to comply with this operating manual or improper performance of repair work, we refer to the contractual arrangements as set out in the purchase agreement.

We explicitly state that only original, replacement and accessory parts approved by us are permitted for use. This also applies, logically, to the use of components from other manufacturers.

For safety reasons, installation and/or use of unauthorised replacement and accessory parts is not permitted and excludes any liability on the part of PYREG GmbH for resultant damages.

PYREG GmbH shall be held liable for any faults or failures only within the context of statutory warranty obligations.

All translation work is performed to the best of the translator's knowledge. PYREG GmbH accepts no liability for translation errors, even if the translation work has been performed by us or on our behalf. The original version of the text alone is binding.

2.6 Copyright

This operating manual must be treated as confidential. It may only be used by authorised personnel (personnel employed by the operator and charged with operating the unit) and may be relinquished to third parties only with the written agreement of PYREG GmbH.

All of the documents are protected by copyright law. Dissemination or reproduction of documents – even in part – as well as use and disclosure of their contents, is prohibited without express permission. Infringements are punishable and shall result in compensation for damages.

We reserve the right to exercise all industrial property rights.

3 Safety

3.1 General safety information

This chapter provides important information on all safety aspects for optimal protection of personnel as well as safe and fault-free unit operation.



DANGER

Danger resulting from failure to observe the safety instructions!

Failure to observe the safety information and instructions provided in this operating manual can pose considerable risk.

- It is imperative that the information and instructions provided in this operating manual are observed.

3.2 Intended use

The P500 is designed and constructed for the following intended purposes only:
The unit is used for thermal recycling of biomass, sewage sludge, agricultural waste products, manufacturing waste etc. with a minimum calorific value of 10 MJ/kg original substance (OS) and a maximum moisture level dependent on the calorific value related to the dry substance. The unit generates exhaust gas heat and carbonaceous mineral substances or vegetable carbon from the fuel. The composition of the products and exhaust gas heat generated depend primarily upon the materials used. The fuel must be pourable and transportable with screw conveyors. The particle size should not fall below 2 x 2 x 2 mm. Preferred dimensions: Ø2 mm to Ø25 mm. Particles of a maximum of 100 mm with 5% of the total mass flow may occur.

The suitability of prospective fuels must be clarified with PYREG GmbH in advance. Written confirmation of the suitability of the fuel employed is a prerequisite for proper use.

Any other use or usage beyond this scope is considered to constitute improper use.



WARNING

Danger resulting from improper use!

Improper use can pose considerable risk.

- It is imperative that the guidelines for proper use provided in this operating manual are observed.



NOTE

Specify the unit's design during the planning phase.



NOTE

When operating within the European Economic Area, the operator is obliged to conduct a risk assessment in accordance with section 2, paragraph 3 of BetrSichV (German Ordinance on Industrial Safety and Health).

3.3 Foreseeable misuse

Use of non-pourable fuel, thermoplastic fuel which becomes sticky and adhesive at high temperatures, etc. can lead to problems.

Deposits of pieces of metal, stones, or similar objects with a particle size greater than 25 mm can result in damage to the unit due to accumulation of particles.

Use of unauthorised fuel by the operator.

The biomass used may, potentially, be biologically hazardous and may not be storage-stable (mould, spores, heat build-up in the storage hopper, etc.).

Claims of any type for damages resulting from use other than the intended purpose are excluded.

The risk shall be borne by the operator alone.



CAUTION

Material damage resulting from unsuitable fuel

Unsuitable fuel can cause material damage to the unit. Personal injury can occur as a consequence.

- The fuel's suitability must always be agreed upon with PYREG GmbH.
- In order to assess fuel suitability in the event of a change in fuel, an appropriate analysis must be provided to PYREG GmbH in advance.
- The fuel may only be used after receipt of written authorisation from PYREG GmbH.



NOTE

The use of biomass, which is subject to waste management regulations, can result in loss of operating licence.



NOTE

Ensure appropriate and safe removal of carbonaceous ashes (avoid formation of dust in the coal shelters – danger of dust explosion).

3.4 Modifications prohibited

Any modification or alteration to the P500, particularly tampering with safety devices, wiring or electronic components, is prohibited and any resultant damages exclude responsibility on the part of PYREG GmbH.



DANGER

Danger to life resulting from tampering with safety devices

Failure to observe the prohibition of tampering can result in malfunctions and severe injury or death.

- The safety devices must be inspected for possible tampering after every period of downtime and before each start-up.



WARNING

Material damage resulting from unauthorised modifications

Modifications to the P500 not authorised by the manufacturer can result in malfunctions and damage to the unit and serious personal injury, as well as environmental damage, may occur as a consequence.

- Any modifications to the P500 require inspection by and written authorisation from the manufacturer.

3.5 Danger from electric current

Electrical connection must be performed by authorised personnel in accordance with VDE regulations. The direction of rotation of all engines and correct phase sequence of the power supply system must be verified before start-up. PYREG GmbH guarantees correct direction of rotation of engines when set to a clockwise direction.



WARNING

Material damage resulting from inadequate qualifications!

Incorrect connection of the power supply can lead to significant personal and material damage.

- Ensure that all tasks are performed by personnel with the appropriate qualifications only.



DANGER

Danger to life from electric current!

Contact with live lines or components presents a danger to life. Observe the following safety instructions in order to avoid electrical hazards:

- Do not operate the P500 if power cables or plugs are damaged.
- Work on electrical equipment may only be performed by a qualified electrician or trained staff under the management and supervision of a qualified electrician, in accordance with electrical engineering standards.
- Defects identified on electrical units/components/equipment must be rectified immediately. In the meantime, in the event of immediate danger, the P500 may not be operated in a defective condition.
- Unit components requiring inspection, maintenance and repair work must be disconnected from the mains supply if specified. Parts which have been disconnected must first be checked for voltage, then earthed and short-circuited and isolated from live neighbouring parts.
- If works are required on live parts, make sure a second person is present who can switch off the main switch in the event of an emergency. Cordon off the work area with a red and white safety chain and a warning sign. Use voltage-isolated tools only.

3.6 Danger from fire and open flames

In certain circumstances, in the event of a unit fault, open flames or similar ignition sources in close proximity to the unit may cause deflagration or sudden combustion.



DANGER

Danger to life from open flames

In certain circumstances, in the event of a unit fault, open flames or similar ignition sources in close proximity to the unit may cause deflagration or sudden combustion.

- The operator is strongly encouraged to impose a complete smoking ban in the vicinity of, and inside, the P500.
- The operator is strongly encouraged to impose a complete ban on open flames in the vicinity of, and inside, the P500.

3.7 Danger from fuel gas

Fuel gas is required for the P500's start-up procedure. It can be obtained from the public grid or from appropriate compressed gas containers.



DANGER

Danger to life from escaping gas

Defective connection to the gas supply can result in explosion or fatal injury.

- The pilot gas burner must be connected to the gas supply by an appropriately authorised specialist company.



NOTE

Local regulations applicable to the installation of compressed gas containers must be observed.

3.8 Operator responsibility

As the P500 is used in a commercial setting, the operator of the P500 is subject to the statutory obligations pertaining to occupational safety.

In addition to the occupational health and safety instructions in this operating manual, the safety, accident prevention and environmental protection regulations that apply for the operation of the P500 must also be adhered to.

The following applies in particular in this regard:

The operator must familiarise himself with the applicable health and safety regulations and must conduct a risk assessment to determine additional hazards arising from specific operating conditions at the operating site. He must put these into effect in the form of operating instructions for the operation of the P500.

Hazard zones that exist between the P500 and customer facilities must be secured by the operator.

The operator must check at regular intervals over the entire operating time of the P500 to determine whether the operating instructions he has compiled are compliant with current regulations and standards, and must update them where necessary.

The operator must clearly define and regulate staff responsibilities with regard to installation, operation, maintenance and cleaning.

The operator must monitor personnel on a regular basis to ensure that work is being carried out safely and with an awareness of potential hazards, and in accordance with the operating manual.

The operator must ensure that this operating manual and all other relevant provisions are accessible to operating and maintenance personnel.

The operator must specify the responsibilities of the machine operator and establish a procedure whereby the machine operator may refuse to follow inadequate safety instructions given by third parties.

The operator must make the required protective equipment available to personnel. Furthermore, the operator is responsible for ensuring that the P500 is always kept in good working order and condition. Hence, the following applies:

The operator must have all safety devices inspected for proper functioning and completeness on a regular basis.

The operator must ensure that the PYREG GmbH operating manual and, in particular, the safety instructions contained therein, are observed during operation of the P500.



NOTE

As an employer, the operator is obliged to conduct a risk assessment for complex machinery and units in accordance with paragraph 3 of BetrSichV (German Ordinance on Industrial Safety and Health).



NOTE

As an employer, the operator should draw up a schedule for regular inspection of safety devices.



NOTE

The operator must ensure that employees certify in writing that they have read the operating manual.

3.9 Personnel requirements

3.9.1 Personnel qualifications



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.

- Ensure that all tasks are performed by personnel with appropriate qualifications only.

The following qualifications are referred to in this operating manual for various activity areas:

Trained Personnel

have been instructed by the operator on the work assigned to them and educated on possible dangers that may arise in the event of improper conduct.

Qualified Personnel

refers to individuals who, due to their specialist training, knowledge and experience, along with their knowledge of the applicable regulations, are suitably qualified to perform the work assigned to them and to independently identify and avoid potential dangers.

Qualified Electrician

refers to individuals who, due to their specialist training, knowledge and experience, along with their knowledge of the applicable standards and regulations, are suitably qualified to perform work on electrical equipment and to independently identify and avoid potential dangers.

The qualified electrician has been trained for the specific operating site at which he/she will be working and is versed in the relevant laws, codes and standards.

Only those individuals who are of legal age and who can be expected to perform their duties in a reliable manner should be authorised to do so. Individuals whose ability to react is impaired, e.g. through drugs, alcohol or medication, are not authorised.

3.9.2 Training of personnel

The operator must provide regular training for personnel.



NOTE

Training must be logged and participants must certify in writing that they have taken part in order to ensure more effective tracking of training activities.

For information on training courses and instruction, please contact:

PYREG GmbH
Trinkbornstrasse 15 – 17
D- 56281 Dörth
Tel.: +49 (0) 6747 95388 – 0
Email: service@pyreg.de
Service: +49 156 04430414

3.10 Correct conduct in the event of accidents and dangerous situations

Preventative measures:

- Always be prepared for accidents or fire
- Keep first aid equipment (first aid kit, blankets etc.) and fire extinguishers ready to hand
- Familiarise personnel with accident reporting, first aid and rescue equipment.
- Keep emergency access routes clear
- In the event of an accident:
 - Remove people from the danger area
 - Instigate first aid measures
 - Inform those responsible at the operation site
 - Alert emergency services
 - Clear emergency access routes

4 Technical Data

The complete P500 unit consists of 2 main structural components.

- The unit platform
- The equipment container

4.1 Dimensions and weights

The unit platform		
Dimensions (L×W×H)	9000x3000x2800	mm
Weight approx.	14,000	kg
The equipment container		
Dimensions (WxDxH)	3000x3000x2950	mm
Weight approx.	4,500	kg

Table 3 Dimensions and weights

When the platform and equipment container are assembled in a row, and including an approximate space requirement calculation of 1.0 m, the maximum size of the floor surface area is approx. 100 m².

4.2 Performance

- Fuel capacity: up to 500 kW
- Annual fuel flow rate: max. 1350 t (approx.) with 10^{MJ}/kg OS calorific value (depending on input material)
- Carbon efficiency: up to 60%
- Thermal heat efficiency: up to 150 kW_{th} exhaust gas heat (fuel-dependent)

4.3 Power supply connections

4.3.1 Electrical energy

400 V, 50 A in accordance with IEC 60309; min. 16 mm²,
Consumption up to max. 100,000 kWh/a approx.

4.3.2 Pneumatic energy

10 bar unoled air via a vertical compressor with a 50 l storage tank. Distribution is via fixed pressure lines with two pressure connections to the unit's feeder side.

4.3.3 Gas

Main burner capacity: 0-200 kW
Start-up burner capacity: max. 150 kW
Gas consumption: approx. 1,500 kg gas/a

Required sewer gas/natural gas/liquid gas/biogas conditions:

Calorific value	≥ 5.8 MJ/kg Nm ³
Flow Pressure (Liquid gas, natural gas)	= 50 mbar (+5 mbar)
Temperature	≤ 30°C
Humidity	≤ 75% saturation
H ₂ S content	≤ 1,000 ppm

Table 4 Quality requirements for fuel gas for the start-up burner

4.3.4 Water

For drinkable water with backflow preventer in accordance with DIN 1988

Flow rate $\leq 5 \text{ m}^3/\text{h}$, consumption approx. $150 \text{ m}^3/\text{a}$

Parameter	Value
Diameter	$\frac{1}{2}"$
Flow rate	$\leq 5 \text{ m}^3/\text{h}$
Operating pressure	$\geq 4, \leq 10 \text{ bar}$
Frost protection	Frost-resistant
Solids content	$\leq 100 \text{ mg/l}$
BOD5/COD5	$\leq 0.05 / \leq 0.1 \text{ g/l}$
pH value	$\geq 6.5, \leq 8$
Temperature	$\geq 0, \leq 20$
Water hardness	$\leq 10^\circ\text{dH}$
Chloride content	$\leq 250 \text{ mg/l}$
Iron content	$\leq 0.2 \text{ mg/l}$
Electrical conductivity	$\leq 2,500 \mu\text{S/cm at } 20^\circ\text{C}$

Table 5 Quality requirements for utilities water

4.3.5 Remote service/EDI

An Internet connection with at least 256 kbit/s upload and download speed is required for remote service. The unit can be connected via LAN cable or WLAN. The firewall must be configured so that virtual private network (VPN) connections are permitted.

4.3.6 Heat intake

Intake option for hot water circuit upon consultation with the manufacturer.

Decouplable temperature level up to 115°C via a plate heat exchanger (customer interface). Heat output of 0 to 150 kW, depending on the unit's feed line.

Heating system for controlled unit shutdown via emergency cooler (installation in fresh air environment preferable).

4.3.7 Feed-in

Conveyor system and/or storage tank for filling the fuel distributor upon consultation with the manufacturer.

4.3.8 Extraction

After the vegetable carbon in the PYREG screw quencher has been moistened and cooled down, a conveyor system is required for its removal. The vegetable carbon can be removed in a Big Bag filling station or, alternatively, in a silo.

4.4 Exhaust stack

An exhaust stack is not included in the scope of delivery. The existing connection must be at least 200 mm in diameter. It is important to ensure that the flue gas in the flue gas heat exchangers is cooled down to below its dew point → condensate formation. Flue gas piping made from V₄A steel or high-quality stainless steel, plastic or other acid-resistant material is required. Drainage of condensate via a suitable neutralisation step is required (up to a pH value of 6-7).



CAUTION

Material damage due to incorrect connection

Failure to follow the energy connection instructions provided in this operating manual can result in significant material damage.

- The operator must provide the connections.

5 Structure and Function

5.1 Basic procedure

The biomass recycling operating procedure is characterised by various process steps which can be summarised as follows:

1. Carbonation of biomass in the PYREG reactors (PYREG procedure).
2. Incineration of the burning gases resulting from mineralisation in the combustion chamber.
3. Extraction of carbonation products (vegetable carbon or carbonisate).
4. Optional heat extraction via a downstream exhaust gas heat exchanger.
5. Exhaust gas stack

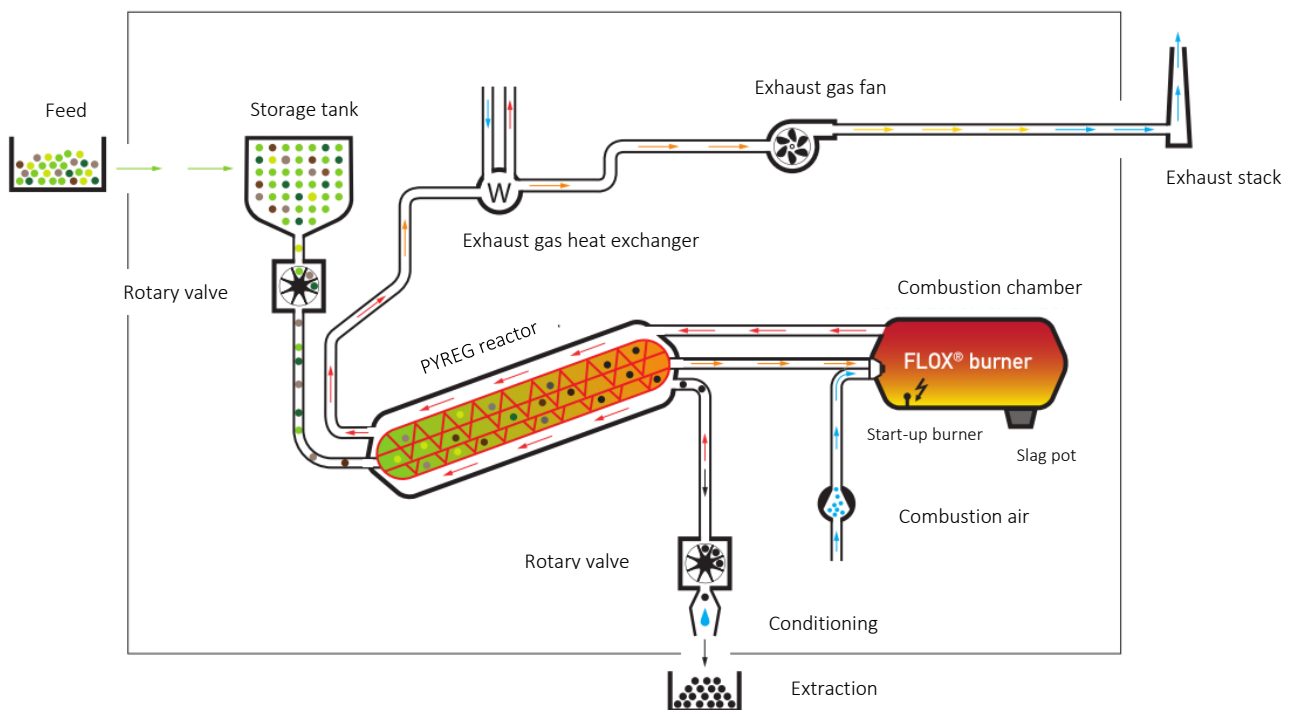


Illustration 1 Process diagram of a P 500 carbonation unit for biomass

The fuel is extracted from the storage tank with the aid of a screw conveyor. After passing through an electromotive-powered rotary valve which prevents air inlet in the PYREG[®] reactor and provides burn-back protection, the fuel is fed to the PYREG[®] reactor.

In the PYREG[®] reactor, two powered screw conveyors, arranged to link in and out of each other, are used to provide continuous transportation through the reactor and support uniform heating of fuel.

The biomass or sewage sludge is heated to a temperature of approx. 700°C by means of heat recovery from the exhaust gases of the downstream combustion chamber. The hot fuel gas thus recovered from degradation is fed directly to the combustion chamber and incinerated at approx. 1100°C-1250°C by means of lambda-controlled supply of combustion air via a controllable air valve and combustion air fan.

The exhaust gas generated in this process is conveyed to the double-walled PYREG[®] reactors in the outer mantle. This heats the fuel conveyed in the inner section and completes the autonomous cycle.

Process heat is extracted in the downstream exhaust gas heat exchangers and made available to the user.

The mineralisation products (vegetable carbon or carbonisate) are removed to a sedimentation tank or bunker (to be installed by the operator) via a screw conveyor with conditioning (water injection) after passing through a rotary valve.

5.2 Characteristics of PYREG procedures

The PYREG reactor with downstream FLOX[®] furnace provides allothermal (extensive exclusion of air) carbonation of fuel and direct combustion of existing hot fuel gas in a combustion chamber.

Particular process characteristics include reduction of dust emissions through indirect burnout of the solid fuel in the gas burner, as well as prevention of thermal NO_x formation by operating the combustion chamber using the FLOX[®] procedure (FLOX[®] = flameless oxidation) with flue gas recirculation (FGR).

Through optimal configuration of combustion in the oxidative combustion chamber atmosphere close to $\lambda=1$, active reduction of NO_x emissions from the oxidation of fuel-bound nitrogen is continued. (LEA: Low Excess Air - air deficiency reaction with the use of reburning effects). An additional downstream oxidation zone for combustion air staging causes afterburning of any CO that may still be present (OFA: Over Fire Air). The carbonisate (vegetable carbon) can be conveyed for further material recycling (biochar/terra preta).

By combining FLOX[®] burner technology with the use of heat for carbonation, drying and combined heat and power (CHP), efficient energy recovery can be achieved.

Furthermore, FLOX[®] combustion can achieve very low levels of exhaust gas emissions, particularly nitrogen oxides and dust; the same low levels cannot be achieved by other combustion processes with these particular fuels.

5.3 Scope of delivery

The unit consists of the following main components:

1. Unit platform (section 5.3.1)
2. Equipment container (section 5.3.2)

Optional parts and components as per the delivery agreement.

The unit can be operated only by running the two components in combination. The unit platform cannot be operated on its own. The two components are connected with screw joints. The joints may not be loosened or unfastened during operation. The tubes between the components are connected at the installation site during unit assembly.



WARNING

Material damage resulting from inadequate connection

Inadequate or loosened, unfastened joints can cause significant material damage and may even result in destruction of the unit.

- All connection work must be performed only by personnel qualified to do so.
- Monitor the connection in accordance with the maintenance schedule in this operating manual.

5.3.1 The unit platform

Serial no.	Description	Quantity [unit]	Numeration as per the pipe and instruments flow sheet in the appendix:		
			individual	right	left
10	Storage tank	1	31B20		
20	Entry hopper	2			
30	Rotary valve material feed	2		32H12	32H11
40	PYREG reactor	2			
50	Main burner	1	34B02		
60	Combustion chamber	1	34D10		
70	Pilot burner	1	34B01		
80	Combustion chamber slag pot	1	34B19		
90	Hot gas cyclone slag pot	1	34B29		
100	Hot gas cyclone	1	34F10		
110	Discharge	1	32H30		
120	Discharge rotary valve	1	32X40		
130	Conditioning screw	1	32H50		
140	Process gas cyclone	1	33F10		
150	High-temperature heat exchanger	1	35W10		
160	Hot gas cyclone rotary valve	1	33X15		

Table 6 Component overview for the unit platform of a P500 unit

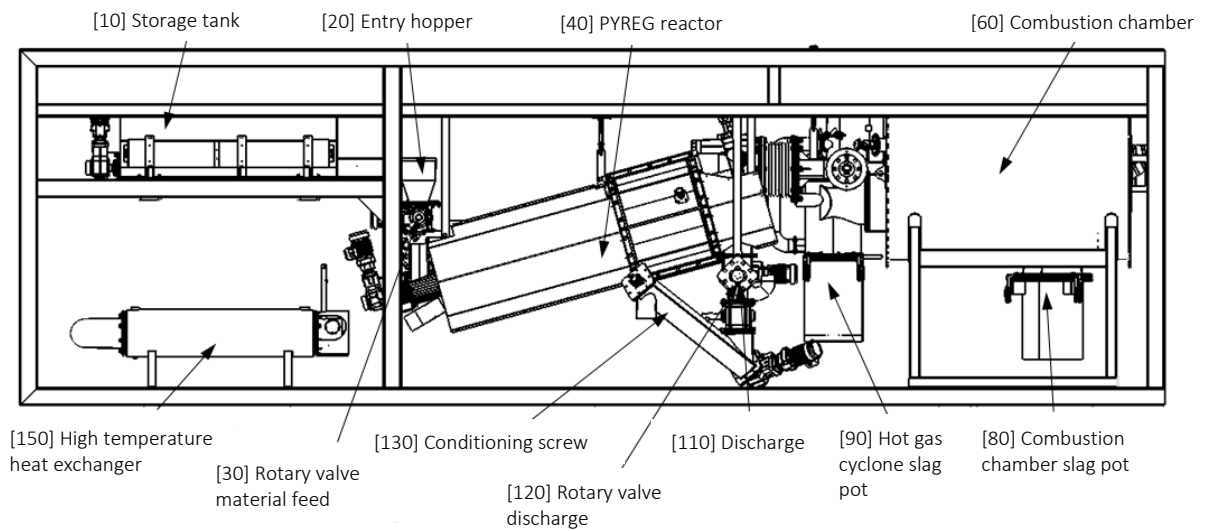


Illustration 2 Unit platform of a P500 unit

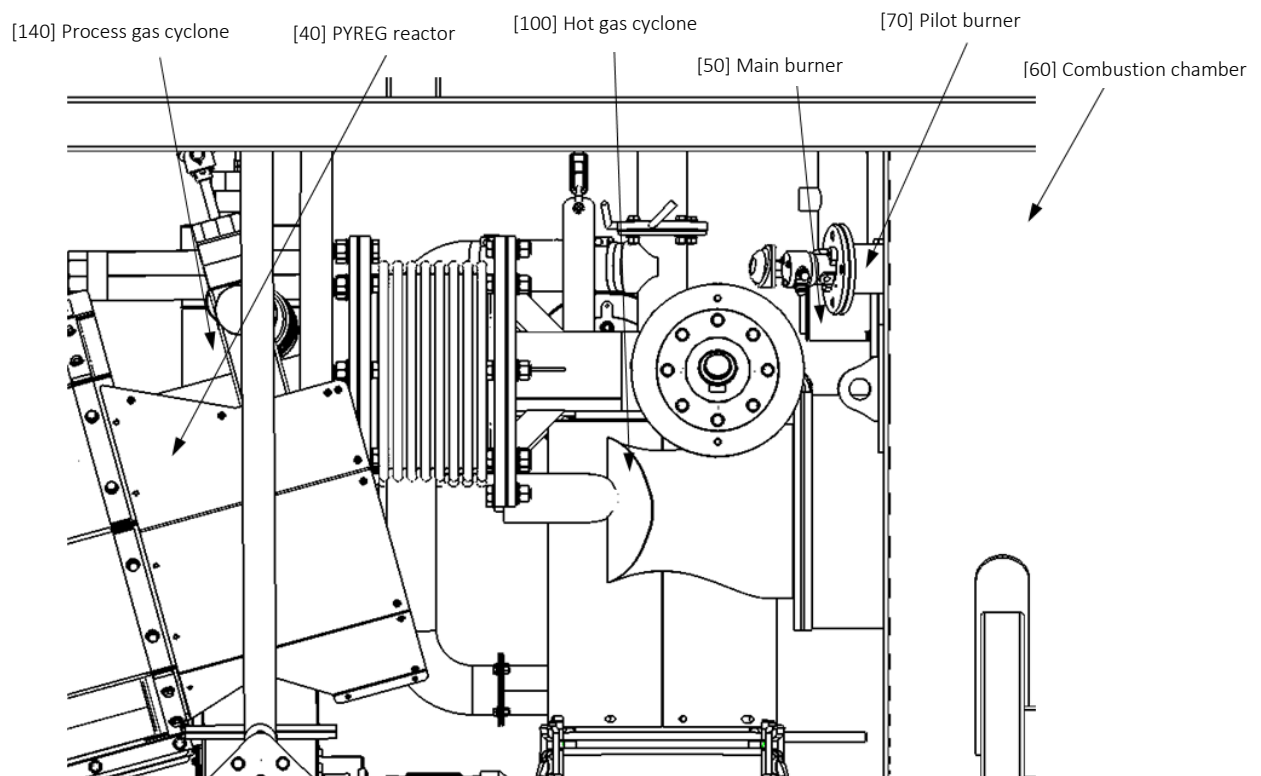


Illustration 3 Detailed illustration of the PYREG® reactor interface to the combustion chamber

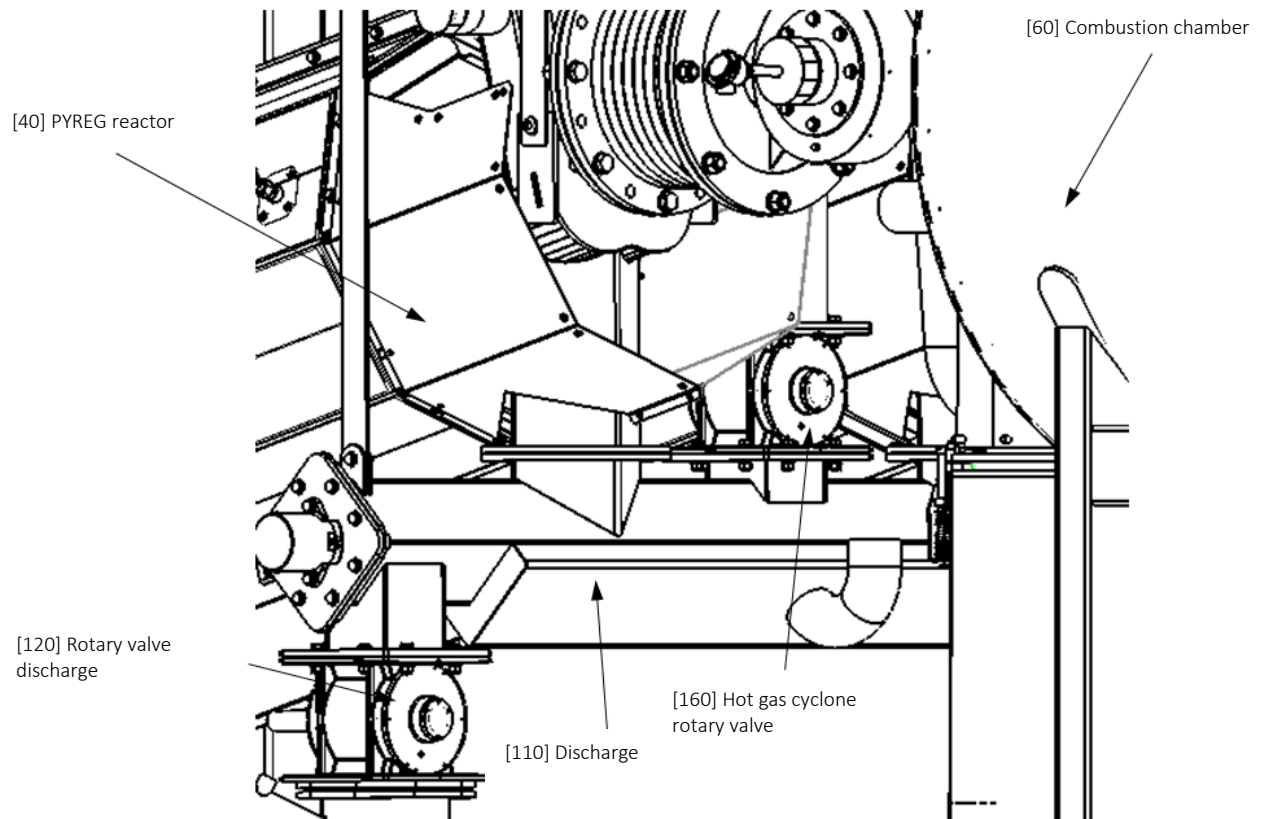


Illustration 4 Detailed illustration of P 500 unit's discharge system



NOTE

Exact listings of the sensors and actuators as per the pipe and instruments flow sheet are provided in the appendix.

5.3.2 The equipment container

Serial no.	Description	Quantity [unit]	Numeration as per the pipe and instruments flow sheet in the appendix:
200	Heat exchanger	1	05w05
210	Low-temperature heat exchanger	1	05W04
	Bomat		
220	Fan tower	1	.-
230	Subdistribution	1	.-

Table 7 Component overview for the P 500 unit's equipment container

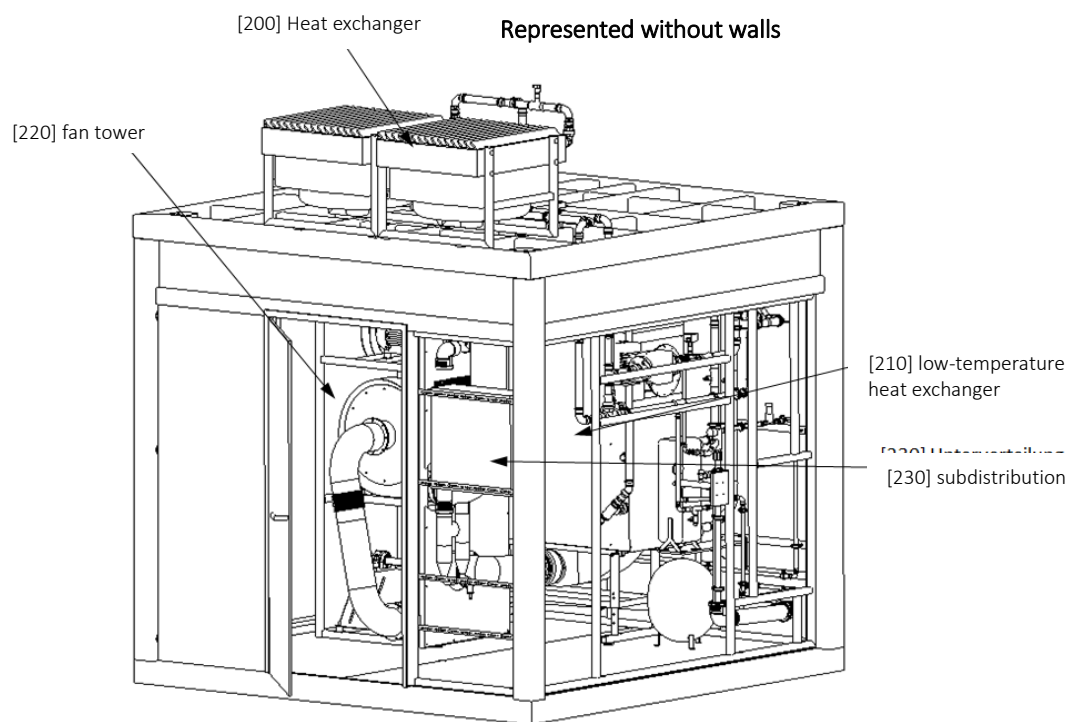


Illustration 5 Equipment container

6 Logistics

6.1 Safety information



DANGER

Danger to life from falling loads!

Loads can fall due to incorrect fastening and can cause serious injury.

- Do not pass under or in front of moving loads.
- Observe the safety instructions provided.



WARNING

Danger of crushing

*There is a danger of crushing during transportation of the P500.
Observe the following safety instructions:*

- Do not reach between the lifting accessory and the load
- Observe warning symbols on the P500



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.

- Ensure that all tasks are performed by personnel with appropriate qualifications only.

6.2 Storage conditions

The unit should be stored, unassembled, between -20 and +35°C.

If storage of the unit in a damp environment is envisaged (includes outdoor storage), a permanent power supply, or assembly and separate storage of the O₂ probe head, is a mandatory requirement (company: LAMTEC).

Moisture can cause defects to the O₂ probe head's test cards.

The head of the probe contains heating for the probe, which prevents moisture on the test card.



WARNING

Material damage resulting from incorrect storage

Incorrect storage of the unassembled P500 can cause damage to the oxygen (O₂) probes.

- Assemble and store the probes separately, ensuring that they are kept dry, in accordance with manufacturer specifications.

6.3 Transport inspection

Scope of delivery see [5.3 Scope of delivery page - 23 -](#)



NOTE

Check for completeness and for visible damage immediately upon delivery. Report incomplete or damaged delivery to the supplier.

Incoming goods inspection

- Inspect for completeness and for visible damage to the unit using the delivery note.
- **In the event of a complaint**

If the consignment has been damaged during transportation:

- Contact the forwarding agent immediately.

6.4 Handling during transportation

The units may be transported as separate components only.

The equipment container and the unit platform may be transported as individual modules only.



WARNING

Material damage due to transportation of the unit as a whole

If the complete unit is transported in an assembled state, significant damage may result and can lead to personal injury.

- Transportation of the individual equipment container and unit platform modules.

The following principles must be observed and adhered to:

- Use only appropriate lifting gear and slings.
- The operator of the lifting device must be authorised to operate it.
- All persons must leave the transportation area before the P500 is lifted.
- Slings must not be damaged and must be designed and labelled for the corresponding load capacity.
- Slings must not be knotted.
- Slings must not lie on sharp edges.
- Slings are to be used at the intended fixing points only.
- The unit platform and equipment container may not be transported in an assembled state.



NOTE

The unit platform and equipment container must not be exposed to hard shocks during transportation. Exercise particular caution when lifting and setting down.






WARNING

Material damage resulting from improper transportation of the P500

Improper transportation of the P500 can result in serious damage to the entire unit.

- Use appropriate measures to protect against shocks and falling.
- The unit platform and the equipment container are to be lifted at the intended fixing points only.

	Weight	Centre of gravity	Load attachment point	Lifting device	
	 in kg			Fork lift	Crane
Packaged unit					
Unit platform	14,000	top-heavy	as illustrated	no	yes
Equipment container	4,500	top-heavy	as illustrated	no	yes

Heavy-duty rollers must be used for positioning on a suitable surface at the installation site. The unit platform and equipment container must be secured against uncontrolled rolling in the process.



DANGER

Danger to life from falling loads!

Loads can fall due to incorrect fastening and can cause serious injury.

- Do not pass under or in front of moving loads.
- Observe the safety instructions provided.



WARNING

Danger of injury resulting from transportation with superstructures

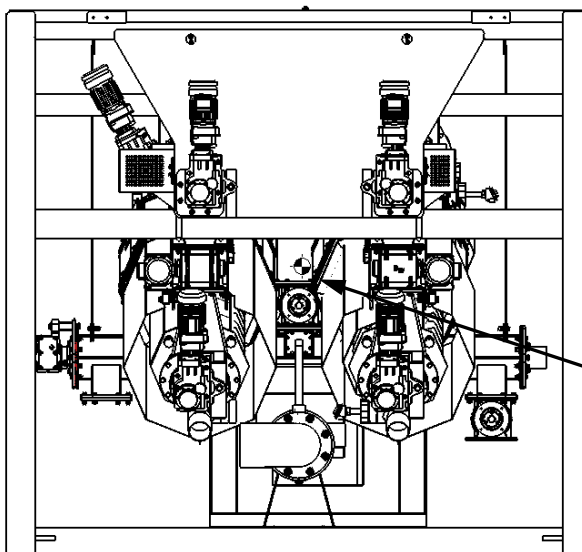
Transportation with superstructures can result in damage and, thus, to personal injury.

All superstructures higher than roof level must be dismantled before transportation.



NOTE

Read the relevant operating manual for the lifting equipment to be used.



General location of the centre of gravity

Illustration 6 Load centre of unit platform - lengthways

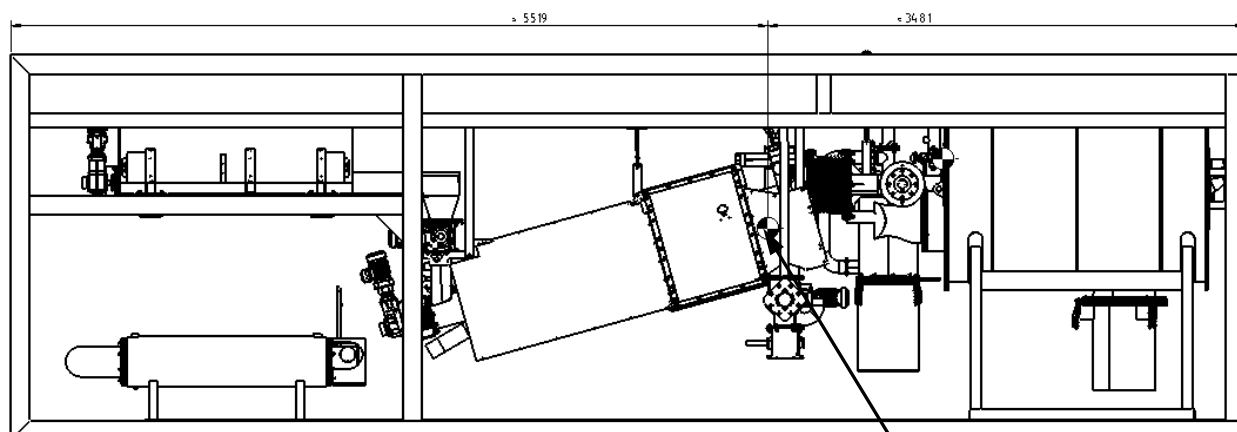


Illustration 7 Load centre of unit platform - side view

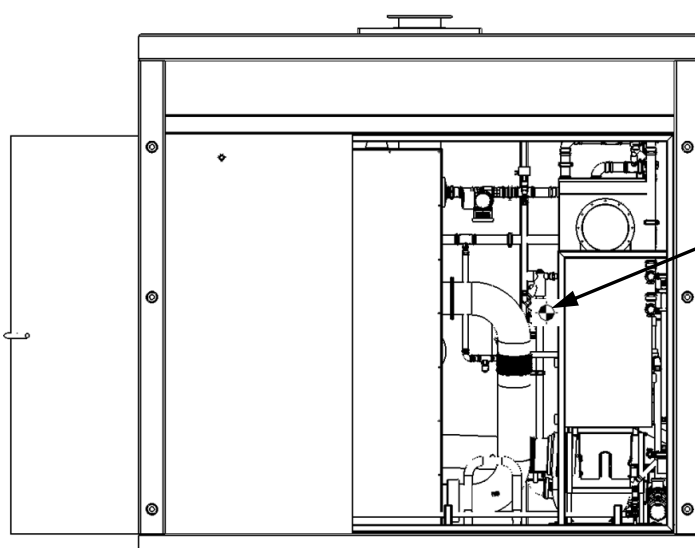


Illustration 8 Equipment container

General location of the
centre of gravity

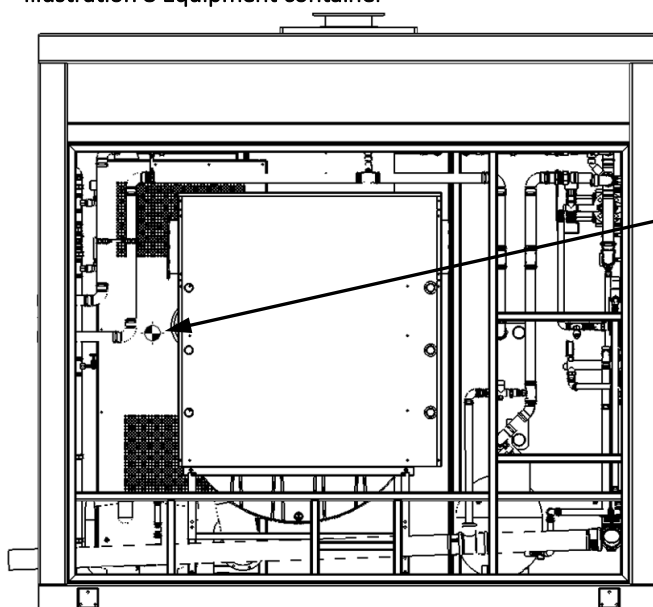


Illustration 9 Equipment container

General location of the
centre of gravity

6.4.1 Transportation with crane



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.

- Ensure that all tasks are performed by personnel with appropriate qualifications only.

- The crane must be equipped to withstand the weight of the transportation units.
- The operator must be authorised to operate the crane.
- Considering the attachment points, lift the unit platform and equipment container onto the crane with the corresponding lifting accessories (e.g. lifting beam, harness, ropes) and transport it.
- The equipment container and platform may only be transported without superstructures.



WARNING

Danger of injury resulting from transportation with superstructures

Transportation with superstructures can result in damage and, thus, to personal injury.

- All superstructures higher than roof level must be dismantled before transportation.

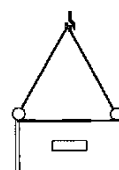
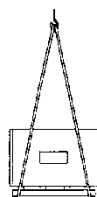


WARNING

Material damage due to incorrect use of load attachment points

This symbol is used only at the points at which the crane can be used for lifting.

- Only the attachment points indicated with the symbol can be used for lifting with a crane.



Arrows indicate attachment points to the unit

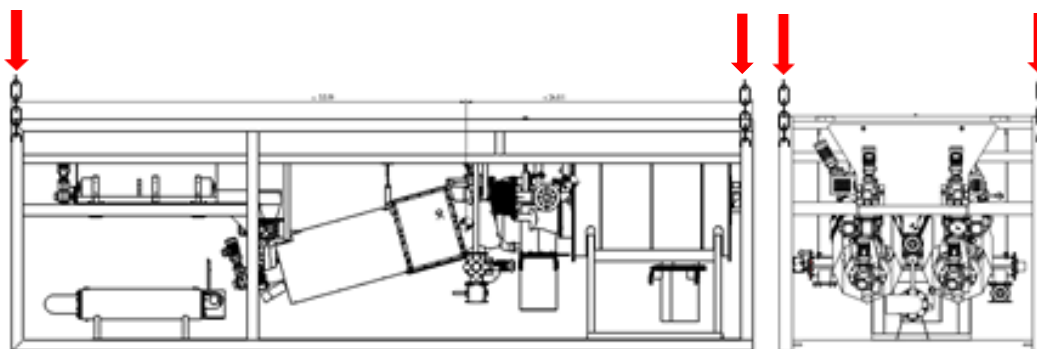
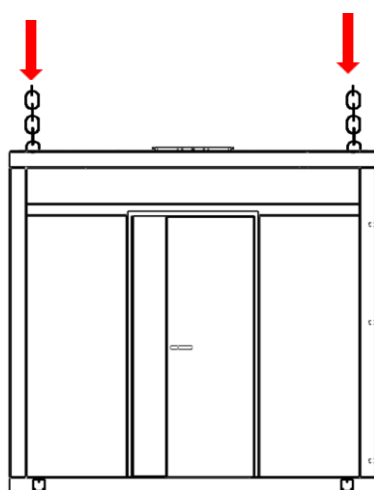


Illustration 10 Unit platform load attachment points



Use only **new**, high-strength EN 1677 - M24 lifting bolts with safety factor 4 for transportation.

Illustration 11 Equipment container load attachment points



WARNING

Risk of injury from transportation with unsuitable lifting accessories

Transportation with unsuitable lifting accessories can result in breaking due to overload and loads being dropped.

- Use suitable lifting accessories.
- Only use high-strength lifting bolts in accordance with DIN ISO EN 1677.

6.4.2 Transportation with forklift

The equipment platform and equipment container are not intended for transportation with a forklift.



WARNING

Material damage during transportation with forklift.

Transportation with a forklift can result in significant material damage to the unit.

- Do not transport using a forklift.

7 Assembly and Connection

7.1 Safety instructions



DANGER

Danger to life from electric current!

Contact with live lines or components presents a danger to life. Observe the following safety instructions in order to avoid electrical hazards:

- Do not operate the P500 if power cables or plugs are damaged.
- Work on electrical equipment may only be performed by a qualified electrician or trained staff under the management and supervision of a qualified electrician, in accordance with electrical engineering standards.
- If works are required on live parts, make sure a second person is present who can switch off the main switch in the event of an emergency. Cordon off the work area with a red and white safety chain and a warning sign. Use voltage-isolated tools only.

WARNING

Danger of injury due to incorrect installation of the P500



Incorrect installation of the P500 can cause serious injury.

- Before starting, ensure that there is sufficient room to carry out the work.
- Ensure that the work area is clean and tidy. Loosely stacked or scattered components and tools can cause accidents.
- Assemble components correctly.
- Secure components so that they cannot fall or topple over.

7.3 Personnel qualifications



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can cause significant personal and material damage.

- Ensure that all tasks are performed by personnel with the appropriate qualifications only.

Work on electrical equipment may only be performed by an electrician or instructed staff under the management and supervision of an electrician, in accordance with electrical engineering standards.



NOTE

PYREG GmbH accepts no warranty claims for the proper functioning of the unit when the P500 is assembled and connected by the customer.

7.4 Requirements at the operation site

As both unit components must be aligned at ground level with the aid of support assemblies and spirit levels, the operator is responsible for ensuring that the surface has sufficient loading capacity.

The maximal angular deviation of the unit from the vertical may not exceed 2° .

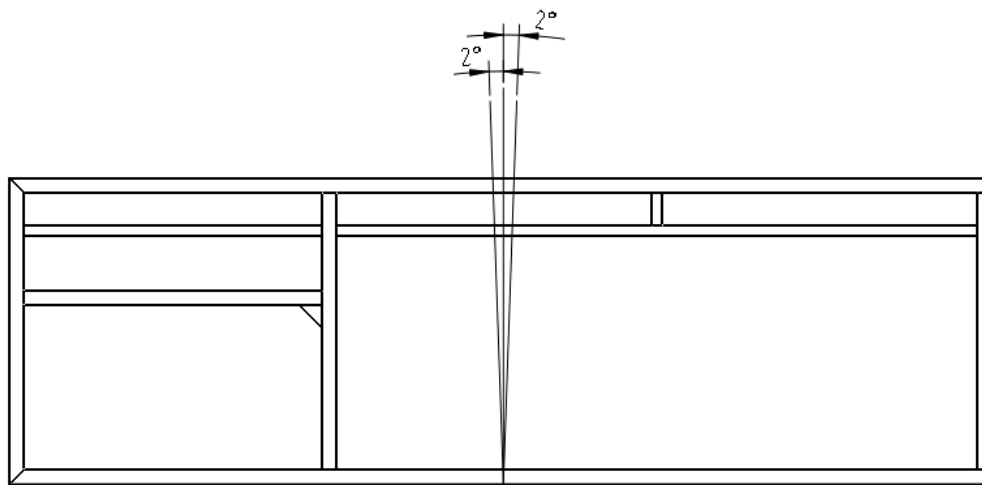


Illustration 12 Unit platform diagram 01

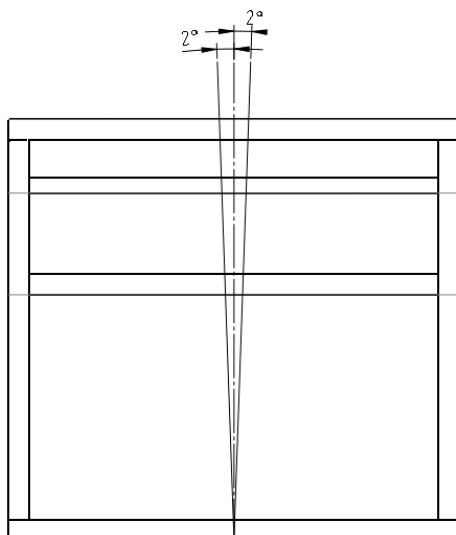


Illustration 13 Unit platform diagram 02

The unit is designed to be assembled outdoors. It can also be assembled in an installation room following consultation with PYREG GmbH. In such instances, the installation room must be ventilated with the required air exchange rate.

The ambient temperature must be between -20 and +35°C.

The installation site must be accessible for a crane; safe unloading of the unit must be ensured.



CAUTION

Material damage due to non-vertical installation

Major angular deviations from the vertical can cause significant material damage to the unit.

- The unit's maximum angular deviation from the vertical must not be exceeded.
- Offsetting by supporting with suitable material is permitted.



DANGER

Danger to life due to inadequate ventilation in the installation area

Failure to comply with the statutory air exchange rate can result in life-threatening situations due to gases.

- The unit's operator can minimise risk by complying with and monitoring statutory provisions.

7.5 Installation

Assembly and commissioning may be performed only by PYREG GmbH or by their authorised service partner.



NOTE

PYREG GmbH accepts no warranty claims for the proper functioning of the unit when the P500 is assembled and connected by the customer.

7.6 Supply connections

7.6.1 Electrical energy

400 V, 50 A in accordance with IEC 60309; min. 16 mm²
Consumption up to max. 100,000 kWh/a approx.

7.6.2 Pneumatic energy

6 bar unoiled air.

7.6.3 Gas

Burner capacity 0-200 kW
Consumption approx. 1,500 kg/a

Required sewer gas/natural gas/liquid gas/biogas conditions:

Calorific value	$\geq 5.8 \text{ MJ/kg Nm}^3$
Pressure	$\geq 50, \leq 250 \text{ mbar}$
Temperature	$\leq 30^\circ\text{C}$
Humidity	$\leq 75\% \text{ saturation}$
H ₂ S content	$\leq 1,000 \text{ ppm}$

Table 8 Gas requirements

7.6.4 Water

For drinkable water with backflow preventer in accordance with DIN 1988

Flow rate $\leq 5 \text{ m}^3/\text{h}$, consumption approx. $150 \text{ m}^3/\text{a}$

approx. $900 \text{ m}^3/\text{a}$ with flue gas scrubbing

Diameter	$\frac{1}{2}"$
Flow rate	$\leq 5 \text{ m}^3/\text{h}$
Operating pressure	$\geq 4, \leq 10 \text{ bar}$
Frost protection	Frost-resistant
Solids content	$\leq 100 \text{ mg/l}$
BOD5/COD5	$\leq 0.05/ \leq 0.1 \text{ g/l}$
pH value	$\geq 6.5, \leq 8$
Temperature	$\geq 0, \leq 20$
Water hardness	$\leq 10^\circ\text{dH}$
Chloride content	$\leq 250 \text{ mg/l}$
Iron content	$\leq 0.2 \text{ mg/l}$
El. conductivity	$\leq 2,500 \mu\text{S/cm at } 20^\circ\text{C}$

Table 9 Requirements for service water

8 Safety Concept

8.1 Basic explosion prevention strategy

Similar to automatic wood combustion, the unit generates combustible and – under certain conditions, explosive – gases from solid fuels. Negative pressure is always employed in the entire gas-conducting part of the unit between the material feed rotary valve and exhaust gas fan in order to ensure safe operation of the unit in all of its phases of operation (see [8.5 Maintenance of negative pressure](#)). This ensures that gases can escape from the unit only via the exhaust gas tract (heat exchanger, exhaust stack) downstream of the exhaust gas fan.



DANGER

Danger to life due to escaping gas

In certain circumstances, in the event of a unit fault, open flames or similar ignition sources in close proximity to the unit may cause deflagration or sudden combustion.

The operator is strongly encouraged to impose a complete smoking ban in the vicinity of, and inside, the P500.

- The operator is strongly encouraged to impose a complete ban on open flames in the vicinity of, and inside, the P500.

8.2 Shutdown in the event of an emergency

Initiating shutdown in the event of an emergency (emergency shutdown procedure) serves to put the unit into a safe state from any operating mode as quickly as possible. For this reason, all of the unit's conveying drives must be disconnected from the mains supply.

The unit's PLC control system, exhaust gas fan, combustion air fan and safety chain continue to be supplied with power via uninterrupted power supply (UPS) in the event of emergency shutdown and also in the event of a grid outage. This maintains the prevailing negative pressure in the unit. (see [8.1 Basic explosion prevention strategy](#))

Positions of EMERGENCY STOP switches



Illustration 15
EMERGENCY STOP 01



Illustration 14
EMERGENCY STOP 02



Illustration 16 EMERGENCY
STOP 03

Due to the immediate loss of fuel supply and reactor conveyance, combined with low quantities of residual biomass in the reactor (approx. 15 kg), burning gas production is suspended within a few minutes. In this operating mode, directed gas flow in the unit is maintained until the unit cools down due to continued operation of the exhaust gas fan.

In the event of an emergency shutdown, it is important to note that the unit will still have components with very hot surfaces.

Hence, a cooldown period must be provided for maintenance work required.

A 12-hour cooldown period must be provided from this operating mode for upkeep work required. This period is 36 hours for work on the combustion chamber.



CAUTION

Danger of injury from hot surfaces

In the event of an emergency shutdown, there remain unit surfaces with a temperature in excess of +65°C.

Burn injuries can occur as a consequence.

- Assembly, dismantling and maintenance work may not be performed in the immediate aftermath of an emergency shutdown.
- Protective clothing and gloves should be worn to avoid injury.

8.3 Operational shutdown

Operational shutdown (safety shutdown) serves to shut the unit down in a safe and scheduled manner. Fuel supply is stopped during this process.

Controlled shutdown is initiated by pressing the “Shut Down Unit” button. Unit operation is sustained until the reactors have fed out the residual material located in the interior. This causes the lower limit of the shutdown temperature for the combustion chamber to be reached, and the unit shuts down automatically. Up until this time, the quality of combustion and mineralisation of residual biomass in the reactor is continuously monitored and ensured by the unit's control system.

In the event of a safety shutdown, it is important to note that the unit will still have components with very hot surfaces. Hence, a 12-hour cooldown period must be provided for maintenance work required. This period is 36 hours in the case of maintenance work on the combustion chamber.



CAUTION

Danger of injury from hot surfaces

In the event of a safety shutdown, there remain unit surfaces with a temperature in excess of +65°C.

Burn injuries can occur as a consequence

- Assembly, dismantling and maintenance work may not be performed in the immediate aftermath of a safety shutdown.
- The unit must cool down for a minimum of 12 hours.
- Protective clothing and gloves should be worn to avoid injury.

8.4 Electrical power failure

Power failures are detected by an integrated network monitoring device. Emergency shutdown is implemented in the event of a power failure (see [8.2 Shutdown in the event of an emergency](#)).

The unit's PLC control system and exhaust gas fan continue to be supplied with power via uninterrupted power supply (UPS) in the event of grid outage and also in the event of a power failure. This maintains the prevailing negative pressure in the unit. (see [8.1 Basic explosion prevention strategy](#))

This period is sufficient to safely shut down the unit and to reach a temperature level (reactors < 400°C, combustion chamber < 750°C) at which gas production can no longer occur because the residual mass in the reactor has either carbonised or is too cold. In the event of a grid outage, leave the unit area and maintain a safe distance of at least

10 m. In the very unlikely event of breakdown of all safety equipment and the UPS, approx. 15 kg of biomass may remain in the hot reactor. Small quantities of fuel gas can escape from the reactors via the feed shafts in these circumstances; however, there is no risk of explosion in this mode.



DANGER

Danger to life due to escaping gas

In certain circumstances, in the event of a unit fault, open flames or similar ignition sources in close proximity to the unit may cause deflagration or sudden combustion.

- The operator is strongly encouraged to impose a complete smoking ban in the vicinity of, and inside, the P500.
- The operator is strongly encouraged to impose a complete ban on open flames in the vicinity of, and inside, the P500.



CAUTION

Danger of injury from hot surfaces

In the event of an emergency shutdown, there remain unit surfaces with a temperature in excess of +65°C.

Burn injuries can occur as a consequence.

- Assembly, dismantling and maintenance work may not be performed in the immediate aftermath of an emergency shutdown.
- The unit must cool down for a minimum of 12 hours.
- Protective clothing and gloves should be worn to avoid injury.

8.5 Maintenance of negative pressure

Negative pressure is continuously recorded by redundant pressure sensors, a safety pressure controller and differential pressure detection of the exhaust gas volume flow and is readjusted by the unit's control system (SIEMENS PLC S7-300). The safety pressure controller is engaged in the unit's safety chain. If the threshold value for negative pressure is not reached, safety shutdown takes place (see 8.3 Operational shutdown) or the unit cannot be put into operation. The exhaust gas fans, which are used to maintain negative pressure, have a redundant design i.e. they have their own electrical power supply (frequency converter) and are mechanically overdimensioned. One of the two exhaust gas fans is used as an emergency fan in the event of an emergency shutdown (see 8.2 Shutdown in the event of an emergency) or a grid outage (see 8.4 Electrical power failure). This means that this fan runs as normal during standard operation and is supplied with electrical power via the UPS in the event of a grid outage or controller breakdown.



NOTE

Exhaust stack systems must be designed according to local design specifications.



CAUTION

Danger of injury from hot surfaces

In the event of a safety shutdown, there remain unit surfaces with a temperature in excess of +65°C.

Burn injuries can occur as a consequence.

- Assembly, dismantling and maintenance work may not be performed in the immediate aftermath of a safety shutdown.
- The unit must cool down for a minimum of 12 hours.
- Protective clothing and gloves should be worn to avoid injury.

8.6 Frost-resistant operation of the heating circuit

The liquid in the equipment container's heating circuit is a mixture of water and antifreeze.

For the mixture ratio for operation up to -26°C, see the Glysofor F safety data sheet.



Warning

Material damage due to inadequate frost protection

If antifreeze is not used in the heating circuit, ambient temperatures of less than 0°C may cause material damage to the unit.

- During seasons in which ambient temperatures of less than +4°C can occur, the liquid in the heating circuit must be adjusted within the mixture so that it is appropriate for the average lowest expected temperatures in the geographical area.



NOTE

In western and central Europe (geographical), a mixture up to -26°C is suggested as per the data sheet.

In the Baltic countries, a mixture up to -30°C is suggested.



Warning

Material damage resulting from inadequate monitoring of the mixture ratio of liquid in the heating circuit

If the mixture ratio of the medium in the heating circuit with the antifreeze is not monitored sufficiently, ambient temperatures of less than 0°C may cause material damage to the unit.

- In seasons in which ambient temperatures of less than +4°C can occur, the ratio of liquid in the heating circuit's liquid mixture must be monitored.
- In seasons in which ambient temperatures of less than +4°C can occur, an inspection of the mixture ratio should be performed once a week.



Warning

Material damage resulting from inadequate monitoring of the mixture ratio of liquid in the heating circuit after a fault

If a fault message alert is displayed after shortfall of minimum pressure in the heating circuit, the mixing ratio of the medium in the heating circuit to the antifreeze must be monitored; otherwise, temperatures of less than 0°C may cause material damage to the unit.

- In seasons in which ambient temperatures of less than +4°C can occur, the ratio of liquid in the heating circuit's liquid mixture must be monitored.
- In such instances, **verifiable** monitoring of the mixture ratio must be carried out within **one hour**.

The fault message can be displayed, for example, as follows:

STM321 safety circuit: Water Container Pressure Monitor
 FLT321 Safety Circuit: Pressure Switch Water Container



NOTE

A standard handheld antifreeze refractometer is recommended for monitoring.



NOTE

We recommend that the unit's operator documents inspections in writing.



Warning

Personal injury resulting from the use of non-recommended antifreeze

If an antifreeze product that has not been specified by the manufacturer is used, personal and environmental damage may result.

- Use antifreeze approved by the manufacturer only.

8.7 Fire protection

8.7.1 Fire protection – general information

Fire protection for the unit and for the installation site in general conforms to the applicable national, local and regional regulations.



NOTE

The operator is responsible for compliance with applicable national, local and regional fire protection regulations.

8.7.2 Backfire protection: storage tank for fuel

Various active and passive measures are used to prevent backfire in the fuel storage tank. Flow of gas is directed from the cold side (feed side) to the hot side (discharge side) in the reactors. The direction of flow is continuously ensured by conducting burning gas to the hot side of the reactor. The direction of flow is continuously ensured by siphoning burning gas on the hot reactor side via the combustion chamber and through the exhaust gas fan. Gas and fuel move through the reactor in continuous current. The reactors are installed at an incline (15°) from the cold side to the hot side so that natural thermals support this direction of flow. This prevents remigration of the hot reaction zone in the direction of the fuel feed shaft (backfire safety). The feed shaft is designed as a manhole with a freefall height of 0.5 m. The reactors are spatially segregated from the fuel distributor by a rotary valve. The rotary valve constitutes an autonomous, mechanical burn-back safety unit. The sluice body and trowel rotor are made from steel and are provided in order to guarantee the best possible spatial segregation with a < 0.5 mm profile. The sluice's four rotor blades, with a wall thickness of > 6 mm, lock the sluice's feed and discharge shafts fully in every operating mode, thus forming a mechanical closure for the reactor in order to prevent burn-through to the storage tank. An additional freefall area for biomass is positioned between the sluice feed shaft and the dosing screw.



NOTE

The fuel storage location and the combustion unit must be separated in accordance with locally applicable regulations. Guideline values according to DIN 4102: Walls F90, doors: T30.

8.7.3 Burn-back protection: reactor discharge

The carbon discharge is equipped with a rotary valve which prevents unwanted air from entering the reactor and also prevents burn-back.

8.7.4 Burn-back protection: coal and ash bunkers

The vegetable carbon/ashes discharged from the reactor are extinguished with water upon entering the conditioning screw and are thus cooled and moistened rapidly (water content > 25%). Any glowing embers that may remain are extinguished in this process and dust particles are bound together in order to prevent dangerous concentration of dust particles in the carbon discharge (carbon dust explosion).



NOTE

Safety monitoring of carbon temperature after extinguishing and available water pressure can be performed as optional.

Safety shutdown of the unit is initiated if a fixed configured temperature threshold is exceeded (see 8.3 Operational shutdown).



CAUTION

Danger of injury from hot surfaces

In the event of a safety shutdown, there remain unit surfaces with a temperature in excess of +65°C.

Burn injuries can occur as a consequence.

- Assembly, dismantling and maintenance work may not be performed in the immediate aftermath of a safety shutdown.
- The unit must cool down for a minimum of 12 hours.
- Protective clothing and gloves should be worn to avoid injury.



NOTE

Safety monitoring of water pressure at the extinguisher's injection is available as optional.

If there is no water pressure at the extinguisher, a safety shutdown (see 8.3 Operational shutdown) is initiated or the unit cannot be started.



NOTE

The operator's coal bunkers must be equipped with manual or independently functioning sprinkler systems in accordance with the requirements of the relevant authority.



NOTE

The water pressure to be maintained by the operator in the sprinkler can, optionally, be monitored using an electromechanical safety pressure controller. This monitoring can be integrated into the unit's safety chain.

If the safety chain is activated, a safety shutdown is initiated (see 8.3 Operational shutdown) and the unit cannot be started up.



CAUTION

Danger of injury from hot surfaces

In the event of a safety shutdown, there remain unit surfaces with a temperature in excess of +65°C.

Burn injuries can occur as a consequence.

- Assembly, dismantling and maintenance work may not be performed in the immediate aftermath of a safety shutdown.
- The unit must cool down for a minimum of 12 hours.
- Protective clothing and gloves should be worn to avoid injury.



CAUTION

Material damage resulting from non-frostproof water supply

If frostproof water supply is not ensured by the operator, material damage to the unit may result.

- The operator must put in place a frostproof extinguisher water supply.



NOTE

The carbon storage site and the P500 must be spatially segregated in accordance with the applicable local regulations. The guideline values according to DIN 4102 apply.

The operator must have additional mobile fire-extinguishing devices available, dimensioned in accordance with local regulations and according to combined fire load.

8.8 Monitoring of External Unit Components

Monitoring of external standard components (water heat exchanger, coal shelter, fuel bunker, sprinklers etc.) is integrated into the unit's control system as standard. Other security-sensitive components (e.g. steam generators, ORC systems etc.) require an additional safety appraisal and integration planning.

8.9 Conduct in the event of an emergency, Emergency Stop

In the event of an emergency (excess temperature, pressure undershoot, etc.), an emergency shutdown procedure (see 8.2 Shutdown in the event of an emergency) is initiated by pressing the Emergency Stop switch.



Illustration 17
Emergency Stop 01



Illustration 19
Emergency Stop 02



Illustration 18
Emergency Stop 03



Illustration 20
Emergency Stop 04

There is an Emergency Stop switch at the switch cabinet of the unit as standard.

The hazard area around the unit must be vacated in the event of an emergency shutdown.



CAUTION

Danger of injury from hot surfaces

In the event of an emergency shutdown, there remain unit surfaces with a temperature in excess of +65°C.

Burn injuries can occur as a consequence.

- Assembly, dismantling and maintenance work may not be performed in the immediate aftermath of an emergency shutdown.
- The unit must cool down for a minimum of 12 hours.
- Protective clothing and gloves should be worn to avoid injury.

8.11 Safety chain

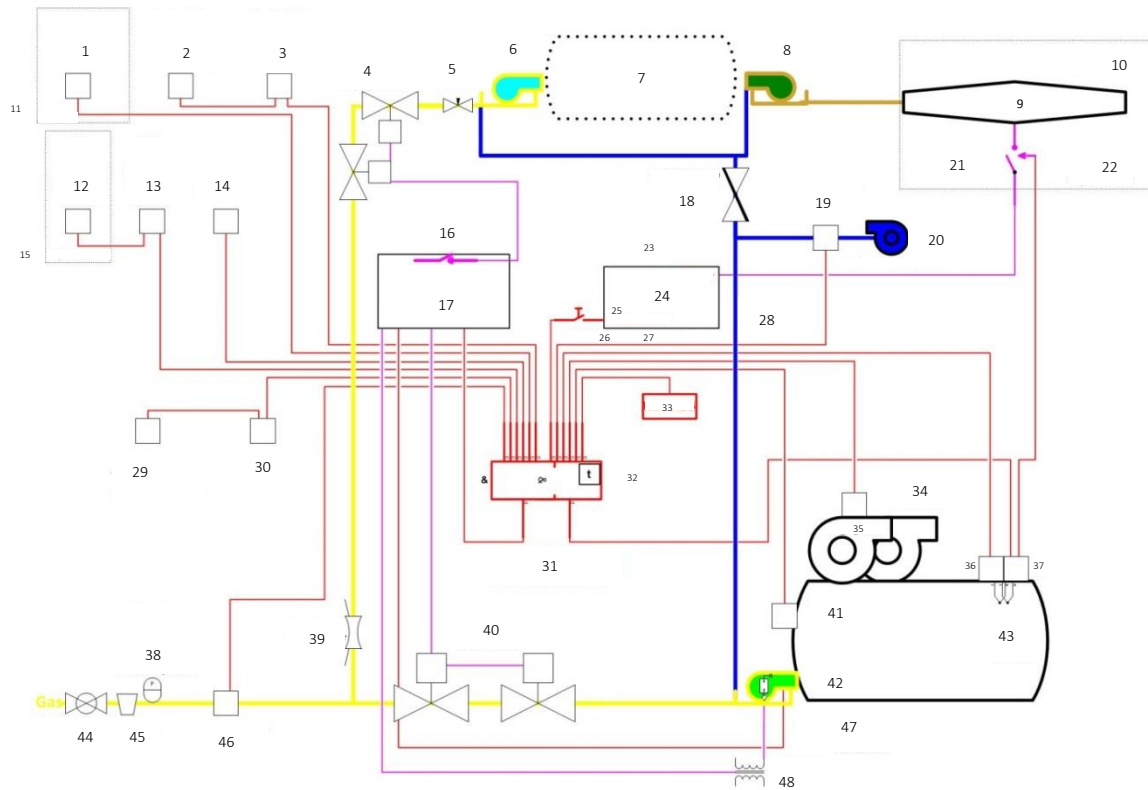


Illustration 21 Safety chain

Safety chain legend

yellow line
blue line
red line

Gas
Air
Safety chain

The Siemens ET200S compact safety controller is a central component of the safety chain. All safety chain conditions (safety-related controls in accordance with EN ISO 13849) must be fulfilled before the start signal reaches the burner control device:

- Key switch activated
- EMERGENCY-OFF switch of external unit components (e.g. heat recovery) not activated
- EMERGENCY-OFF switch not activated
- Rotary feeder's cam switch activated
- Carbon discharge temperature within permissible range (safety temperature monitor) (optional)
- Temperature of feeder within permissible range (safety temperature monitor)
- Temperature of combustion chamber within permissible range (safety temperature limiter)
- Exhaust gas temperature (safety temperature limiter)
- Water container flow temperature (safety temperature limiter)
- "Pressure monitor start bypass" pushbutton activated
- Lambda measurement active
- Gas pressure within admissible range (pressure monitor excess pressure)
- Combustion air pressure within admissible range (pressure monitor excess pressure)
- Exhaust gas pressure within admissible range (pressure monitor negative pressure)
- Water container pressure on (pressure monitor excess pressure)
- Extinguisher water pressure (pressure monitor excess pressure)
- Water heat exchanger flow rate given (paddle monitor)
- Bomat water temperature within admissible range (safety temperature limiter)

Optional functions if required by the operator:

- Drinkable water pressure (pressure monitor excess pressure)
- Coal bunker sprinkler water pressure on (safety pressure monitor) (optional)
- Coal bunker temperature within admissible range (optional external safety temperature monitor)
- Water heat exchanger return flow temperature within admissible range (optional external safety temperature monitor)

In parallel, the negative pressure values of the reactors, volume flow measurement and all temperature measurements as well as exhaust gas oxygen concentration within the specified limit values are monitored via the PLC's analog value input (NOT a safety-related control) and reported in the event of excess or shortfall, which triggers a safety shutdown (see [8.3 Operational shutdown](#)).

8.12 Chain barriers

The unit platform is equipped with chain barriers at its accessible sides. These are intended to impede entry to the unit during operation and cool-down.

This provides protection from injury due to hot surfaces.



CAUTION

Danger of injury from hot surfaces

During operation and in the event of an emergency shutdown, there remain unit surfaces with a temperature in excess of +65°C. Burn injuries can occur as a consequence.

- The chain barrier must be closed during operation.
- It is not permitted to either climb over or crawl under the chain.
- Protective clothing and gloves should be worn to avoid injury.



The chain is fastened using a spring clip with a screw closure.

The closure must be closed during operation and the chain must be attached accordingly.

Illustration 22 Spring clip with screw closure



NOTE

The operator has a duty of care to indicate closure of the chain to operating personnel.

9 Operating and Control Panels

9.1 Safety instructions

The unit may be put into operation by trained and instructed personnel only. Training and instruction is conducted exclusively by PYREG GmbH or by their authorised service partner.



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.



- Ensure that all tasks are performed by personnel with appropriate qualifications only.



NOTE

Training must be logged and participants must certify in writing that they have taken part in order to ensure more effective tracking of training activities.

For information on training courses and instruction, please contact:

PYREG GmbH
 Trinkbornstrasse 15 – 17
 D- 56281 Dörth
 Tel.: +49 (0) 6747 95388 – 0
 Email: service@pyreg.de
 Service: +49 156 04430414

9.2 Initial start-up

The unit is put into operation for the first time by PYREG GmbH, prior to delivery. The following fuel-dependent parameters are recorded during this process:

- The feeding screws' conveying capacity
- The fuel's calorific value in relation to the dry substance content
- The performance of the fuel used
- The values for optimal fuel performance

For calculation of the individual parameters, see [13.3 Definition of unit parameters](#).



NOTE

This data is directly dependent upon the fuel employed.
The operator must provide sufficient quantities of the fuel.

9.3 Returning to service

Return to service after substantial modification can also be performed only by PYREG GmbH or by their authorised service partner, or by trained and instructed personnel.



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.

- Ensure that all tasks are performed by personnel with appropriate qualifications only.



9.4 Operating and control units

There is a central operation and control unit for operating the unit located at the switch cabinet.

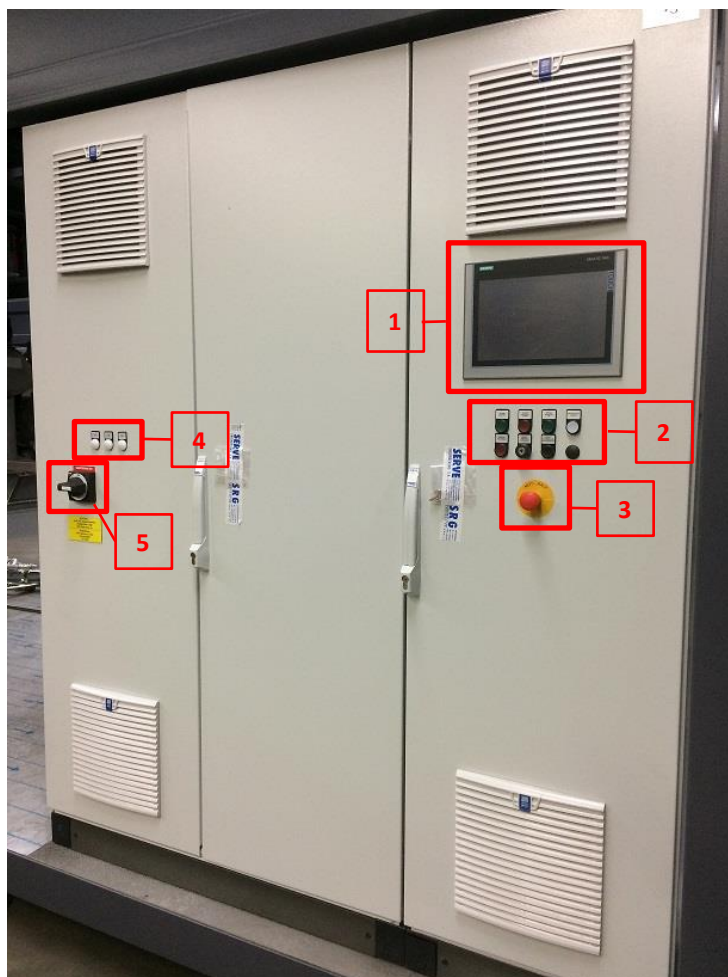
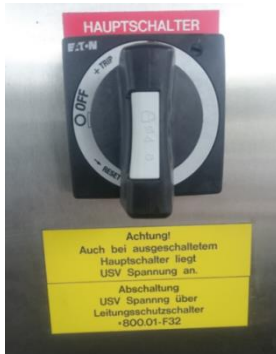


Illustration 23 Operating and control units

This consists of:

Serial no.	Description	Link
1	Touch-sensitive screen (touch panel)	9.5 Program-controlled Unit Operation Page - 67 -
2	Starter unit	Illustration 27 Starter unit Page - 65 -
3	Emergency-Stop	Illustration 25 Emergency Stop, Page - 64 -
4	Optical phase display	Illustration 26 Optical phase display, Page - 65 -
5	Main switch	Illustration 24 Main switch, Page - 64 -

Table 10 Operating and control units



The main switch is used to turn the switch cabinet mains voltage on and off.

Illustration 24 Main switch on switch cabinet of a P500 unit



DANGER

Danger to life from electric current!

For safety-related reasons, elements in the switch cabinet continue to conduct voltage when the selection switch is set to "0 OFF".

- Work on electrical equipment may only be performed by a qualified electrician or trained staff under the management and supervision of a qualified electrician, in accordance with electrical engineering standards.
- If works are required on live parts, make sure a second person is present who can switch off the main switch in the event of an emergency. Cordon off the work area with a red and white safety chain and a warning sign. Use voltage-isolated tools only.



The Emergency Stop switch shuts down the drives in an emergency situation (see [8.2 Shutdown in the event of an emergency](#)). It can be unlocked by turning it to the right.

Illustration 25 Emergency Stop switch on the P500 unit



Illumination of the individual control lamps (L1, L2, L3) indicates that all phases of the power supply are on. If one or more of the control lamps does not light up, there is a fault to the switch cabinet's power supply.

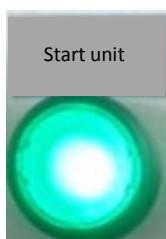
Illustration 26 Optical phase display

9.4.1 Starter unit



The unit's starter unit has the following illuminated pushbuttons:

Illustration 27 Starter unit



Starts when the unit is activated

The optical functions:

Illuminated button is flashing	=>	unit is in the starting procedure
Illuminated button is flashing	=>	unit is in standard operating mode

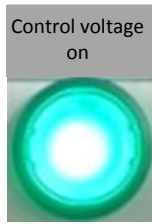
Illustration 28 Start unit



Activation triggers operational shutdown
(see [8.3 Operational shutdown](#))

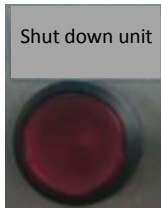
The optical functions:

Illustration 29 Shut down unit



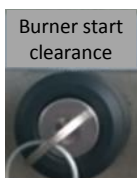
The unit becomes electrically live when activated.
This illuminated button is the first to be activated. If the button does not light up, the unit cannot be started.

Illustration 30 Control voltage on



The optical functions:
Illuminated button is flashing => unit has a fault
Illuminated button is flashing => unit is in standard operating mode

Illustration 31 Shut down unit



This key switch starts the pilot burner during the unit's starting procedure

Illustration 32 Burner start clearance



Short-term, active bypass of the safety chain
To be activated only in the event of
[13.3.2](#) 12.4.2 Calculation of feeding screw' conveying capacity

Illustration 33 Pressure monitor bypass



WARNING

Bodily injury resulting from failure to observe the operating manual

If the safety chain is programmed for temporary active bypass by activating this button, serious injury may occur if the measures prescribed in this operating manual are not observed.

➤ Read the operating manual.

9.5 Program-controlled Unit Operation

9.5.1 General information

A touch-sensitive screen (touch panel) is used for program-controlled unit operation. This is installed in the switch cabinet.

The touch panel is the P500's main control device.

Individual process parameters are configured by means of various entries into the panel.

All functions are selected via the start screen. This is done by tapping the icons with the fingers.

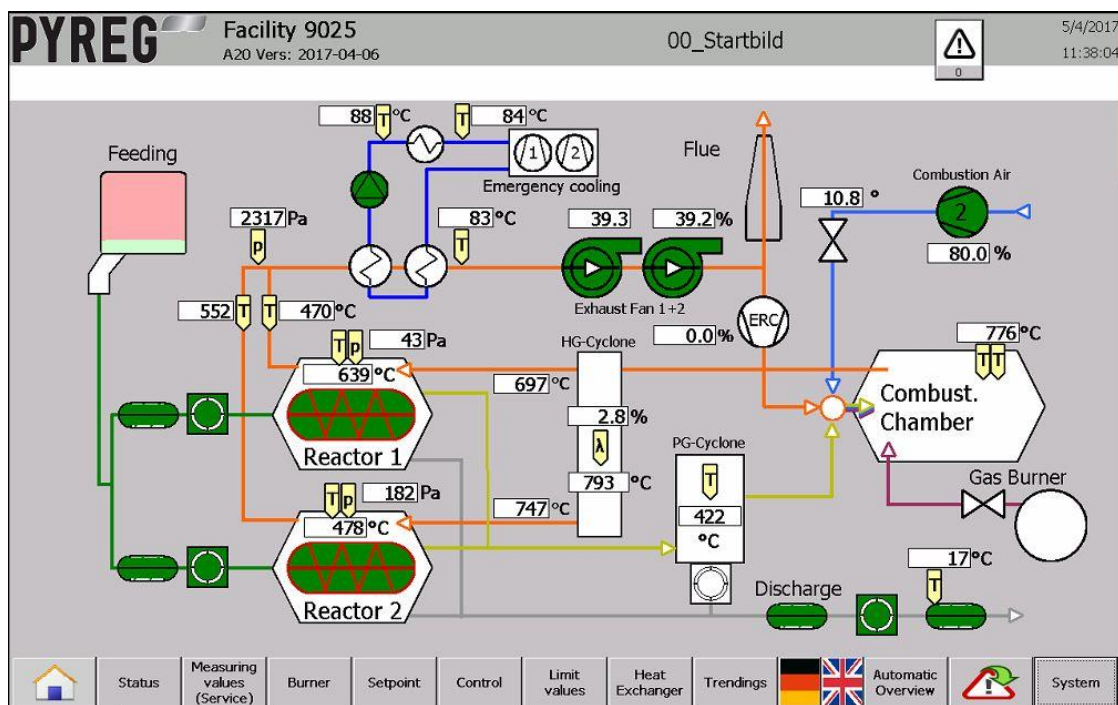


Illustration 34 Start screen



CAUTION

Material damage resulting from use of hard objects

Use of hard objects (pens, pencils, fingernails etc.) may result in material damage to the touch panel.

- Operate with fingertips only.

9.5.2 Open input screen



Illustration 35 Submenu keypad

The input screen is opened by touching a number, provided that it is editable. A new value can be entered in the input screen using the numeric keypad.

The following edit functions are available:

Description	Function
↵ Enter	Confirms the value entered and applies it in the selected menu
←	Deletes the last entered item
Del	Overwrites the complete entry
Ins	Pastes to the cursor position
ESC	Exits the entry screen without saving the value

Table 11 Edit functions

9.5.3 Open drop down menu

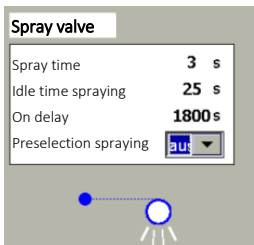


Illustration 36 Submenu

In some submenus, small arrows can be seen beside the entries.

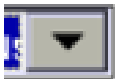


Illustration 37 Arrow

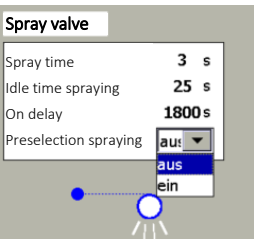


Illustration 38 Drop down menu

The drop down menu is opened by tapping the arrow. The individual selection options can now be activated by touching them.

9.5.4 The start screen

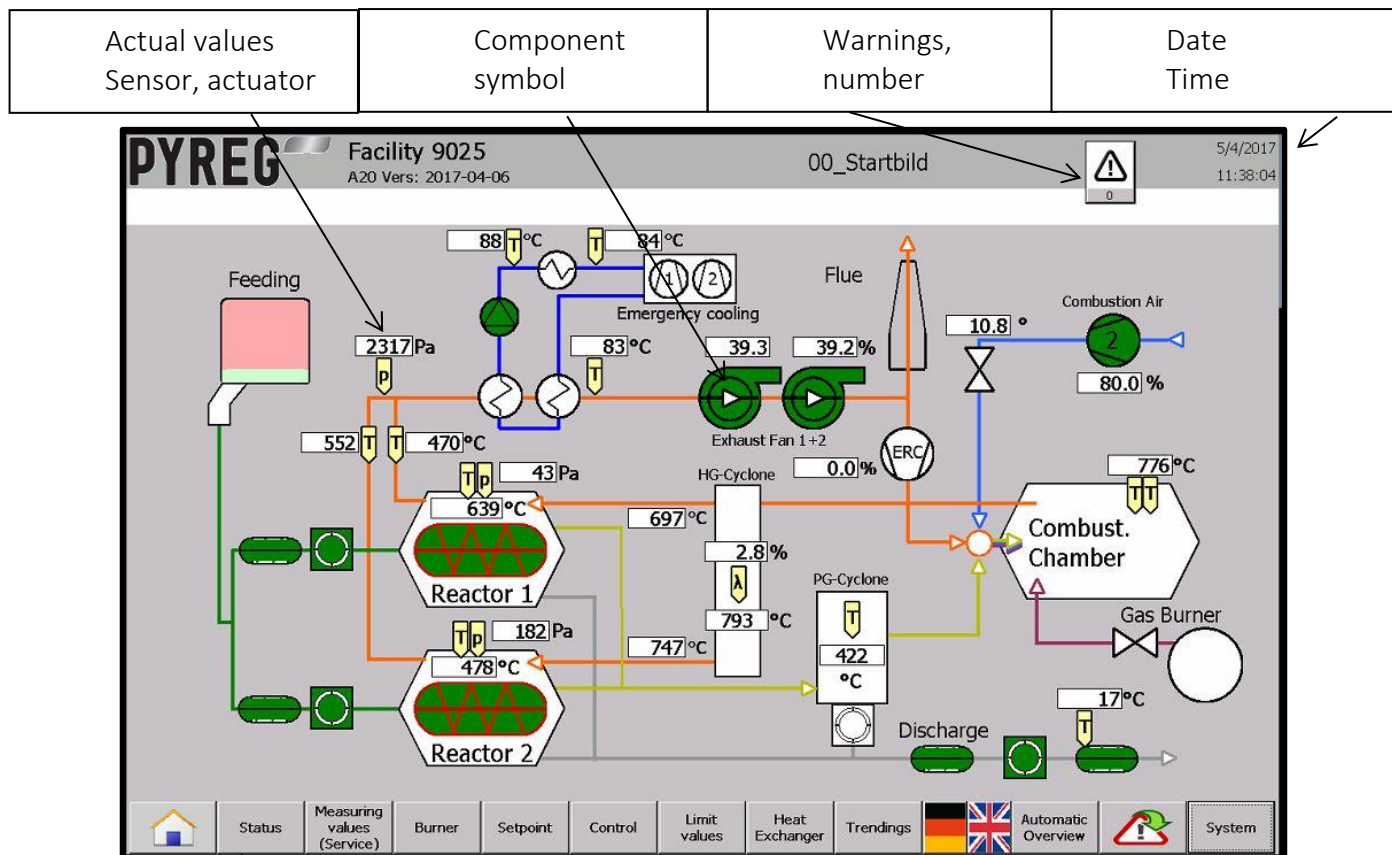
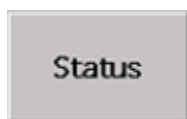


Illustration 39 Start screen

All parameters relevant to operation, e.g. pressure or temperature, are visible in the start screen.

Individual submenu items are accessed by touching the relevant component icon or fields with numerical values.

9.5.5 Status overview



The status screen is opened by touching the *Status* button in the start screen (see Illustration 39 Start screen).

Illustration 40 Status button

Facility 9025
A20 Vers: 2017-05-11

03_Status

5/12/2017
15:56:20

Everything in AUTO

System ON

System shut down

Emergency Shutdown

Normal Operation

Release Burner

Main Gas Valve

Post heating

Hot-Start Temp. reached

Belt Conveyor start delay	5 s	0 s	Feeding Screw 2 Imax Return time	1.0s	0.0 s
Belt Conveyor stop delay(Level-Sensor)	30 s	0 s	Burner flushing time	10 s	0 s
Feeding Floor On delay	5 s	0 s	Burner pre heating time	5 s	0 s
Feeding Floor overrun	5 s	0 s	Burner MIN post heating time	300 s	0 s
Reactor 1 On delay	1 s	0 s	Burner Cool down time	1800 s	0 s
Reactor 1 overrun	1800 s	1790 s	Rotary Airlocks 1 on delay	3 s	0 s
Reactor 2 On delay	2 s	0 s	Rotary Airlocks 1 overrun	3 s	0 s
Reactor 2 overrun	1800 s	1790 s	Rotary Airlocks 2 on delay	3 s	0 s
Feeding Screw 1 On delay	4 s	0 s	Rotary Airlocks 2 overrun	3 s	0 s
Feeding Screw 1 Overrun	4 s	0 s	Rotary Airlock overrun	1800 s	0 s
Feeding Screw 1 Imax Return time	1.0 s	0.0s	Cole conveyor screw overrun	1800 s	0 s
Feeding Screw 2 On delay	4 s	0 s	Spray Valve spray time	1 s	0 s
Feeding Screw 2 Overrun	4 s	0 s	Spray Valve idle time	10 s	10 s

System Start

System Stop

Fault Acknowledge

Reset Emerg. Shutdown

Status
Measuring values (Service)
Burner
Setpoint
Control
Limit values
Heat Exchanger
Trendings

Automatic Overview

System

Illustration 41 Status screen

The values in the status screen show the unit's current operating state. The active functions are shaded here in green. The meanings of the individual touch surfaces are listed below:

Description	Program sequence/mode
All automatic	All actuators are in automatic mode.
Unit on	The unit is switched on.
Unit shutting down	The unit is in shutdown mode; if not an emergency shutdown, then: Sliding floor coming out. Feed worms stop. Reactors run dry for the configured time and then stop. Discharge screw, rotary valves, screws and extinguisher are operational until the unit is switched off. The unit is shut down after the configured time has expired.
Emergency shutdown	The unit switches to safe shutdown mode; the unit is run dry (or not, depending on the reason for the fault).
Standard operation	The burner chamber temperature exceeds the start-up temperature and is less than 1300°C. Additionally, all actuators are operational.
Burner enabled	The key switch to enable the burner is switched on, the system is switched on and there are no faults present.
Main gas valve	The main gas valve is opened and the burner is started.
Reheating	Reheating selection is activated and the combustion chamber and reactor temperatures have fallen below the configured limit values.
Hot start temperature reached	The temperature of the combustion chamber is higher than the hot start temperature and the temperature of the reactors also exceeds their hot start temperature.

Table 12 Message alerts in the status screen

Reactor 2 stopping	1800 s	1730 s
--------------------	--------	--------

Illustration 42 Set-point values column display

The various time sequences and throughput times can also be viewed in this menu. The left column highlights the configured set-point values, while the actual value is indicated in the right column.

9.6 Unit Start-up

The operating parameter settings described in the following section must be checked before starting up the unit.

9.6.1 Combustion air fan

9.6.2 Oxygen valve

9.6.3 Lambda temperature control

9.6.4 Combustion chamber/reactors hot start temperature

9.6.5 Start-up temperature

9.6.6 Oxygen value

9.6.7 Feed material

The operating parameters' values are very much dependent on the fuel employed. These must be readjusted in the value ranges numbered here for an optimal process.



DANGER

Danger to life resulting from incorrectly configured parameters

Failure to observe the operating parameters indicated here can result in severe injuries caused by deflagration.



- The operating parameters defined in this operating manual must be strictly adhered to in order to prevent this risk.

The operating parameters are selected via the control system's start screen.

9.6.1 Combustion air fan

The combustion air fan's rotational speed can be adjusted via the frequency and determines the quantity of combustion air.

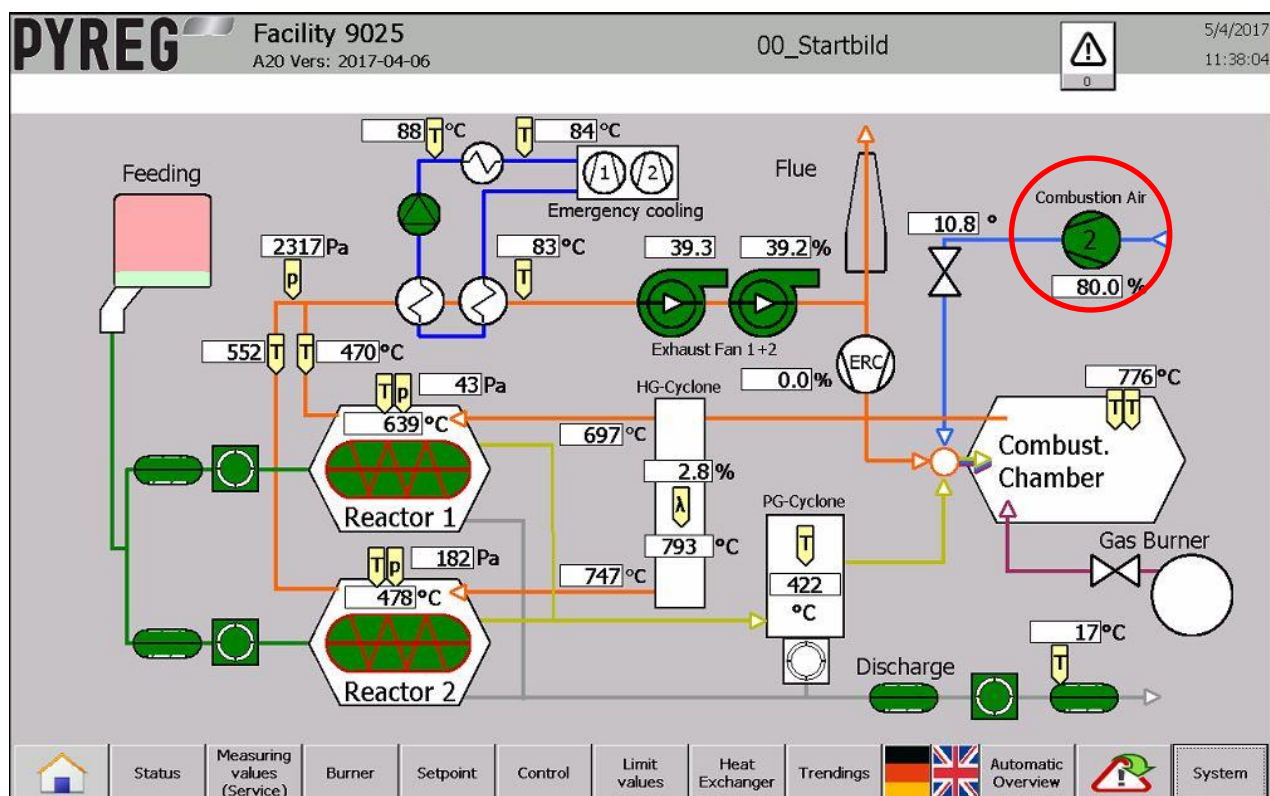
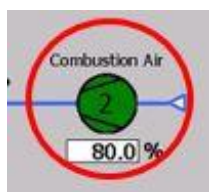


Illustration 43 Start screen 01



By tapping the icon for the combustion air fan, highlighted in red in the illustration above, the user is taken to the air supply submenu. This menu is illustrated in [Illustration 45 Combustion air submenu](#).

Illustration 44 Combustion air icon

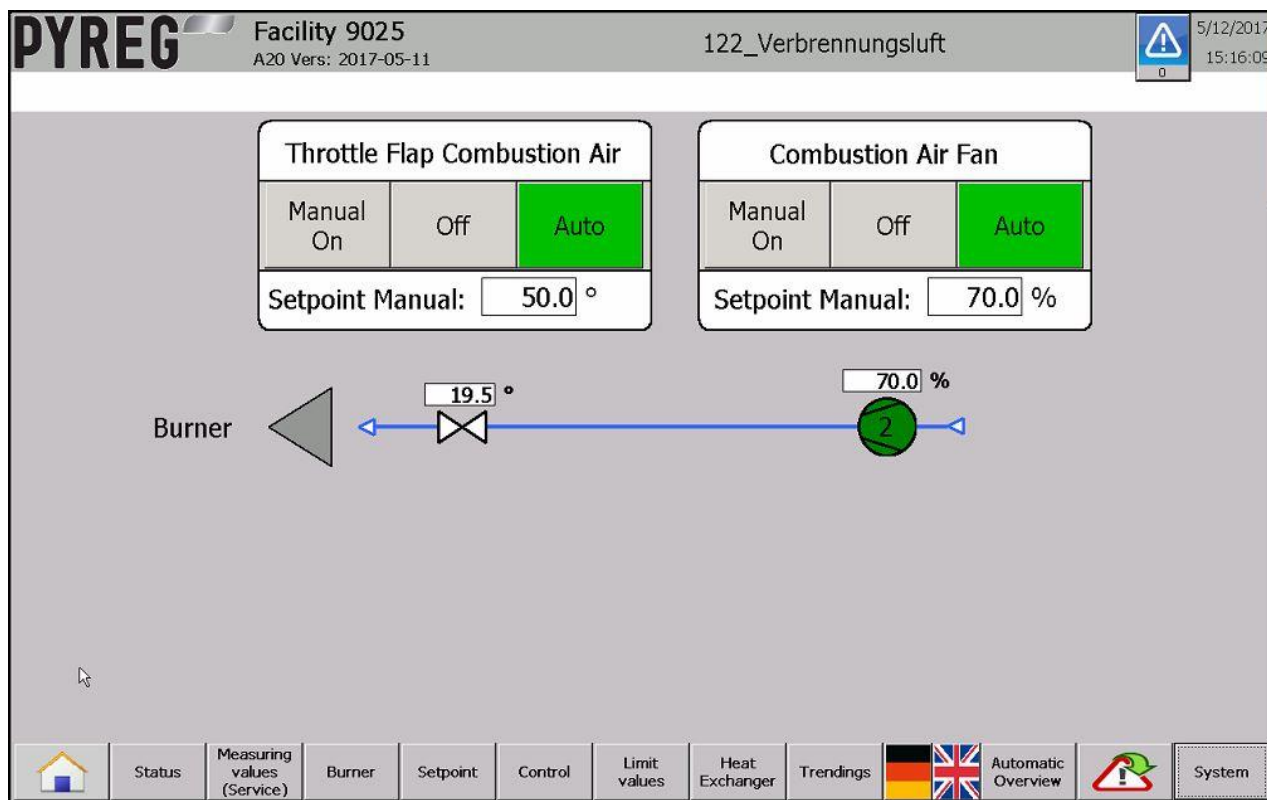
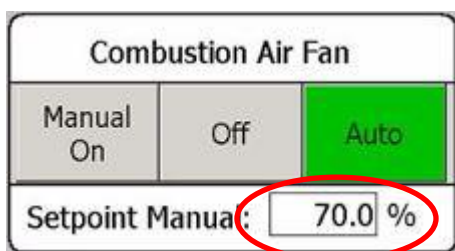


Illustration 45 Combustion air submenu

The “manual set-point value” for the fan is located under the input screen for combustion air fan 2. A keyboard is displayed when this field, marked red, is tapped. Enter the set-point value here and confirm with ↵ Enter.



The set-point value for starting up the unit should be between 65% and 75%, depending on gas quality.

Illustration 46 Manual set-point value



NOTE

Recommended set-point value: 70%

9.6.2 Oxygen valve

In addition to the rotation speed of the combustion air fan, the air supply for starting the pilot burner can be configured at the angular position for the oxygen valve.

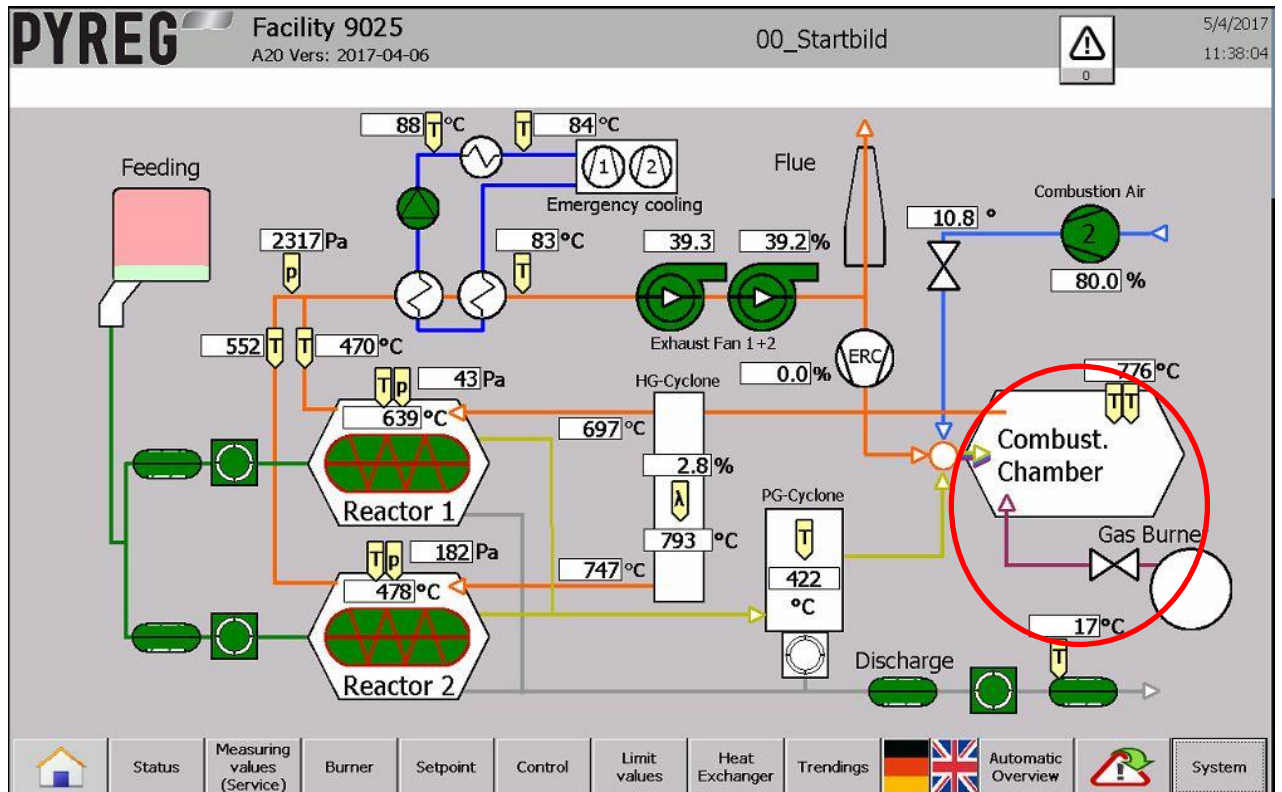


Illustration 47 Start screen 02

This value is configured in the submenu for burner configuration. This is reached via the "Burner" menu item.

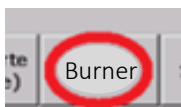


Illustration 48 Burner menu selection

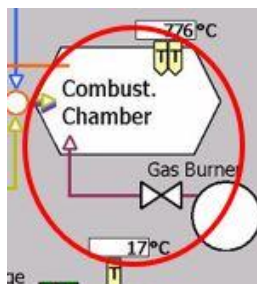


Illustration 49 Burner icon

Or by tapping the burner icon, each marked in red.

The submenu for burner configuration is shown in the illustration below. The field for adjustment of the oxygen valve at burner start-up has been highlighted in red.

For further information on the burner menu see [9.10.1 Burner menu](#) , Page - 100 -

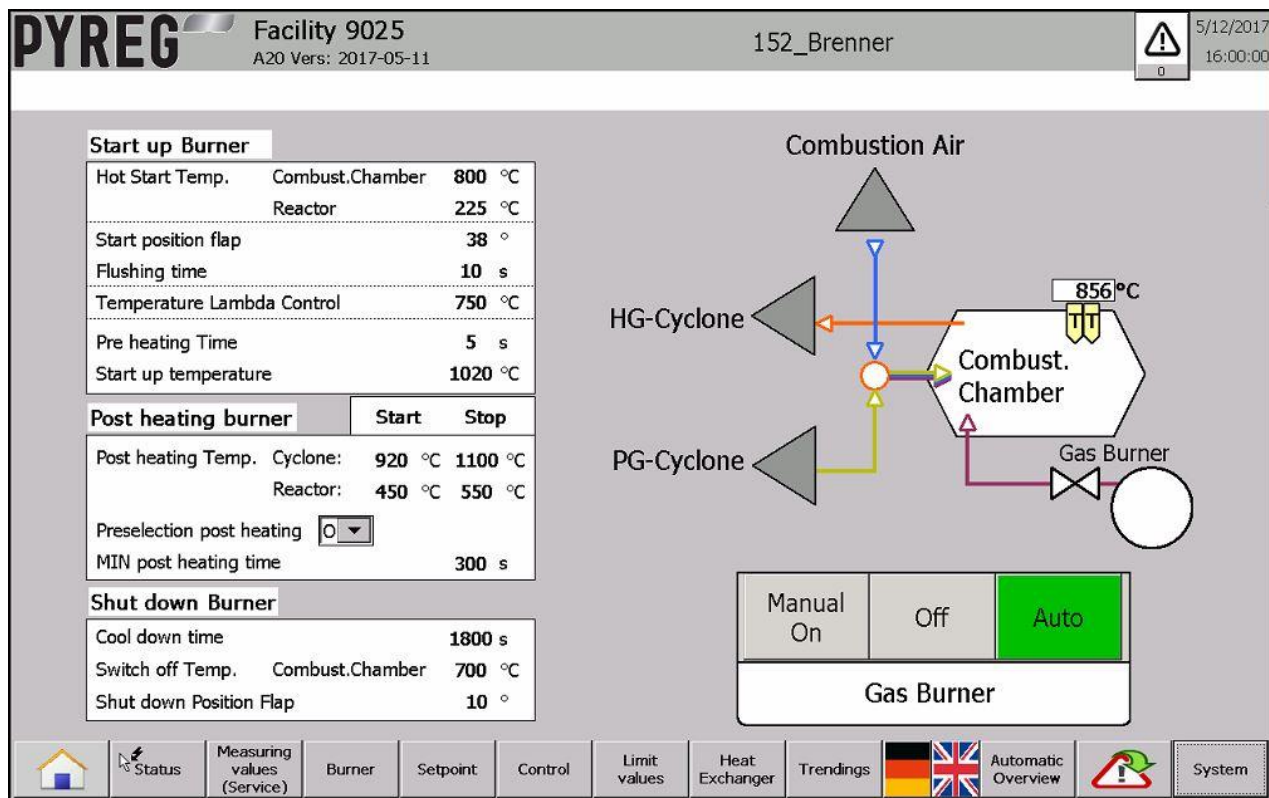


Illustration 50 Burner screen



An input window opens when this value is selected.

Illustration 51 Valve start-up position

The set-point value is entered and confirmed with ↵ Enter.

The set-point value for starting the burner is between 25° and 40°, depending on gas quality.



NOTE

Recommended set-point value: 37°



NOTE

CAUTION: Ensure that the oxygen value does not fall below 1 due to the valve position during start-up. It must be readjusted manually if necessary.

The oxygen value of 1 can be viewed in Illustration 47 Start screen 02.

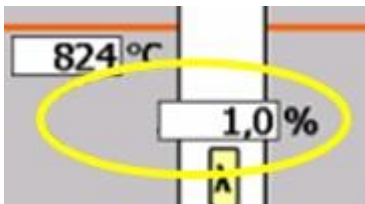


Illustration 52 Oxygen value

9.6.3 Lambda temperature control

The value configured in [9.6.2 Oxygen valve](#) is maintained until the configured temperature for lambda control is reached.

When this temperature mark is exceeded, the unit's automatic lambda control system assumes control of the oxygen valve and configures it according to the set-point value. When the temperature falls below this, the valve readjusts according to the value entered.

The lambda controller's starting temperature can be controlled via the burner as described in [9.6.2 Oxygen valve](#).

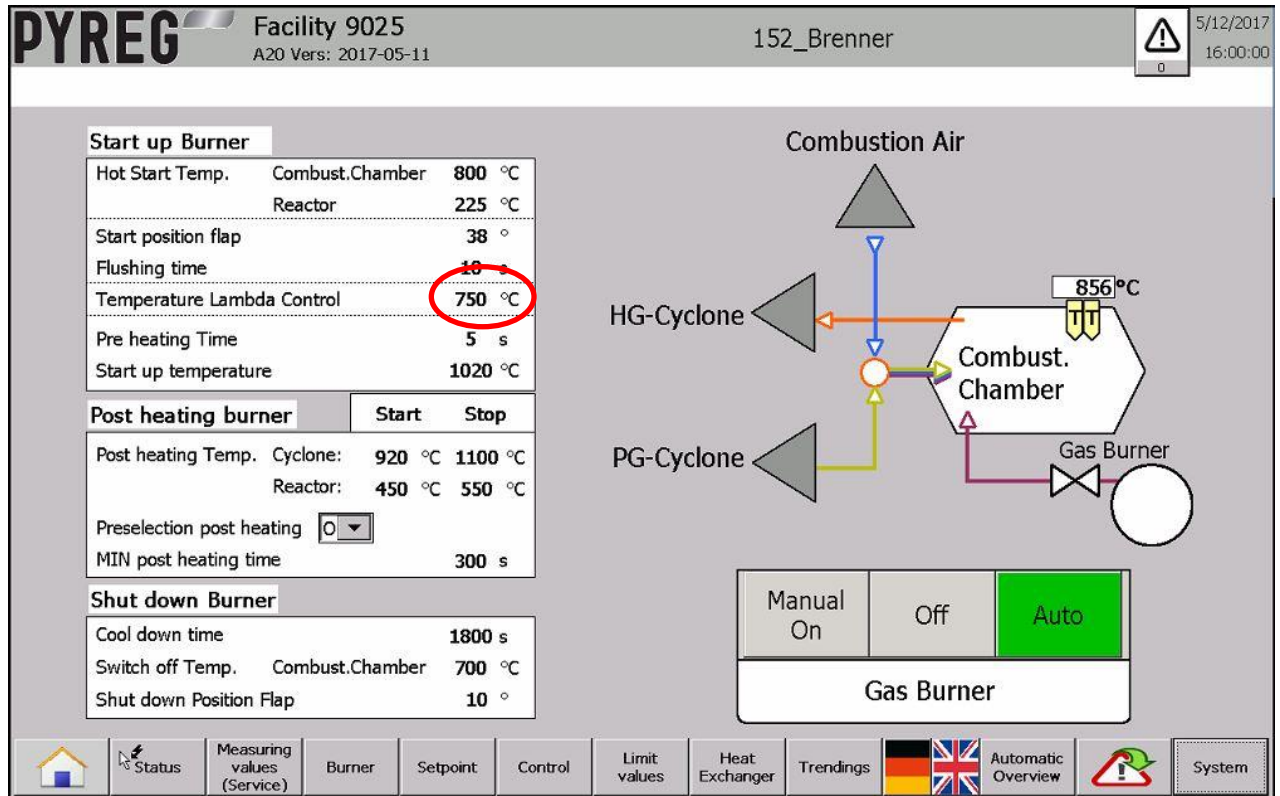


Illustration 53 Burner screen

Flushing time	15 s
Temperature Lambda Control	750 °C

Illustration 54 Temperature Lambda Control

An entry screen is opened by selecting the "Temperature Lambda Control" field highlighted in red, in which the set-point value can be configured and confirmed with ↵ Enter.



NOTE

Recommended set-point value: 750°C

9.6.4 Combustion chamber/reactors hot start temperature

As soon as the hot start temperatures of the reactors and combustion chamber are exceeded, the system begins throughput of material. These temperatures can be configured in the burner submenu, which is reached as described in [9.6.2 Oxygen valve](#).

Illustration 55 Burner screen

Illustration 56 Temperature setting

By tapping the relevant value, an entry window is opened in which the set-point value can be configured. This must be confirmed using ↵ Enter.



NOTE

The minimum value for the hot start temperature

- is **900°C** for the combustion chamber.
- is **400°C** for the reactor.



CAUTION

Material damage resulting from incorrectly configured minimum values



If manual adjustment results in hot start temperature values for the reactors and the combustion chamber falling below the minimum values, significant material damage to the unit may result.

- It is imperative that the minimum values provided here are adhered to.

9.6.5 Start-up temperature

The start-up burner switches itself off when the configured start-up temperature is exceeded during heating. The start-up temperature can be configured in the burner submenu. This can be accessed as described in [9.6.2 Oxygen valve](#).

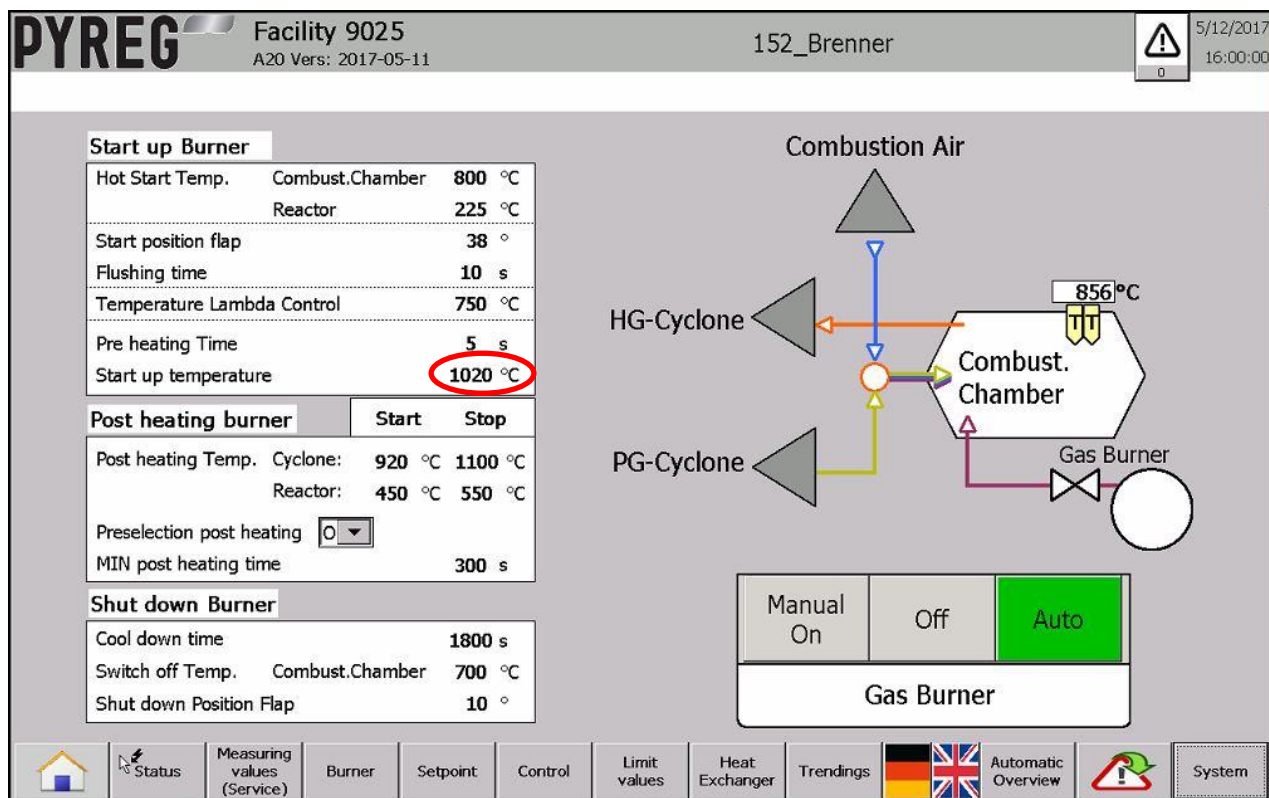


Illustration 57 Burner screen

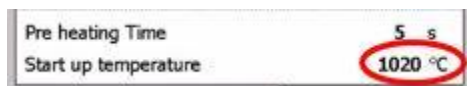


Illustration 58 Start-up temperature

When the value for the start-up temperature (highlighted in red) is selected, an entry window opens in which the limit value can be entered and confirmed with ↵ Enter.



NOTE

The minimum value for the start-up temperature is 1050°C.

It is important to monitor that the temperature is configured so that the PYREG process runs autonomously after the start-up burner is shut down and that temperatures do not drop dramatically after shutting off the start-up burner.

9.6.6 Oxygen value

When “*Lambda temperature control*” is exceeded, the oxygen value controls the oxygen valve and, thus, regulates the quantity of oxygen supplied to the combustion. The set-point value for the oxygen value can be adjusted under the “*set-point values*” menu item in the lower menu bar.

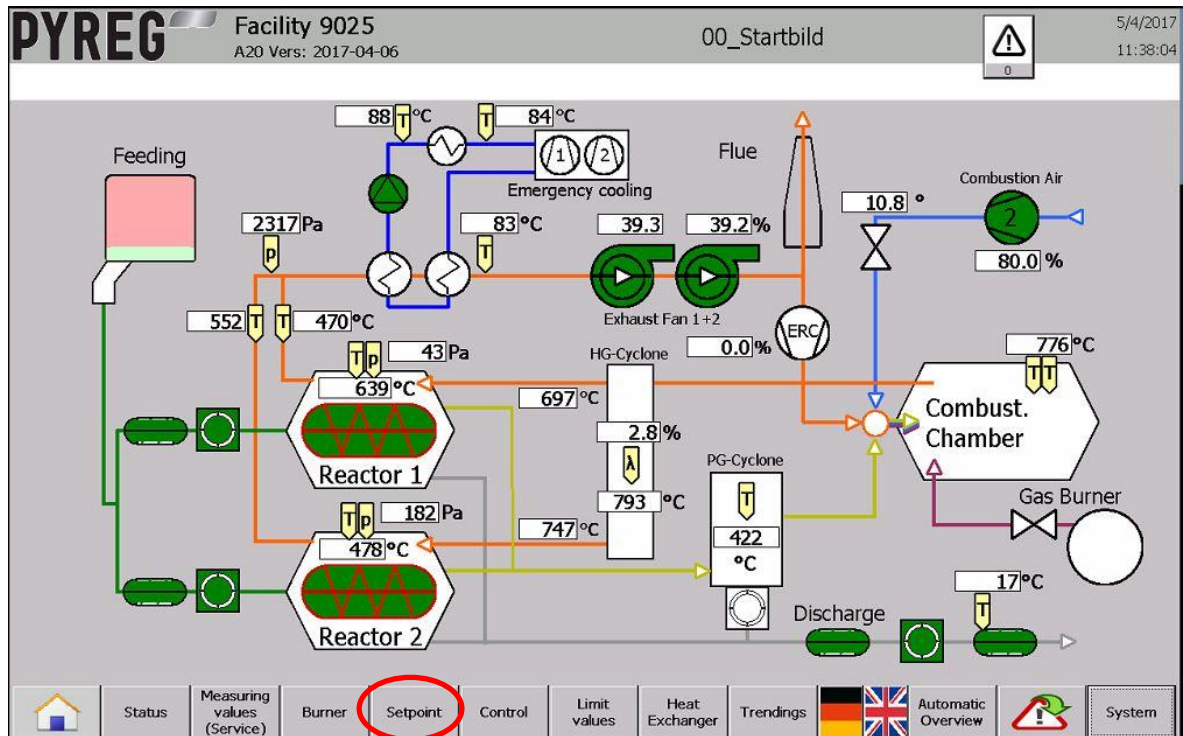


Illustration 59 Start screen

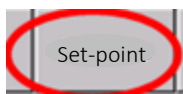


Illustration 60 Set-point value control surface

When the "Set-point values" touch surface is selected, the window shown opens for the set-point values.

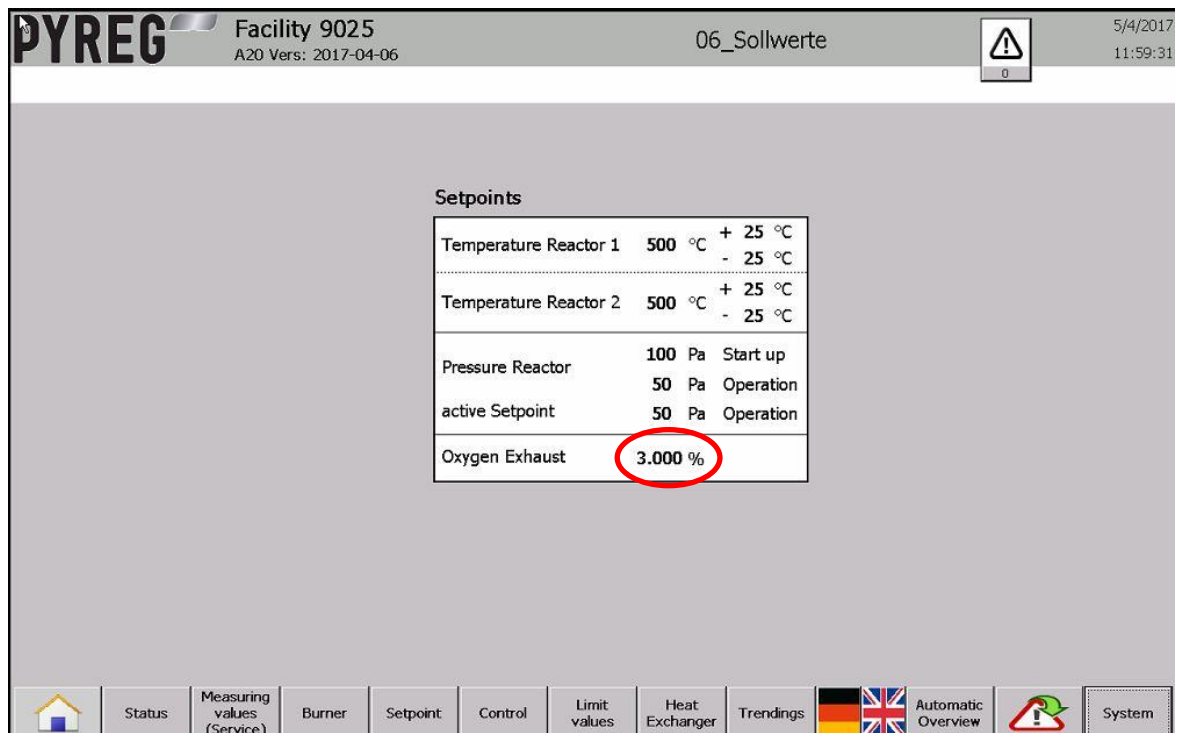


Illustration 61 Set-point value screen



When "Oxygen Exhaust value" is selected, an entry window opens in which the set-point value can be entered and confirmed with ↵.



NOTE

The set-point value for start-up is 3%.



NOTE

It is important to ensure that this value is not reduced to under 1% in normal mode.

9.6.7 Feed material start-up

The feed quantity can be configured in the feeding screw submenu.

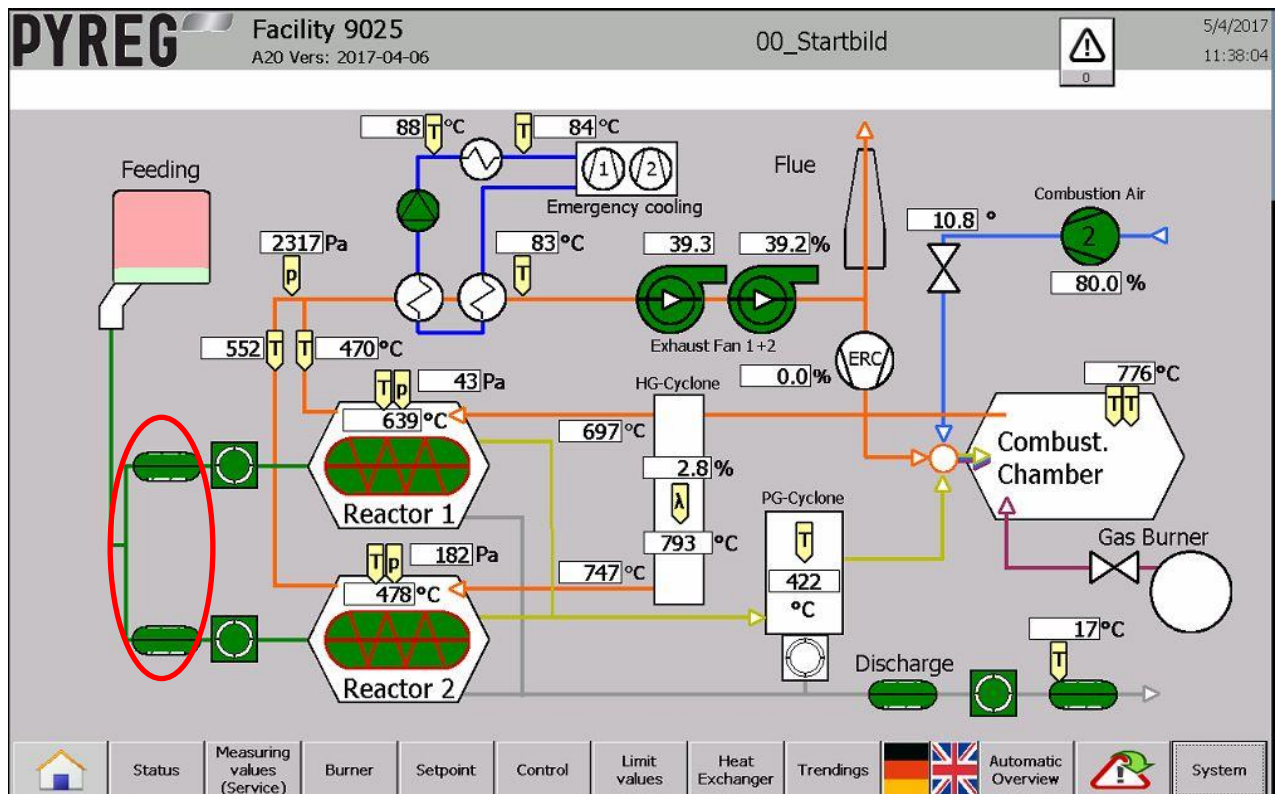
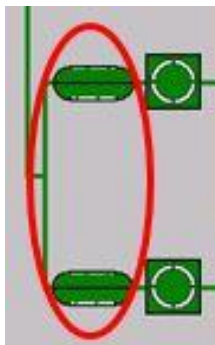


Illustration 62 Start screen



This is reached by tapping the feeding screw icon, highlighted here in red.

Illustration 63 Feeding screw

Various settings can be configured in the feeding screw submenu.

Feeding Screw 1

On Delay	4 s Act.		
Overrun time	4 s	Stop time	0.3 s
Imax reverse time	1.0 s	ON Time	0.0 s
	A ○	B ○	C ●
Cycle time	10.0 s	10.0 s	10.0 s
ON Time	3.0 s	5.5 s	2.0 s

Feeding Screw 2

On Delay	4 s Act.		
Overrun time	4 s	Stop time	0.3 s
Imax reverse time	1.0 s	ON Time	0.0 s
	A ○	B ○	C ●
Cycle time	10.0 s	10.0 s	10.0 s
ON Time	3.0 s	5.5 s	2.0 s

Feeding → Rotary Airlocks 1+2

Manual On Off Auto

Manual On Off Auto

Feeding Screw 2

Navigation bar: Home, Status, Measuring values (Service), Burner, Setpoint, Control, Limit values, Heat Exchanger, Trendings, Automatic Overview, System

Illustration 64 Feeding screw submenu

	A ○	B ○	C ●
Cycle time	10.0 s	10.0 s	10.0 s
ON Time	3.0 s	5.5 s	2.0 s

As shown in the illustration, the feed is split across three programs: A, B and C.

Illustration 65 Feeding screw programs

Switching for these programs is based on the reactor's current temperature. The programs serve primarily to start up the unit, as the feed can be increased to a maximum slowly and according to temperature.

Selection of each program is dependent upon the reactors' operating temperature. The letters here stand for the following operating phases:

- A => Temperature within set-point range
- B => Temperature too high
- C => Temperature too low

The feed begins when the temperature is raised with Program C. When the temperature increases, the feed is also increased by jumping to Program A.

As soon as the reactors' required temperature is exceeded, the feed switches to Program B and the configured feed is conveyed.

Note the capacity of the unit when configuring these values.

The initial settings are configured exclusively by PYREG employees and can only be increased following consultation with PYREG GmbH, using the same material.

The cycle time value (10 s) must not be modified by the operator under any circumstances without consulting with the manufacturer.



CAUTION

Material damage due to incorrectly configured parameters

If the parameters configured here are set too high without consulting with the manufacturer, significant material damage to the unit can result. It is also possible that personal injury may occur as a consequence.

- It is imperative that the preset values are adhered to.
- Change the values only after consultation with the manufacturer.

The maximum feed quantity conforms to the material's characteristics. The dry matter content and calorific value are the crucial elements in this regard.

This means that these variables must be recalculated in the event of a change in material (see [13.3 Definition of unit parameters](#)). This should be performed only after consulting with the manufacturer.

For consultation, please contact:

Trinkbornstrasse 15 – 17
D- 56281 Dörth
Tel.: +49 (0) 6747 95388 – 0
Email: service@pyreg.de

9.6.8 Starting the unit

When the unit is started up, all of its gas-carrying components are preflushed with air in a time-controlled manner (safety time relay) before the igniter is started in order to prevent the burner from igniting in a potentially explosive atmosphere.

The main burner's magnetic gas valve is opened when the igniter's safety operating signal contact is closed, the safety chain is positive and there are concurrent main burner requests from the PLC and the key switch. The igniter's placement in front of the pilot burner ensures safe ignition in all operating conditions.

If the igniter or an element of the safety chain breaks down, the burner control device's operating signal contact is opened and gas supply to the igniter and main burner is suspended.

The unit performs a safety shutdown (8.3 Operational shutdown). Monitoring of the igniter's flame signal thus serves to directly monitor the main burner.

The unit can be started after checking the set-point values.

The two “Acknowledge fault/combined fault” and “Pressure monitoring start bypass” buttons are pressed and held down simultaneously in order to do this.



Illustration 66 Button on switch cabinet

Allow the “Start unit” illuminated button to flash at least 10 times.
Up to 15 start attempts are required after a unit shutdown.

There must be no additional faults displayed on the start screen after the unit is started.

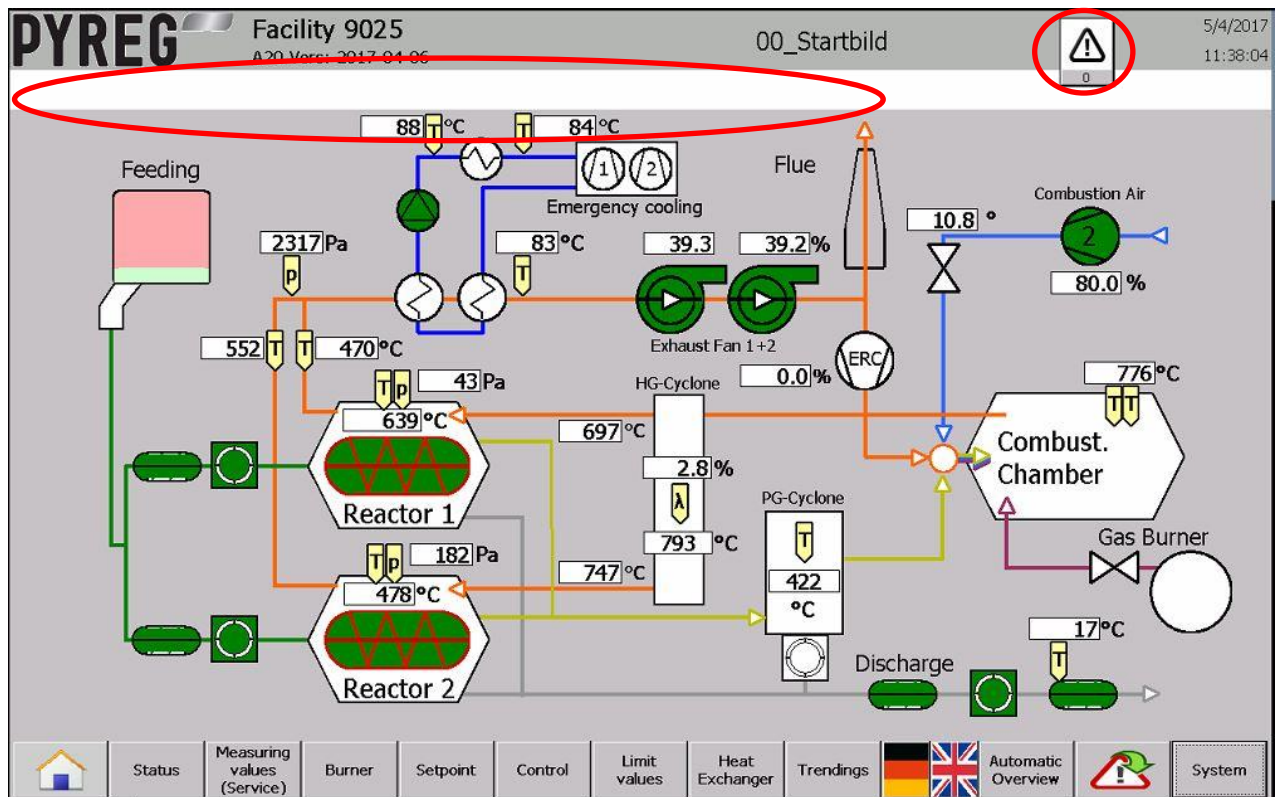


Illustration 67 Start screen

This is the case if no text appears in the message alert bar.



In addition, the number 0 is displayed below the warning triangle.

Illustration 68 Number of warnings - warning triangle

Once there are no additional message alerts, the “Start unit” button is additionally selected and all three buttons are pressed and held down simultaneously for approx. 10 seconds.



The unit starts up and the green “Start unit” button begins to flash. After the combustion chamber has been rinsed for a defined period of time, the burner starters autonomously.

Illustration 69 “Start unit” button

The pilot burner's gas/air ratio is preset as a fixed value using ball valves. The pilot burner has flame ionisation detection as well as a spark plug for electrical ignition (high-voltage ignition). There are two de-energised closed solenoid valves, pressure monitoring, a filter and a ball valve fitted upstream in the burner's gas passage in accordance with DIN 746-2.



NOTE

Gas pressure regulation, safety isolation valve for pressure monitoring and blow-off valve must be integrated into the operator's gas supply.

If, after passing through the safety chain and preflush time, a burner start request for the pilot burner is received, the burner control unit is activated. The burner control unit (Krom Schröder IFD 454, (S)) passes through the start procedure specified on the hardware when the burner is started.

9.7 Operating the Unit

The PYREG reactor generates gas from solid biomass. As the PYREG reactor's supply of gas to the main burner cannot be controlled with a valve or butterfly valve on account of the gas's composition (temperature > 500°C, dust content, tar content, etc.), the reactor's operation is activated only when the start-up temperature of the combustion chamber is reached with interaction with the safety chain. This ensures that a sustained ignition source is available in the reactor and ignites generated combustible gas components in the combustion chamber in all circumstances.

If the PYREG unit is sufficiently preheated, the pilot burner can be shut down by the PLC. The combustion chamber's energy supply is then ensured by the PYREG reactor's generated fuel gas with the FLOX® burner. If needed, in the event of insufficient gas production, FLOX® combustion can be supported by the PYREG reactor above the start-up temperature of the combustion chamber by starting the pilot burner. If the temperature falls below the FLOX® burner's operating range, the main burner is shut down.

The exhaust gas fan output, extinguishing of mineral material and unit temperatures are the main elements to be considered during operation.

After start-up, a combustion temperature of between 950°C and 1400°C is guaranteed due to the combustion chamber's permanent temperature monitoring and a redundant double thermocouple for maximum and start-up temperature. The minimum temperature can be guaranteed by restarting the pilot burner.

Insufficient temperatures outside of the start-up phase and excess temperatures in the combustion chamber trigger a safety shutdown ([8.3 Operational shutdown](#)).

9.7.1 Shutting down the main burner

The main burner's energy supply is shut down by interrupting the fuel supply to the PYREG reactor by:

- the operator
- the safety chain
- PLC.

Residual biomass for discharge continues to be moved through the reactor at reduced speed when the unit is cooling down so that approx. 30 minutes pass before gas production is stopped completely.

Operation of the FLOX® burner, monitored by the high-temperature monitor, ensures safe maintenance of the minimum operating temperature and, thus, also guarantees a minimum combustion chamber shutdown temperature of > 950°C.

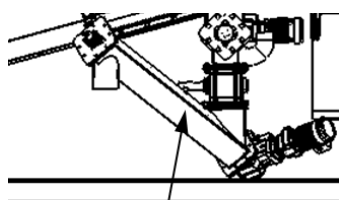
The combustion chamber's cooling gradient allows the combustion chamber temperature to fall to 750°C in approx. 45 minutes. This ensures that any residual gas that may be present is combusted safely when the reactors are shut down.

9.7.2 Restarting main burner

As long as the combustion chamber temperature is $> 1050^{\circ}\text{C}$, the main burner can be restarted immediately after a fault shutdown by starting the PYREG reactors.

If the temperature has fallen below 1050°C , restart can be performed by starting the pilot burner. The unit preflush period must be allowed for before the burner is started (PLC).

9.7.3 Extinguishing



[130] Conditioning screw

A configured time elapses, starting from the time at which the unit begins to process material. This is the waiting period until the commencement of water injection into the conditioning screw (see Illustration 2 Unit platform, [page - 25 -](#)). This period can be configured in the discharge submenu.

Illustration 70 Conditioning screw

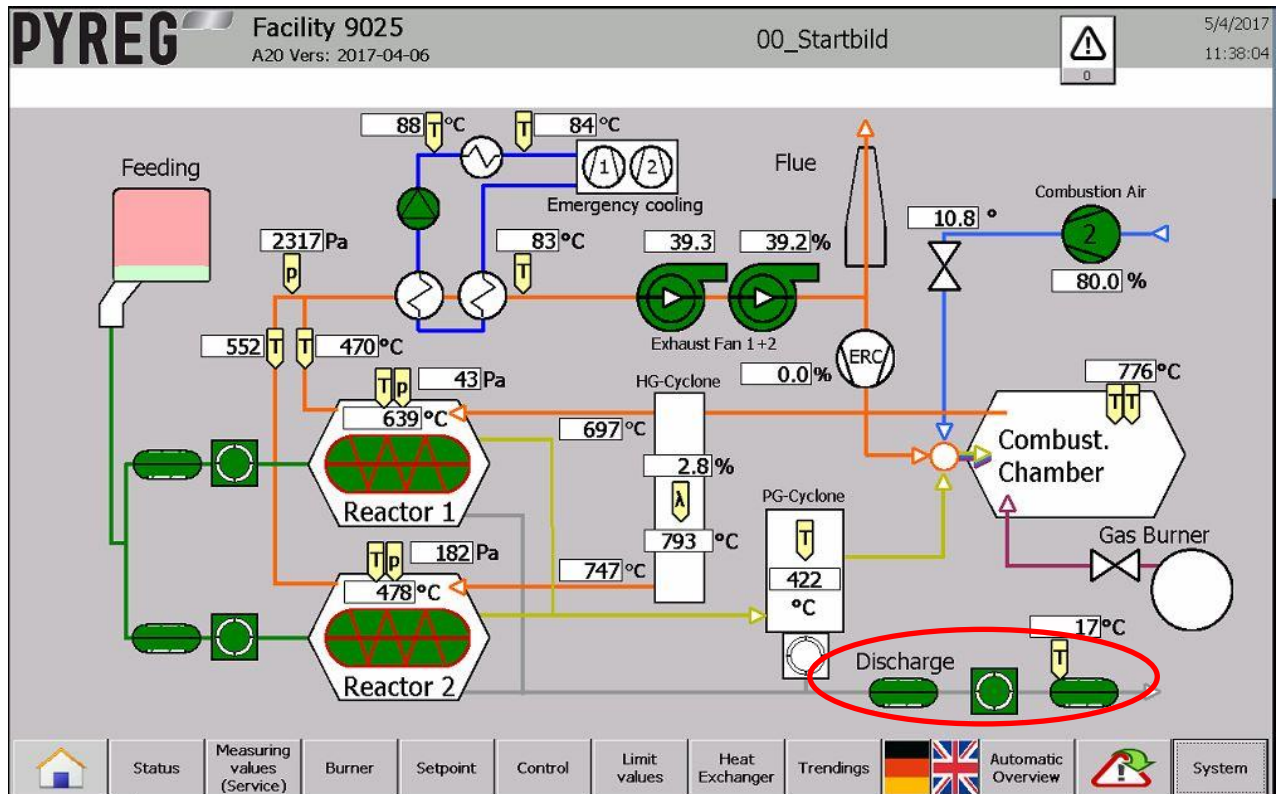


Illustration 71 Start screen



In this submenu, the start screen is reached by tapping the discharge screws.

Illustration 72 Contact surface discharge screws

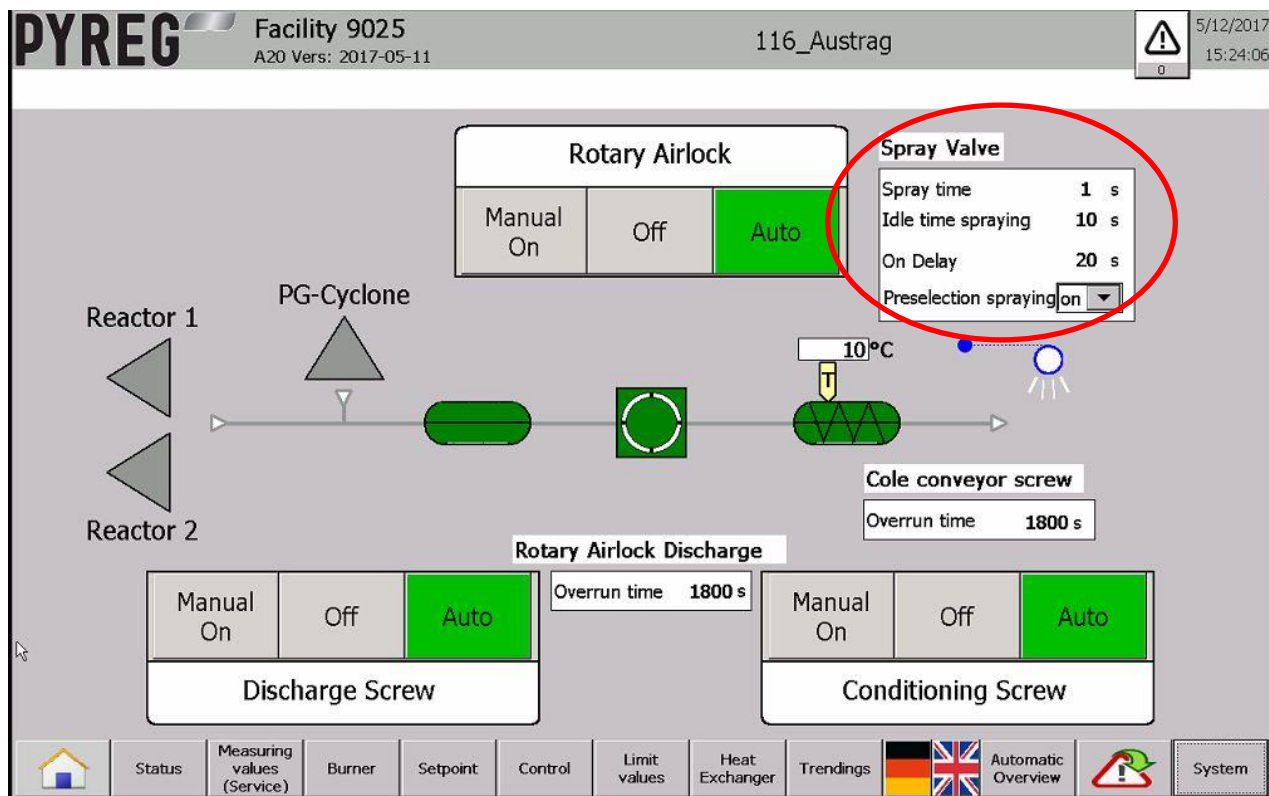


Illustration 73 Discharge screen menu



Illustration 74 Spray valve contact surface

In the illustration above, the configuration area for extinguishing of carbon is highlighted in red.

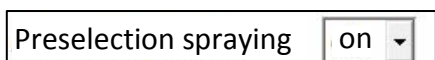


Illustration 75 Preselection spraying touch surface



Illustration 76 Spray time

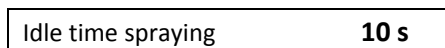


Illustration 77 Idle time spraying

Here, water injection can be turned on or off using the drop down menu under the “Preselection spraying” item.

Water injection is time-sequenced. The sprayed period can be adjusted using the “Spray time” value. The pause time is defined via the “Idle time spraying” value.

The second value, “Idle time spraying”, defines the waiting period from commencement of feed to beginning of water injection in the conditioning screw.

When the relevant value is tapped, an entry window opens in which the values can be entered and confirmed with ↵ Enter.



NOTE

The required mixture of mineral material and water must be observed when configuring these values.



CAUTION

Material damage due to inadequate extinguishing

Inadequate extinguishing can result in spontaneous combustion of material.

- Select water injection times so that the material is sufficiently cooled down.

Flue gas fan capacity – exhaust gas fan capacity must be monitored regularly during unit operation.

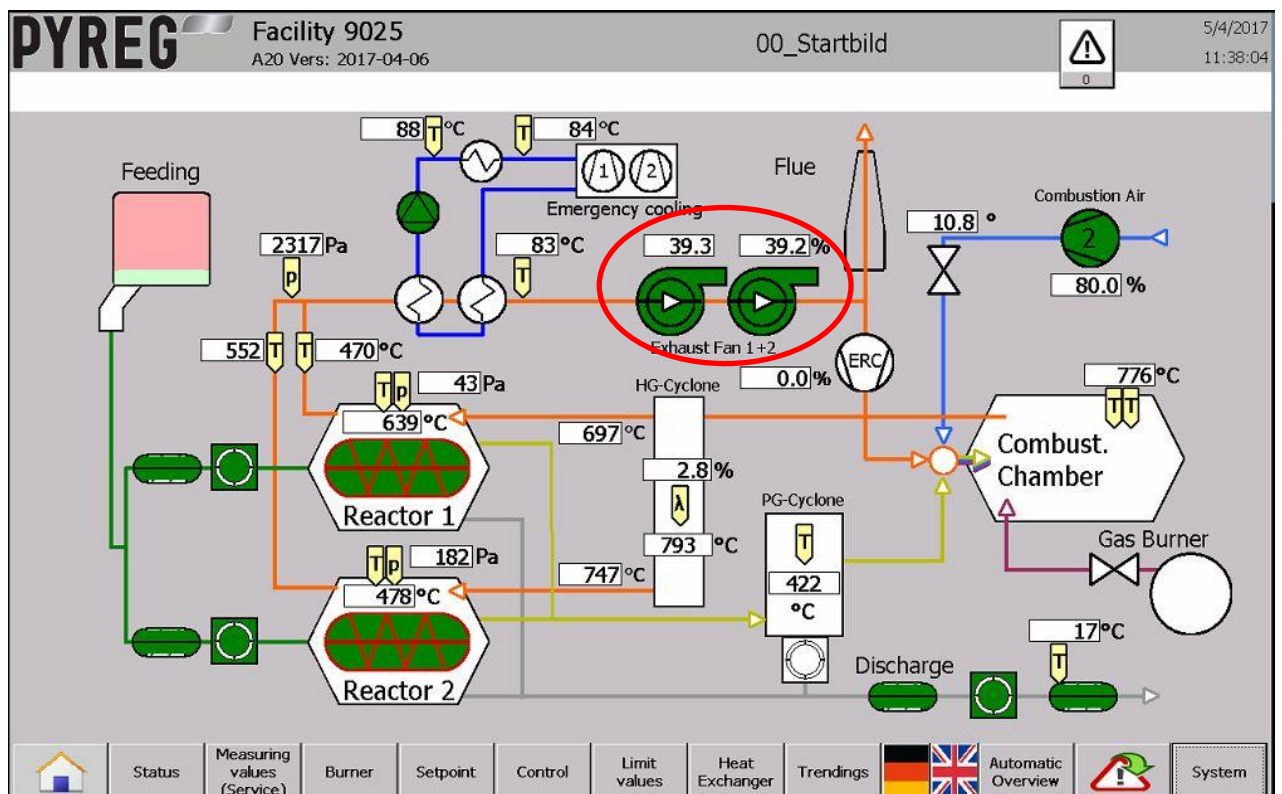


Illustration 78 Start screen



These values can be read from the start screen. The value is a percentage figure of the fan's maximum capacity.

Illustration 79 Fan capacity

Countermeasures must be taken if the fans' capacity approaches the maximum of 100%.



CAUTION

Material damage due to fan overload

If the fans are operated continuously at the upper limit of capacity, major material damage can result due to destruction of the fan.

- Prevent overload by monitoring utilisation and controlling as appropriate.

There are two options for reducing exhaust gas fan output:

- Reduction of negative pressure in the P500 unit
- Reducing fuel feed quantity

Checking negative pressure

The first option is monitoring of the configured active set-point for negative pressure.



NOTE

This should fall below the range of 30 to 100 Pa during operation.

This value can be configured and monitored in the "Set-point value" submenu, which is accessed by touching the relevant touch surface.

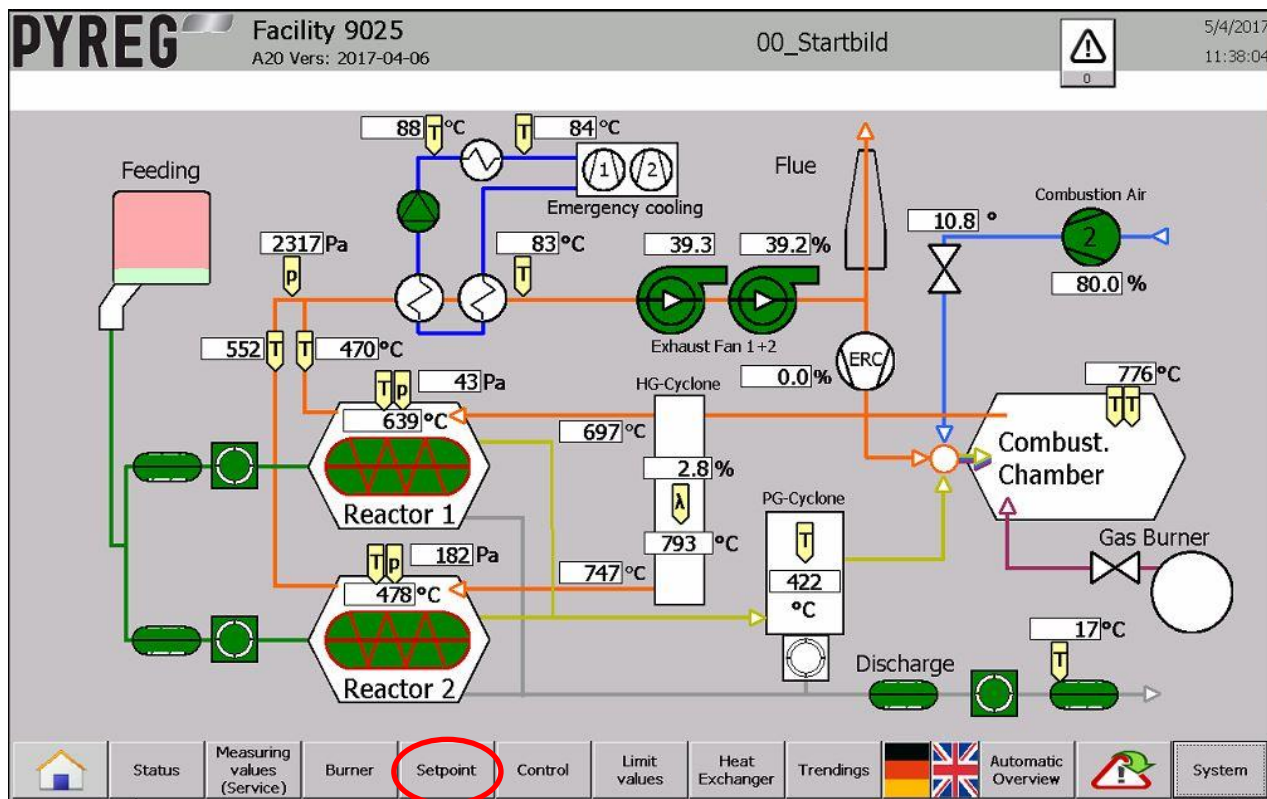


Illustration 80 Start screen



When the “Setpoint values” touch surface is selected, the window shown opens for the set-point values.

Illustration 81 Set-point values touch pad

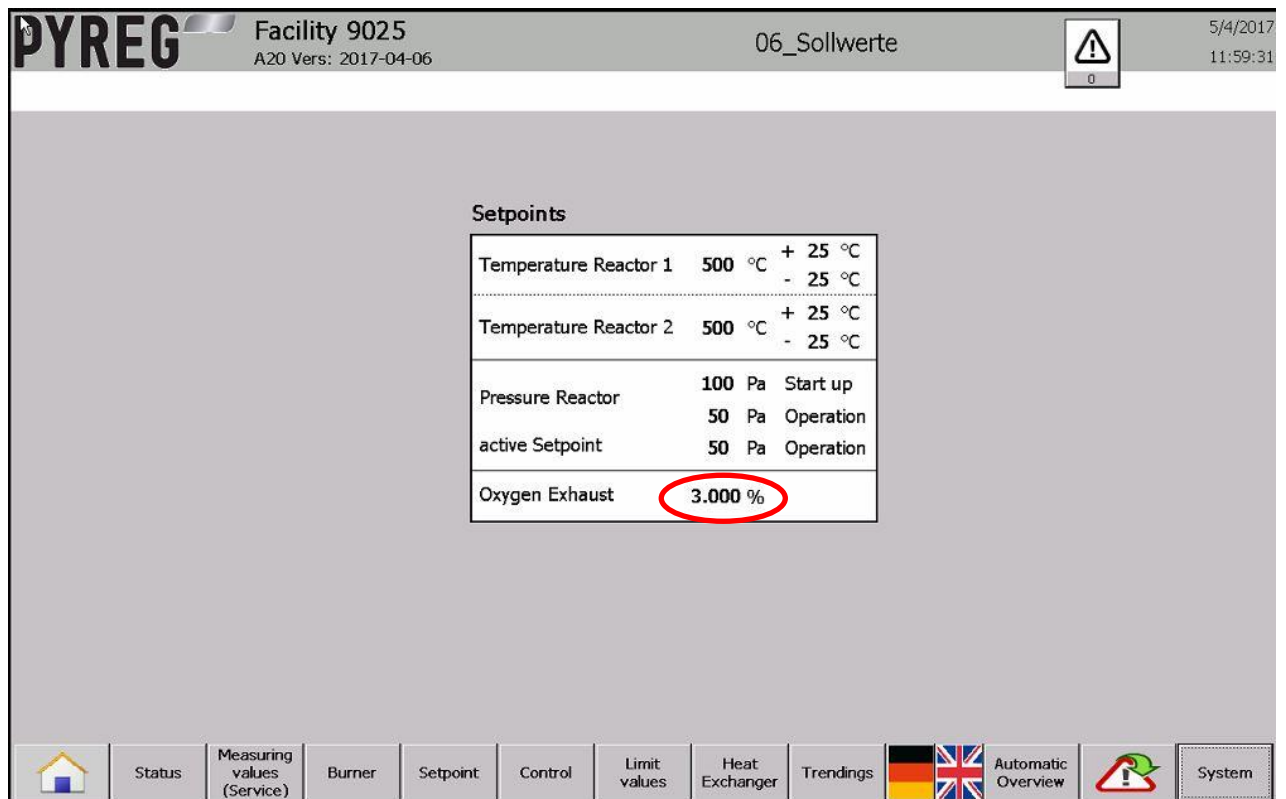


Illustration 82 Set-point values menu screen

The measurement point for the actual value of the controller is located on the reactors' feeder shaft (VEGA, VEGABAR 82). The exhaust gas fans build up the negative pressure in the unit and are regulated on the basis of the relevant active set-point value entered. There are two different set-point values. One regulates the fans for start-up operation ("Start-up") and the other regulates the pressure for operation of the unit ("Operation"). The respective active set-point value is displayed under the "Active" item. The second option for reducing fan load is the reduction of the unit's system capacity. This means that the throughput quantity and, thus, the feed must be reduced.

Reducing feed quantity

The feed quantity can be configured in the feeding screw submenu. This submenu is accessed by tapping on the icon for the feeding screw; see also [9.6.7 Feed material start-up](#).

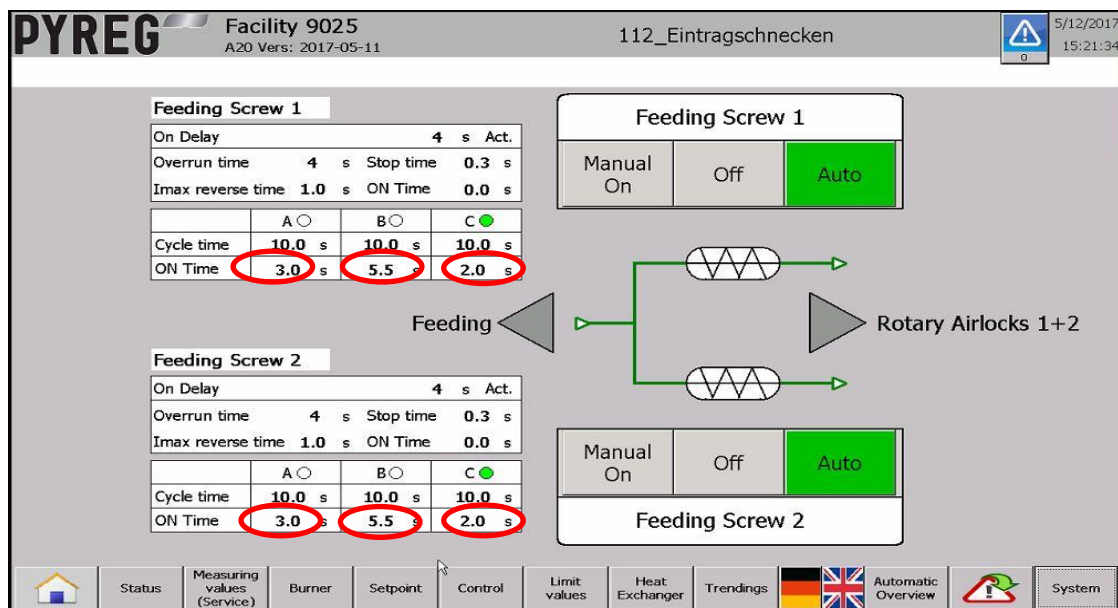


Illustration 83 Feeding Screw

In this case, the feed should be decreased in small steps. However, on account of the system's inertia, there should be at least a half hour between the individual steps so that the effects are apparent.

In addition, all feed programs should be modified.

9.7.4 Unit temperatures

The key temperatures are the hot gas cyclone temperature, the combustion chamber temperature and the reactors' temperature.

Limit values at which the unit shuts down:

Combustion chamber:	1300°C
Cyclone:	1100°C
Reactors:	800°C

It should be noted that the temperature of the combustion chamber and of the hot gas cyclone have a direct correlation.

By increasing the oxygen value and incrementing the combustion air fan's rotational speed, the temperatures of the combustion chamber and the hot gas cyclone can be reduced.

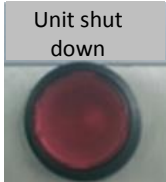
Caution: It is important to ensure that emission values are maintained during this process.

The set-point for the oxygen value is configured in the "Set-point values" submenu. This submenu is accessed by tapping the "Set-point values" touch surface in the lower menu bar. The set-point value can be adjusted under the "Oxygen exhaust gas" item in the corresponding submenu. See also 8.1.6 Oxygen value.

By tapping the icon for the combustion air fan, the user is taken to the air supply submenu. The set-point value for the fan can be adjusted under the "Manual set-point value" item for combustion air fan 2. See also 9.6.1 Combustion air fan.

The temperature of the reactors cannot be influenced directly.

9.8 Shutting down the unit



Activation triggers an operational shutdown (see [8.3 Operational shutdown](#)).

Illustration 84 Unit shut down button



CAUTION

Danger of injury from hot surfaces

In the event of unit shutdown, there remain unit surfaces with a temperature in excess of +65°C.

Burn injuries can occur as a consequence.

- Assembly, dismantling and maintenance work may not be performed in the immediate aftermath of a shutdown.
- The unit must cool down for a minimum of 12 hours.
- Protective clothing and gloves should be worn to avoid injury.

9.10 Further description of menus for operation

9.10.1 Burner menu

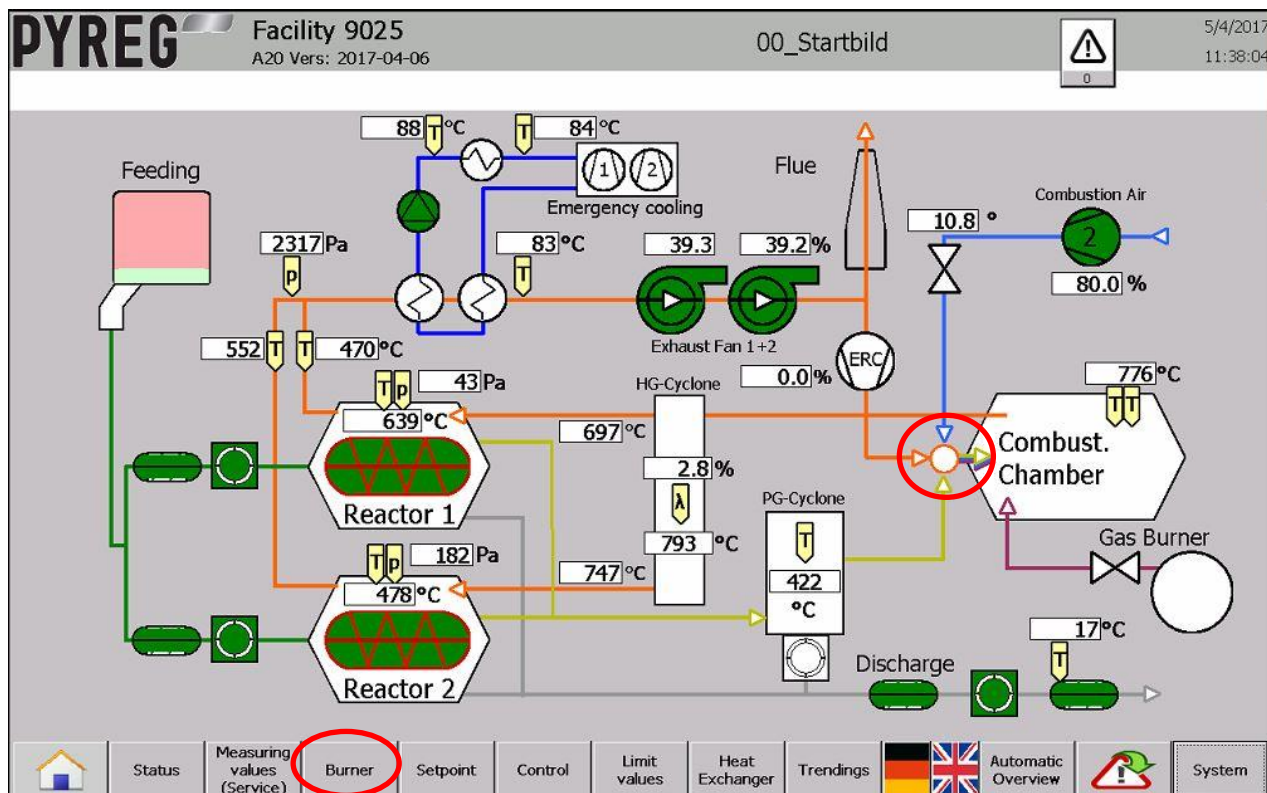


Illustration 85 Start screen

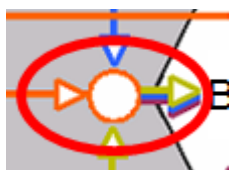


Illustration 86 Burner symbol area



Illustration 85 Burner menu button

The burner menu is accessed either via the arrow buttons for the burner's surrounding components or via the burner button in the lower menu bar.

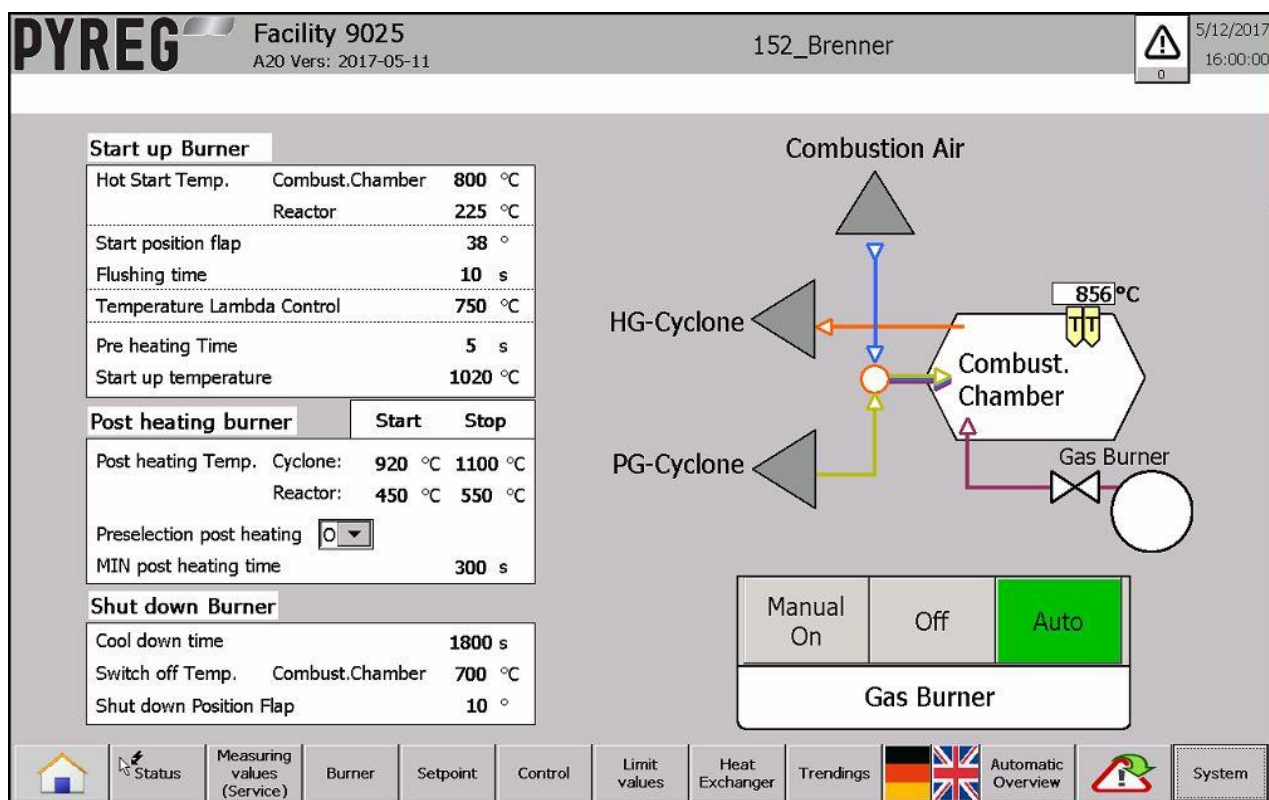
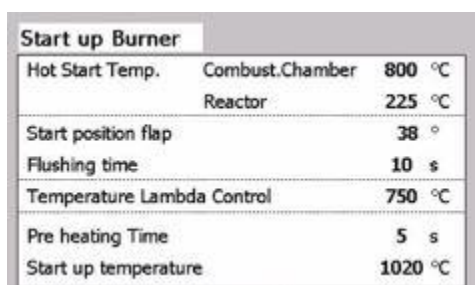


Illustration 88 Burner menu

Various parameters can be configured in the burner menu, which consists of three windows. The windows' individual functions are listed and explained below:



Burner start-up menu

Illustration 87 Burner start-up menu

Hot Start Temp.	Combust.Chamber	800 °C
	Reactor	225 °C

Illustration 88 Hot start temperature

Hot start temperature:
Clearance for feed of material is provided as soon as the configured temperatures for the reactors and the combustion chamber have been reached.

Depending on the fuel employed, the process can be started as from these temperatures.



NOTE

Temperature values cannot fall below the following lower limits during operation:

Combustion chamber: 900°C
Reactors: 400°C



CAUTION

Material damage due to incorrect parameter configuration

If values fall below lower limits, significant material damage to the unit can result.

- Adhere to the limit values provided here.
- Read the operating instructions.

Start position flap	38 °
---------------------	------

Illustration 89 Start position flap

Start position flap:
Air valve's starting angle at unit start-up.

Flushing time	10 s
---------------	------

Illustration 90 Flushing time

Flushing time:
Purge period, during which the unit is air-purged before burner clearance is given.

Temperature Lambda Control	750 °C
----------------------------	--------

Illustration 91 Temperature Lambda Control

Temperature Lambda Control:
Temperature from which the lambda control system controls the air valve setting angle.

Pre-heating time **5 s**

Illustration 92 Pre-heating time

Pre-heating time:

The minimum duration for which the burner can be operated.

Start-up temperature **1020 °C**

Illustration 93 Start-up temperature

Start-up temperature:

The burner's upper shut-off temperature.

Post heating burner		Start	Stop
Post heating Temp. Cyclone:		920 °C	1100 °C
Reactor:		450 °C	550 °C
Preselection post heating	<input type="button" value="0"/> ▼		
MIN post heating time			300 s

Post heating burner menu

Illustration 94 Post heating burner

Post heating Temp. Cyclone:	920 °C	1100 °C
Reactor:	450 °C	550 °C

Illustration 95 Post heating Temperature

Post heating Temperature:

The temperatures for the cyclone and the reactors at which the burner is started are configured under the **Start** column. The temperatures at which the burner is shut down are configured under the **Stop** column.

Preselection post heating ▼

Illustration 96 Preselection post heating

Preselection post heating:

Preselection post heating is activated/deactivated via the drop down menu.

MIN post heating time **300 s**

Illustration 97 Min. postheating time

MIN postheating time:

This time specifies how long reheating remains active, even if the upper shutdown temperature has already been reached.

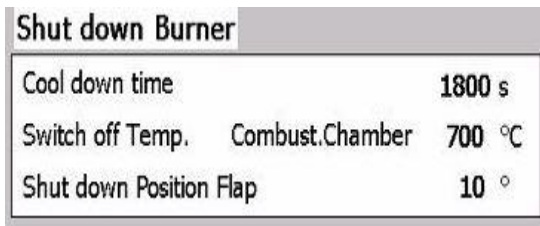


Illustration 98 Shut down Burner menu

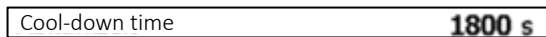


Illustration 99 Cool-down time

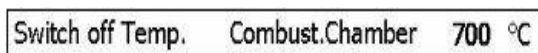


Illustration 100 Shut-off temperature

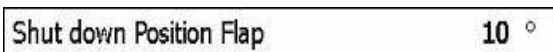


Illustration 101 Shut down position flap

Burner shutdown menu

Cool-down time:

Is the fans' stopping time after temperatures have fallen below the shut-off temperature.

Switch-off Temperature:

The temperature must have fallen below this value before the unit is completely shut down.

Shut down PositionnFlap:

The air valve's minimum starting angle at unit shutdown.

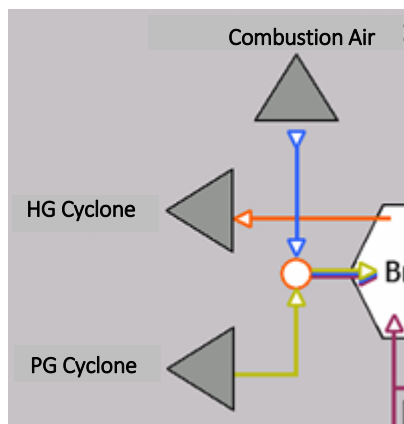


Illustration 102 Burner menu - other items

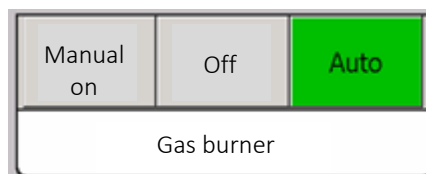


Illustration 103 Selection switch in burner menu

By tapping the grey arrow buttons, the menus for the corresponding items before or after the burner are activated.

Redundant to the automatic system overview, a switch is shown in the burner menu; this is used to switch between the three switching steps.



NOTE

For safety reasons, the "Manual on" function is disabled for the user.

9.10.2 Set-point values



This menu is accessed via the “Set-point values” button in the lower menu bar.

Illustration 104 Set-point value menu button

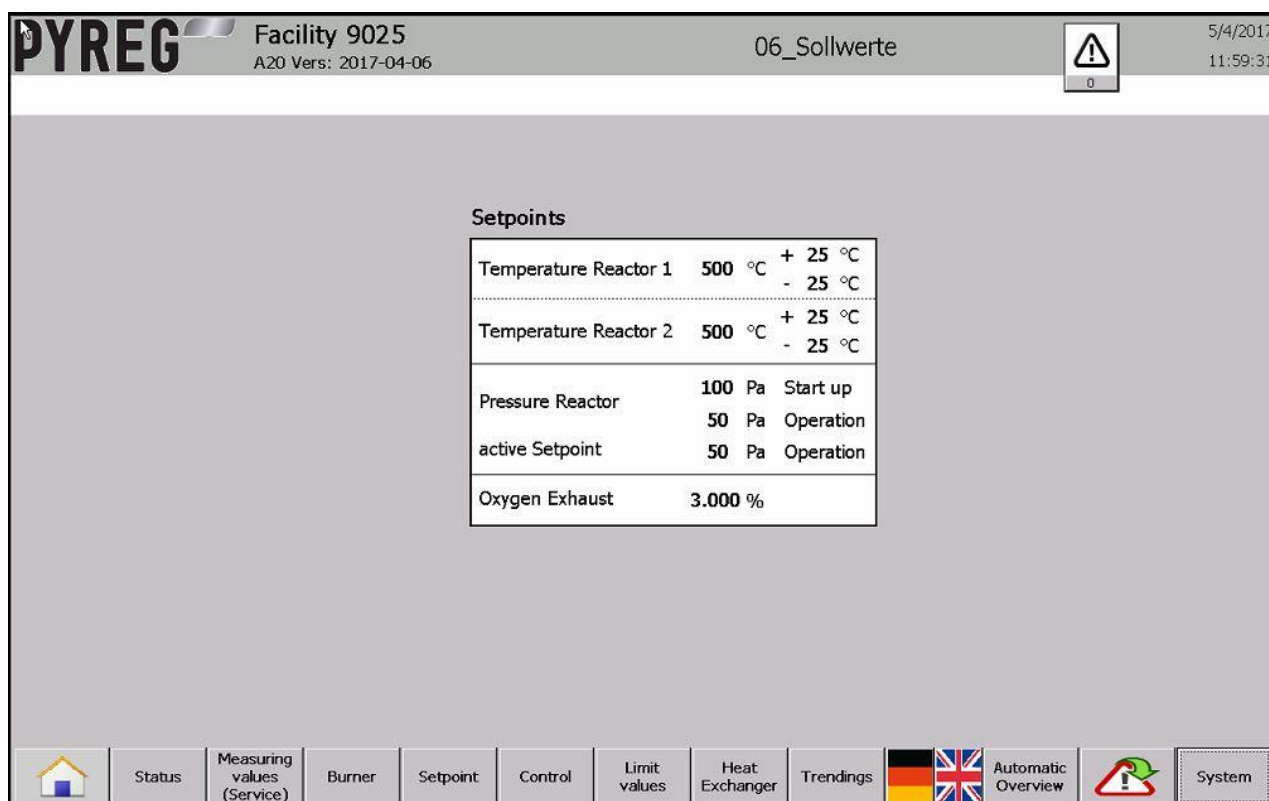


Illustration 107 Set-point value screen menu

The following parameters can be configured via this menu screen:

Temperature Reactor 1	500 °C	+ 25 °C	- 25 °C
Temperature Reactor 2	500 °C	+ 25 °C	- 25 °C

Temperatures of both reactors.

These are the guide temperatures for the feeding screw' individual process programs A, B and C for material stockage as well as the reactor screws. The

temperatures behind the set-point temperatures define the start and end points of the individual process programs.

The process programs carry out the individual process steps for the various operating phases with the corresponding settings.

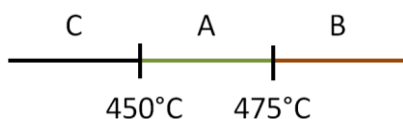


Illustration 105 Temperature-dependent process programs

The letters here stand for the operating phases:

- A => Temperature within set-point range
- B => Temperature too high
- C => Temperature too low

Reactor pressure	100 Pa Start-up	I
	50 Pa Operation	

Illustration 106 Pressure in reactor

Reactors pressure:

The values for the reactors' internal pressure for start-up mode as well as standard operation can be configured here.

Active set-point valve	50 Pa Operation
------------------------	-----------------

Illustration 107 active set-point value

The respective active set-point value is displayed in the item underneath.

Oxygen Exhaust	3.000 %
----------------	---------

Illustration 108 Oxygen gas Exhaust

Oxygen gas Exhaust:

The residual oxygen content of the exhaust gas can be configured via this menu item.



NOTE

The oxygen content set-point value must be configured between 1 and 3.



CAUTION

Material damage due to incorrect parameter configuration

If limit values are set outside of the limit threshold, significant material damage to the unit can result.

- Adhere to the limit values provided here.
- Read the operating instructions.

9.10.3 Heat exchanger

By clicking on the “Heat exchanger” icon in the “Start screen” display, the user is taken to the next submenu for the PYREG unit's heat extraction.

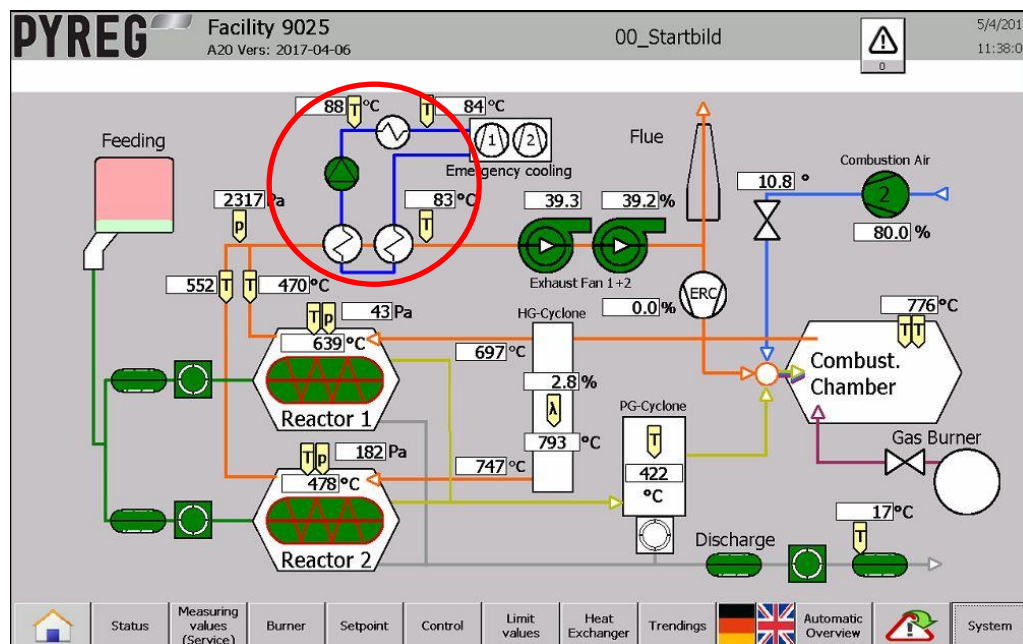


Illustration 112 Heat exchanger menu button

Information on the settings of the individual mixers, the current temperatures and the pumps is provided in this menu screen.

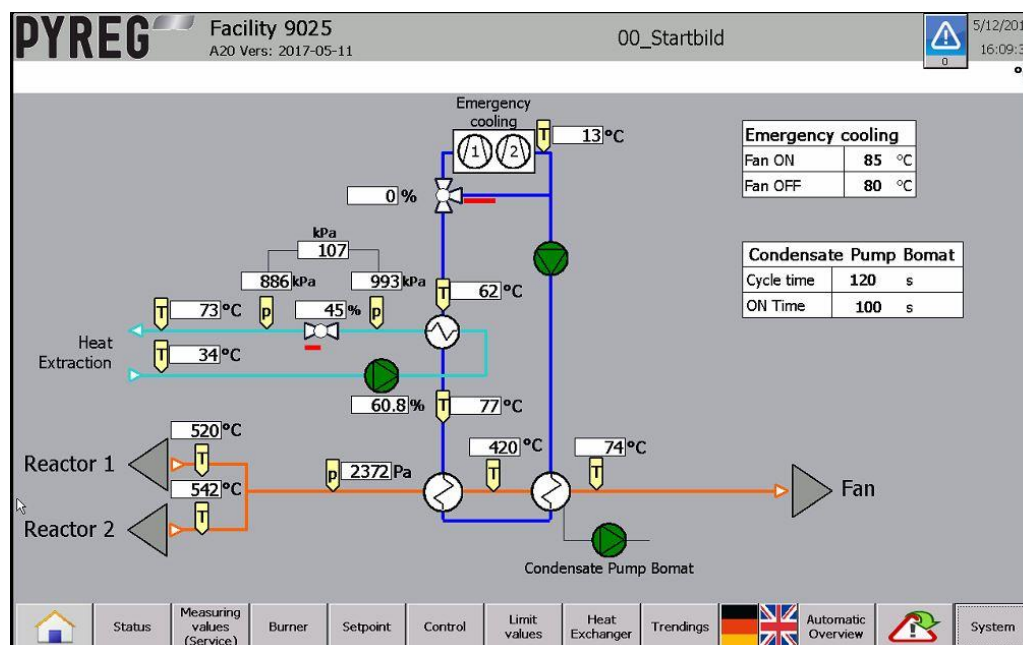
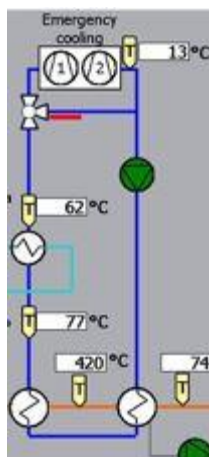


Illustration 113 Heat exchanger menu screen

The temperatures of the flue gas route to the reactors to the high-temperature heat exchanger (HT HE) and to the low temperature heat exchanger (LT HE) are illustrated in the red line. In addition, the unit's inlet pressure is displayed in Pascal (Pa).



The icon for the circulating pump in the PYREG unit's heating circuit (blue line) is shown in green when in operation, does not light up when switched off, and is red in the event of a fault.

Illustration 109 Heat exchanger menu screen

Controlling the Emergency Cooling System

Emergency cooling	
Fan ON	85 °C
Fan OFF	80 °C

The emergency cooling system temperatures can be adjusted by entering the start and stop temperatures for the fan.

Illustration 110 Heat exchanger menu screen



NOTE

The set-point value for fan ON must be set to between 80°C and 95°C, and the set-point value for fan OFF must be between 60°C and 70°C.

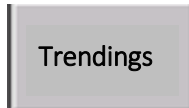
Flue gas in the heat exchanger system results in water condensation when the unit is operated. This condensate is discharged from the low temperature heat exchanger with a pump.

Condensate Pump Bomat		
Cycle time	120	s
ON Time	100	s

The cycle time i.e. the cycles for the condensate and the duty cycle (pulse time) can be varied.

Illustration 111 Heat exchanger menu screen

9.10.4 Curves



In this menu, the user is taken to the lower main menu bar via the “Trendings” menu button.

Illustration 112 Trendings menu button

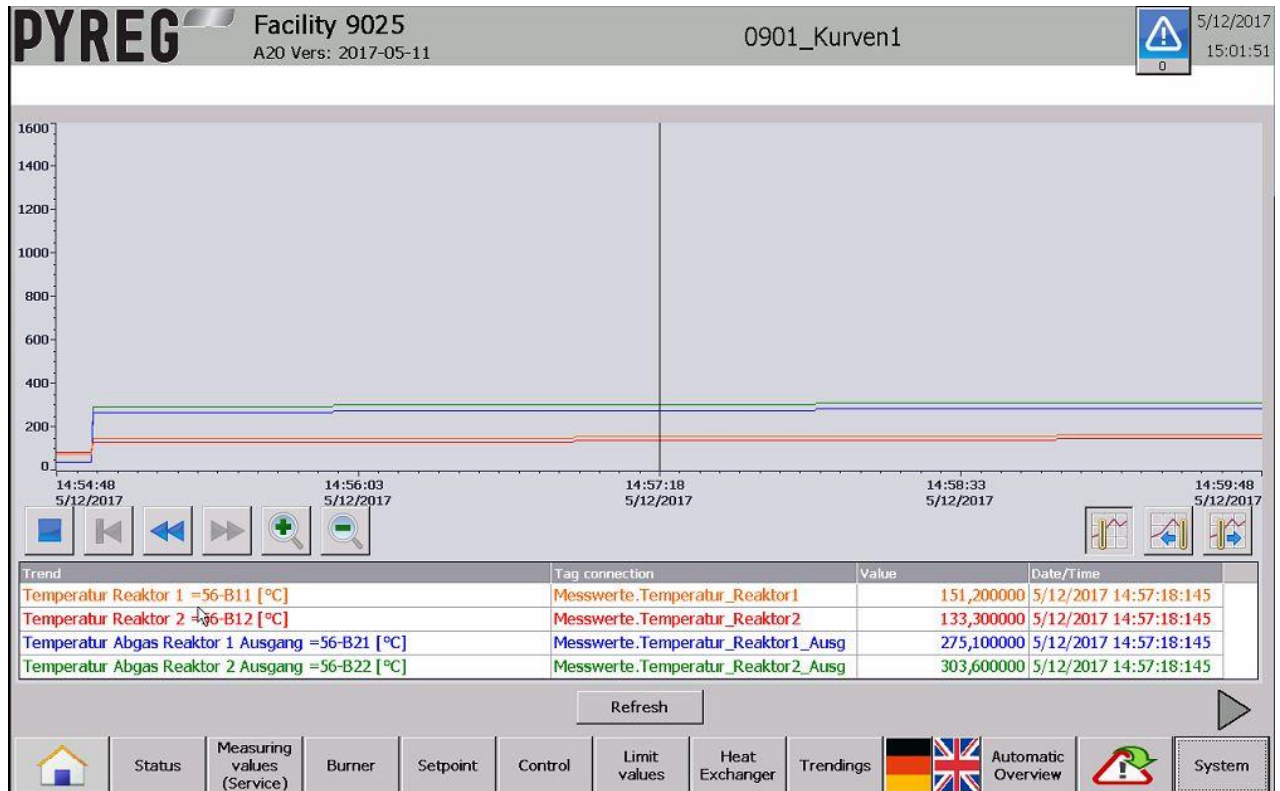


Illustration 118 Trendings menu screen

The sensors' various diagrams can be illustrated using this menu screen.

In Fehler! Verweisquelle konnte nicht gefunden werden., the respective temperature profiles of both reactors are illustrated as an example.



Additional diagrams can be accessed by tapping on the arrow symbol on the right-hand side.

Illustration 113 Arrow



Furthermore, it is possible to enlarge or reduce the selected time period so that anomalies or long-term trends can be investigated.

Illustration 114 Plus Minus menu button

9.10.5 Automatic Overview

Automatic overview

In this menu, the user is taken to the lower main menu bar via the “Automatic overview” menu button.

Illustration 115 Automatic overview menu button

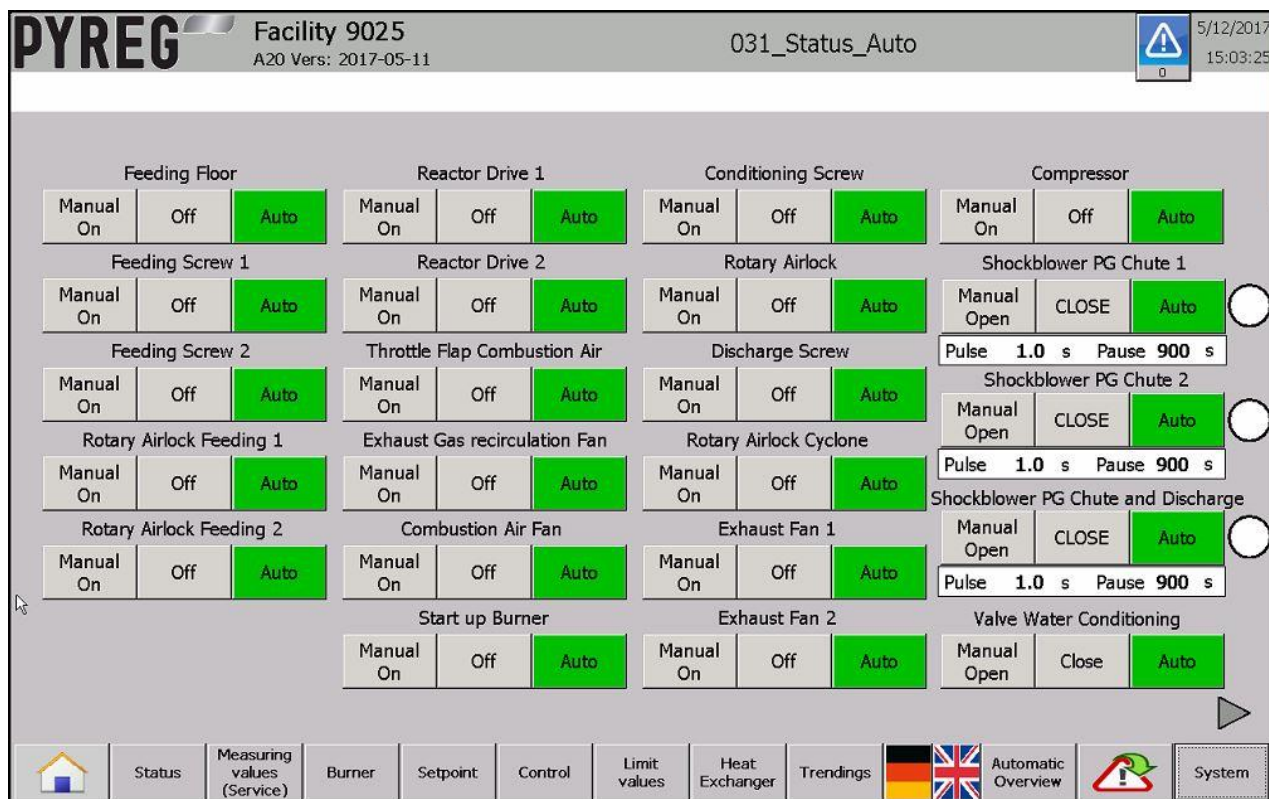


Illustration 116 Automatic overview screen menu

This menu screen shows the operating conditions for individual actuators. The operating conditions can be adjusted independently of each other.



WARNING

Material damage due to incorrect selection during operation

If automatic operation of individual actuators is suspended during operation, significant material damage can result.

- Work with the menu only when the unit is not operational.
- Ensure that all tasks are performed by personnel with appropriate qualifications only.

Operating conditions – meanings:

Operating state

Action



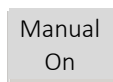
Automatic

The actuators are controlled via the unit's control system.



Downtime:



The actuators are manually shut down, they are no longer switchable for the unit and must be reset to “Auto” for standard operation.



Manual operation:

The actuators are switched on manually. They are no longer switchable for the unit and must be reset to “Auto” for standard operation.

Table 13 Operating conditions

The heat exchanger's and emission control's individual menu windows are activated with the arrows below on the right , or below on the left .

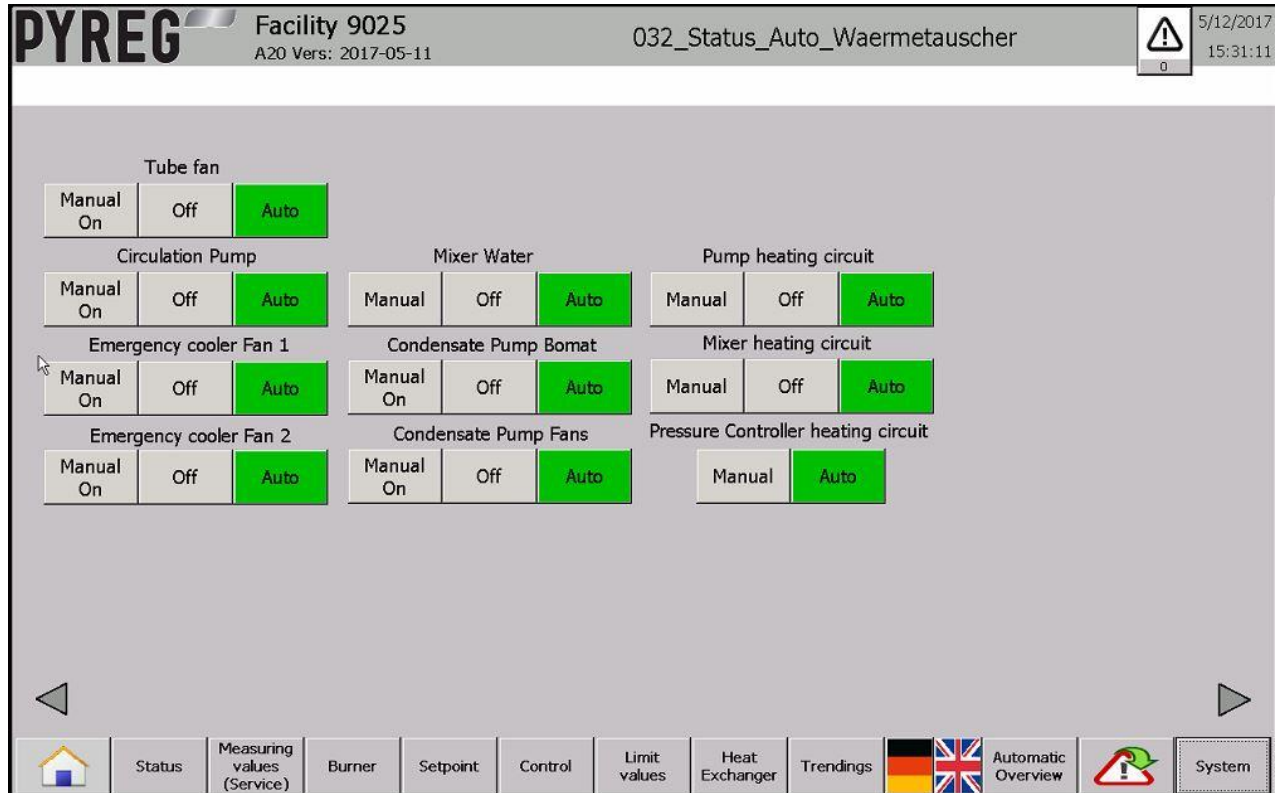


Illustration 117 Heat exchanger Auto menu window

9.10.6 Message alerts



This menu takes the user to the lower main menu bar via the “Warning triangle” menu button.

Illustration 118 Warning triangle menu button

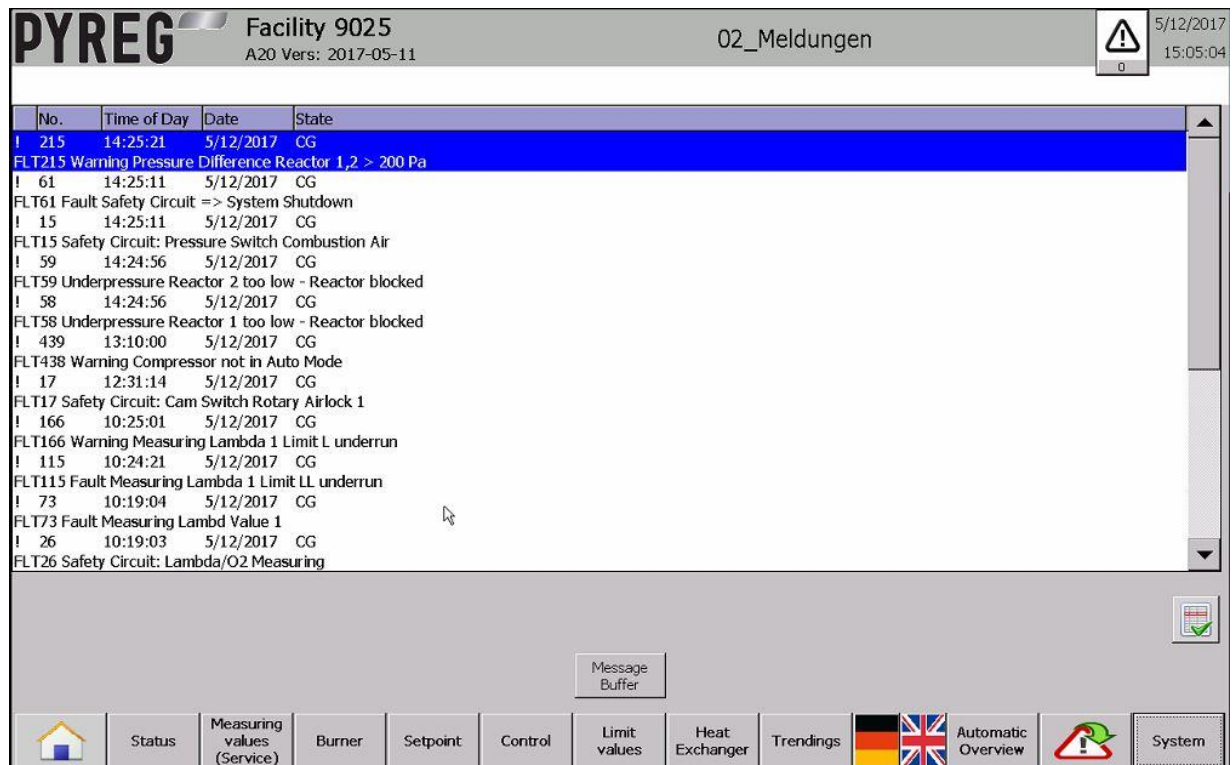


Illustration 125 Message alerts menu window

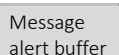
Currently active and not yet acknowledged message alerts are listed chronologically in this menu window.



Message alerts that are no longer active are deleted and, in some cases, acknowledged in this menu window with the aid of the checkmark touch surface.

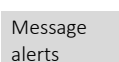
Illustration 119 Checkmark menu button

Deletion triggers a shift to a buffer.



These can then be accessed via the “Message alert buffer” menu item.

Illustration 120 Message alert buffer menu button



The user is returned once again to the current message alerts window via the “Message alerts” button.

Illustration 121 Message alerts menu button

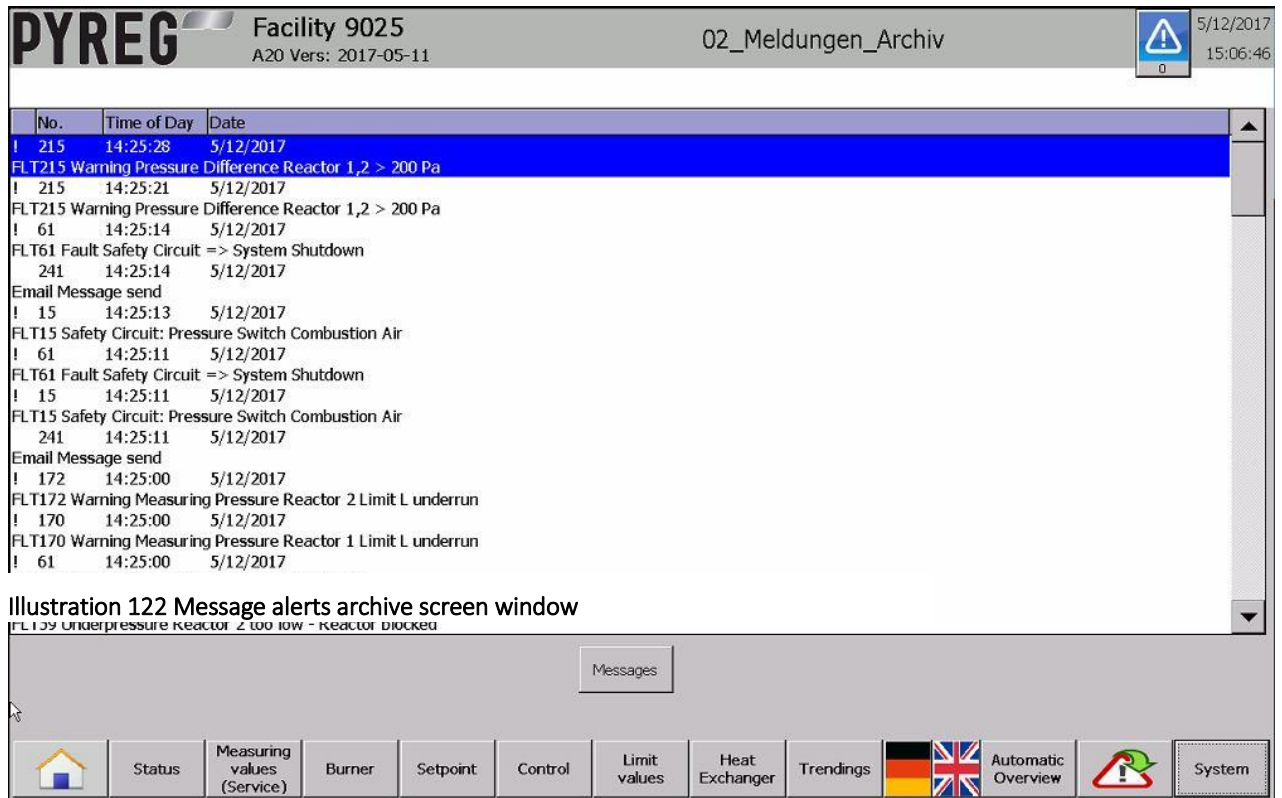


Illustration 129 Message alerts archive screen window



If there are current active message alerts, the user is alerted to them in all screen menus by a flashing warning triangle on the upper right-hand side. The number underneath indicates the number of active message alerts.

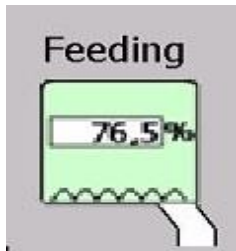
Illustration 123 Number of message alerts warning

In addition, as seen in illustration 12.4-4, the user is informed of the nature of the fault with a plain text message alert. This can be seen between the header line and the unit visualisation.



Illustration 124 Plain text error message

9.10.7 Sliding floor in the storage tank



In this menu, the user is taken to the start screen via the “Sliding floor” screen icon.

Illustration 125 Sliding floor screen icon

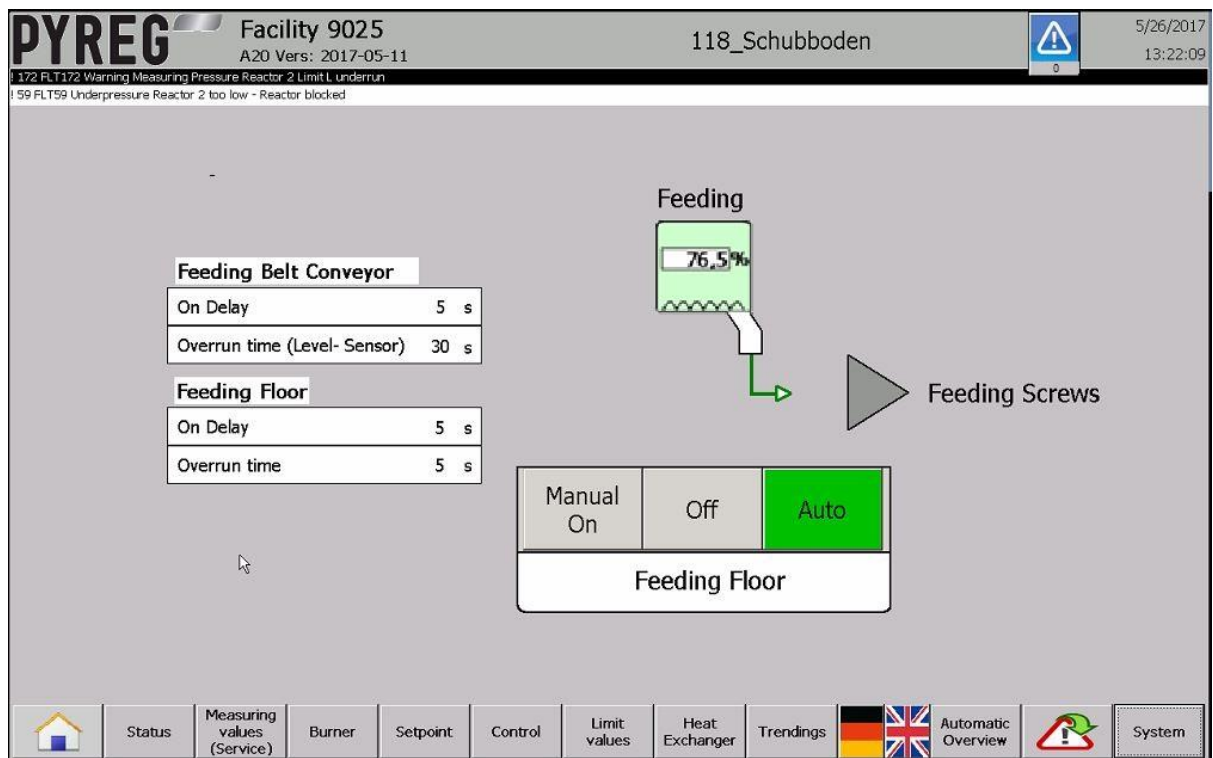


Illustration 126 Sliding floor screen menu

The On delay, as well as the sliding floor's overrun time and an optional conveyor belt, can be configured via this screen menu.

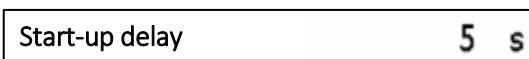


Illustration 127 On delay

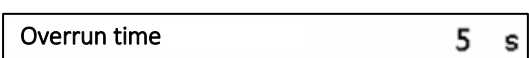
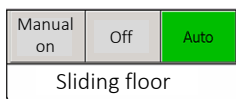


Illustration 128 Overrun time

The On delay is the period that elapses after reaching the feed temperature before the conveyor belt or the sliding floor are put into operation.

“Overrun time” refers to the period of time that elapses after manual shutdown of the unit before the relevant component is shut down.



In addition, the sliding floor can be configured to the various operating conditions redundant to the automatic overview (see [Table 13 Operating conditions, page - 111 -](#)).

Illustration 129 Sliding floor operating conditions



WARNING

Material damage due to incorrect selection during operation

If automatic operation of individual actuators is suspended during operation, significant material damage can result.

- Work with the menu only when the unit is not operational.
- Ensure that all tasks are performed by personnel with appropriate qualifications only.



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.

- Ensure that all tasks are performed by personnel with appropriate qualifications only.

9.10.8 Fuel Feed



Illustration 131
Arrow symbol

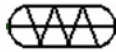


Illustration 130
Screw menu button

The submenu is activated by tapping on the “Sliding floor” arrow in the menu screen or by tapping on the “Screw” icon in the start screen.

Feeding Screw 1

On Delay	4 s Act.		
Overrun time	4 s	Stop time	0.3 s
Imax reverse time	1.0 s	ON Time	0.0 s
	A <input type="radio"/>	B <input type="radio"/>	C <input checked="" type="radio"/>
Cycle time	10.0 s	10.0 s	10.0 s
ON Time	3.0 s	5.5 s	2.0 s

Feeding Screw 2

On Delay	4 s Act.		
Overrun time	4 s	Stop time	0.3 s
Imax reverse time	1.0 s	ON Time	0.0 s
	A <input type="radio"/>	B <input type="radio"/>	C <input checked="" type="radio"/>
Cycle time	10.0 s	10.0 s	10.0 s
ON Time	3.0 s	5.5 s	2.0 s

Feeding Screw 1 Manual: On, Off, Auto (Auto is selected)

Feeding Screw 2 Manual: On, Off, Auto (Auto is selected)

Diagram: Feeding → Rotary Airlocks 1+2

Bottom Bar: Home, Status, Measuring values (Service), Burner, Setpoint, Control, Limit values, Heat Exchanger, Trendings, Automatic Overview, System

Illustration 139 Feeding Screw menu screen

The unit's capacity is configured in this screen. The two main parameters for capacity configuration are the cycle time and the pulse time.

The cycle time shows the period of time for a feeding screw motion cycle. This includes downtime as well as the period of time during which the screw rotates.

The period of time during which the screw rotates is known as the pulse time.

By configuring the cycle time to 10 seconds, the pulse time to be configured can be calculated as a percentage of the screw' maximum output volume.

For more information, see [9.6.7 Feed material start-up, page - 83 -](#) and subsequent pages, as well as [13.3 Definition of unit parameters page - 196 -](#).



CAUTION

Material damage due to incorrectly configured parameters

If the parameters configured here are set too high without consulting with the manufacturer, significant material damage to the unit can result. It is also possible that personal injury may occur as a consequence.

- It is imperative that the preset values are adhered to.
- Change the values only after consultation with the manufacturer.

The various levels of capacity can be configured using the three possible programs A, B and C. Selection of each program is dependent upon the reactors' operating temperature.

The letters here stand for the operating phases:

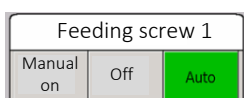
A => Temperature within set-point range

B => Temperature too high

C => Temperature too low

In this way, for example, an increasing temperature can be countered by setting a lower performance in program B.

The target temperature range can be adjusted in the "Set-point values" submenu (see [9.10.2 Set-point values page - 105 -](#)).



In addition, the feeding screw can be set to the various operating conditions redundant to the Automatic overview (see [Table 13 Operating conditions, page - 111 -](#)).

Illustration 132 Feeding screw operating conditions



WARNING

Material damage due to incorrect selection during operation

If automatic operation of individual actuators is suspended during operation, significant material damage can result.

- Work with the menu only when the unit is not operational. Ensure that all tasks are performed by personnel with appropriate qualifications only.

9.10.9 Rotary valve feed



Illustration 134
Arrow symbol



Illustration 133
Menu button
Rotary valve

The submenu is activated by tapping on the “Sliding floor” arrow in the menu screen or by tapping on the “Rotary valve” icon in the start screen.

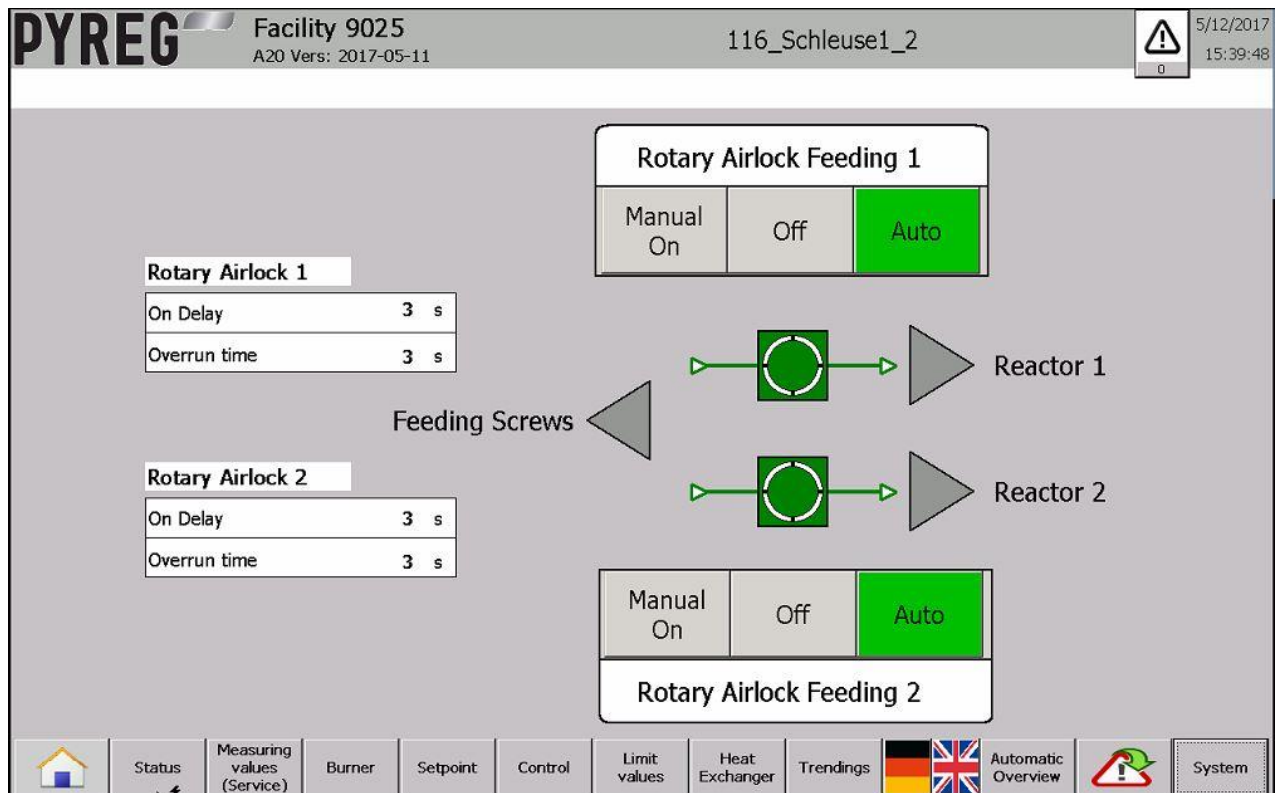


Illustration 143 Rotary valves menu screen

The on delay, as well as the reactor's rotary valves' overrun time to the reactors, can be configured via this menu screen.

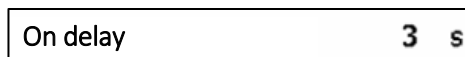


Illustration 135 On delay

Here, the on delay is the period that elapses after reaching the feed temperature before the rotary valves are put into operation.

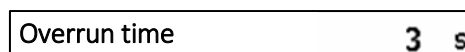
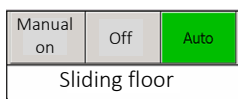


Illustration 136 Overrun time

“Overrun time” refers to the period of time that elapses after manual shutdown of the unit before the valves are shut down.



In addition, the rotary valves can be configured to the various operating conditions redundant to the automatic overview (see [Table 13 Operating conditions, page - 111 -](#)).

Illustration 137 Rotary valve operating conditions



WARNING

Material damage due to incorrect selection during operation

If automatic operation of individual actuators is suspended during operation, significant material damage can result.

- Work with the menu only when the unit is not operational. Ensure that all tasks are performed by personnel with appropriate qualifications only.

The corresponding submenus for components in front of or behind the valves can be accessed via the two grey arrow buttons.

9.10.10 Reactors



Illustration 139
Arrow Symbol

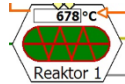


Illustration 138
Menu button
Reactor

The relevant submenus are activated by tapping on the “Rotary valves” arrow in the menu screen or by tapping on the “Rotary valve” icon in the start screen.

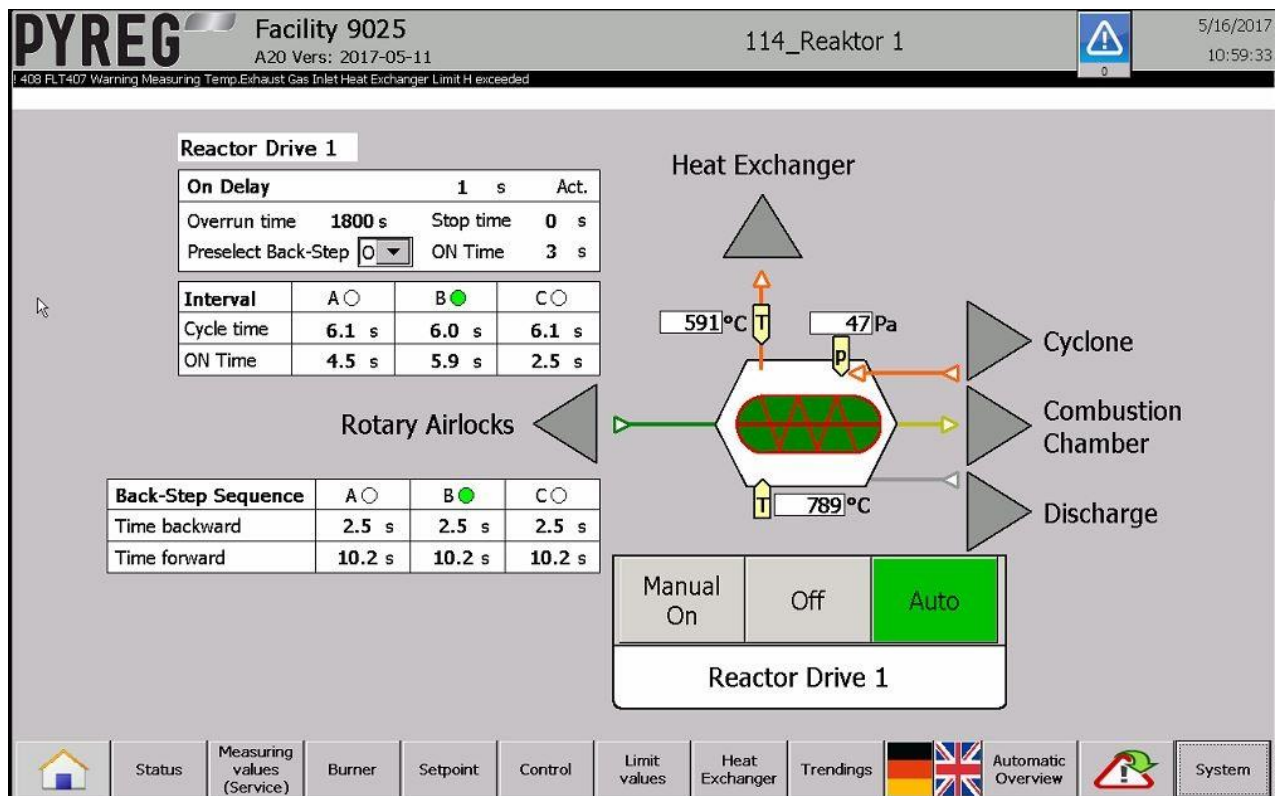


Illustration 149 Reactor menu screen

On Delay	1 s	Act.
Overrun time	1800 s	Stop time 0 s
Preselect Back-Step	0	ON Time 3 s

Illustration 140 On delay

Overrun time **1800 s**

Illustration 141 Overrun time

On delay:

The unit begins the feed as soon as the combustion chamber and reactors' hot start temperature is reached. "On delay" describes the period of time from reaching the hot start temperatures to start-up of the reactors.

The reactor "Overrun time" describes the period of time from unit shutdown to shutdown of the reactors.

Interval	A ○	B ●	C ○
Cycle time	6.1 s	6.0 s	6.1 s
ON Time	4.5 s	5.9 s	2.5 s

The various cycle times and on times can be configured for different temperatures in the three process programs A, B and C.

Illustration 142 Reactor process programs

The letters here stand for the operating phases:

A => Temperature within set-point range

B => Temperature too high

C => Temperature too low

The reactors' set-point temperature can be configured in the "Set-point values" submenu (see [9.10.2 Set-point values page - 105 -](#)).

Cycle time	6,1 s
------------	-------

Here, the **cycle time** describes the reactor screws' motion cycle. It includes the pause time as well as the period of time during which the screw rotates.

Illustration 143 Cycle time

On time	6,0 s
---------	-------

This period during which the screw rotates is called **pulse time**.

Illustration 144 On time

Preselect Back Step t a ▼

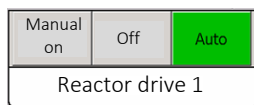
A preselect back-step function can be activated by opening the drop down menu.

Illustration 145 Preselect Back-Step

Back-Step Sequence	A ○	B ●	C ○
Time backward	2.5 s	2.5 s	2.5 s
Time forward	10.2 s	10.2 s	10.2 s

There are also three different parameter sets here, which have the same underlying foundations as the previous ones. However, the forward and return time are configured here, rather than the cycle and pulse time.

Illustration 146 Back Step Sequence



In addition, the reactors can be configured to the various operating modes redundant to the automatic overview (see [Table 13 Operating conditions, page - 111 -](#)).

Illustration 147 Reactors' operating conditions



WARNING

Material damage due to incorrect selection during operation

If automatic operation of individual actuators is suspended during operation, significant material damage can result.

- Work with the menu only when the unit is not operational. Ensure that all tasks are performed by personnel with appropriate qualifications only.

The corresponding submenus for components in front of or behind the reactors can be accessed via the two grey arrow buttons.



Illustration 148
Arrow symbol

By tapping on the arrow in the "Reactor" menu screen, the corresponding submenus for the components in front of or behind the reactors are activated.

9.10.11 Cyclones



Illustration 150
Arrow symbol

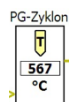


Illustration 149
Menu button
Cyclone

The relevant submenus are activated by tapping on the “Reactor” arrow in the menu screen or by tapping on the “Cyclone” icon in the start screen.

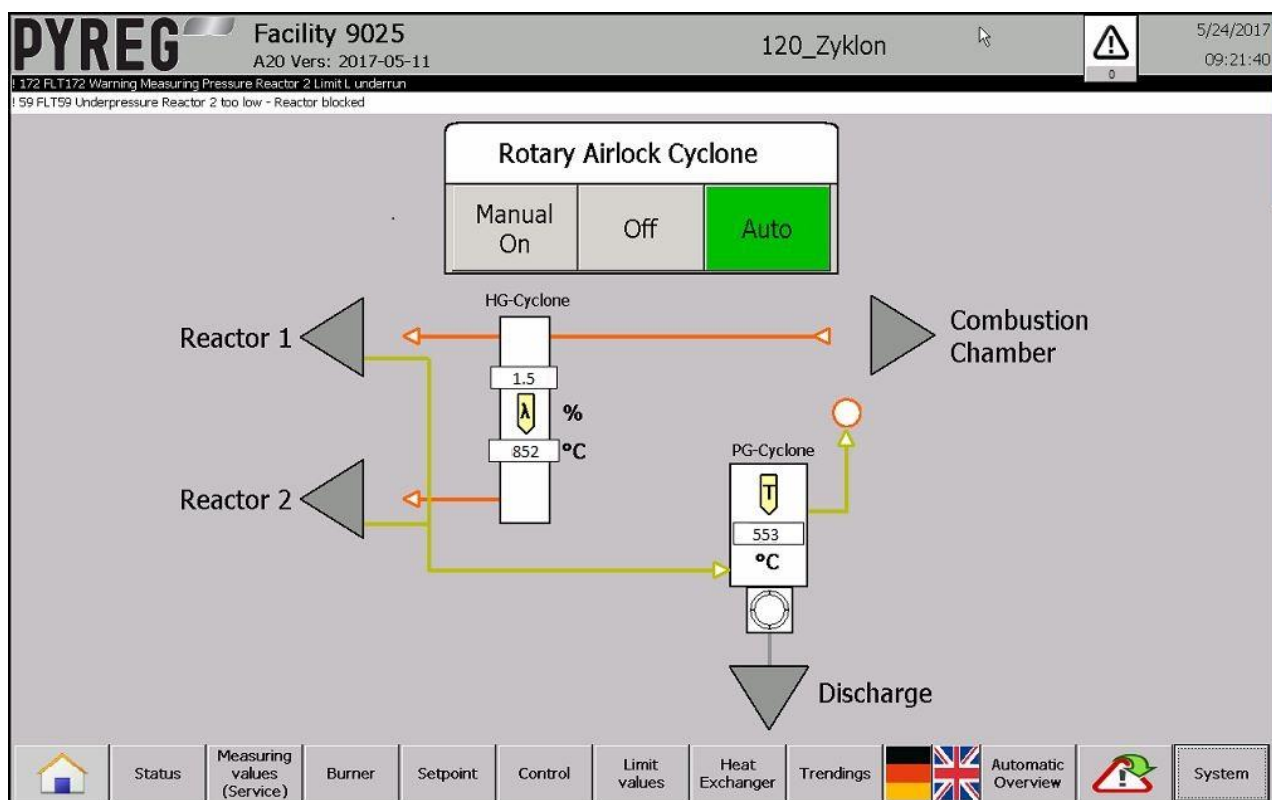
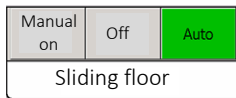


Illustration 151 Cyclone menu screen



Illustration 152
Arrow symbol

By tapping on the arrow in the “Cyclone” menu screen, the corresponding submenus for the components in front of or behind the cyclones are activated.



In addition, the rotary valves under the process gas cyclone can be configured to the various operating modes redundant to the automatic overview (see [Table 13 Operating conditions, page - 111 -](#)).

Illustration 153 PG cyclone operating conditions



WARNING

Material damage due to incorrect selection during operation

If automatic operation of individual actuators is suspended during operation, significant material damage can result.

- Work with the menu only when the unit is not operational. Ensure that all tasks are performed by personnel with appropriate qualifications only.

9.10.12 Discharge



Illustration 155
Arrow symbol



Illustration 154
Menu button
Discharge

The relevant submenus are activated by tapping on the “Cyclone” arrow in the menu screen or by tapping on the “Reactor” icon in the start screen.

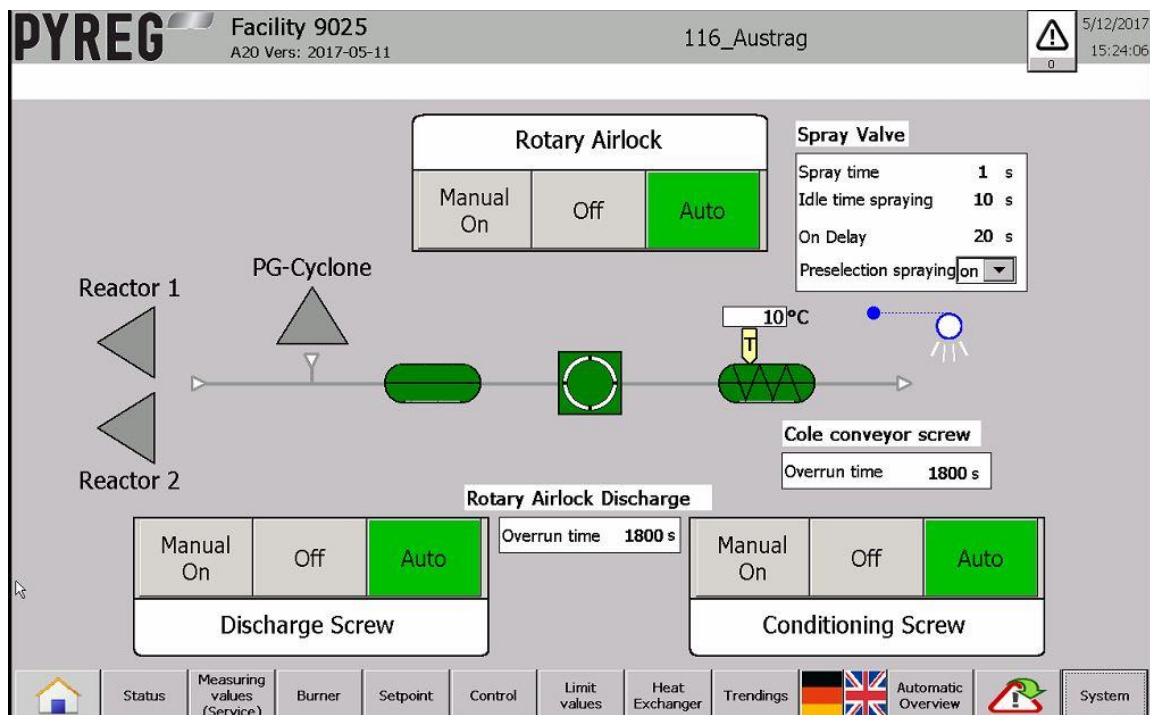


Illustration 156 Discharge menu screen

9.10 Further description of menus for operation

Discharge rotary valve

Overrun time **1800 s**

Illustration 157 Discharge overrun time

The rotary valve “Overrun time” describes the period of time from unit shutdown to shutdown of the rotary valves.

Cole conveyor screw

Overrun time **1800 s**

Illustration 158 Screw overrun time

The screw conveyor “Overrun time” describes the period of time from unit shutdown to shutdown of the screw conveyor.

Spray Valve

Spray time **1 s**
 Idle time spraying **10 s**
 On Delay **20 s**
 Preselection spraying **on**

Illustration 159 Spray valve contact surface

In the illustration above, the configuration area for extinguishing of carbon is highlighted in red.

Preselection spraying **on**

Illustration 160 Preselection spraying touch surface

Here, water injection can be turned on or off using the drop down menu under the “Preselection spraying” item.

Spray time **1 s**

Illustration 161 Spray time

Water injection is time-sequenced. The spray period can be adjusted using the “Spray time” value. The pause time is defined via the “Idle time spraying” value.

Idle time spraying **10 s**

Illustration 162 Idle time spraying

The second value, “Idle time spraying” defines the waiting period from commencement of feed to beginning of water injection in the conditioning screws.

When the relevant value is tapped, an entry window opens in which the value can be entered and confirmed with ↵ Enter.



NOTE

The required mixture of mineral material and water must be observed when configuring these values.

CAUTION



Material damage due to inadequate extinguishing

Inadequate extinguishing can result in spontaneous combustion of material.

- Select water injection times so that the material is sufficiently cooled down.



Illustration 163
Arrow symbol

By tapping on the arrow in the “Discharge” menu screen, the corresponding submenus for the components before or behind discharge are activated.

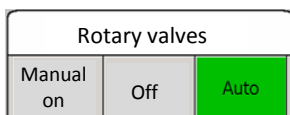


Illustration 164 PG cyclone operating conditions

In addition, the rotary valves at discharge, the screw quencher and the discharge screws can be configured to the various operating modes redundant to the automatic overview (see [Table 13 Operating conditions, page - 111 -](#)).



WARNING

Material damage due to incorrect selection during operation

If automatic operation of individual actuators is suspended during operation, significant material damage can result.

- Work with the menu only when the unit is not operational. Ensure that all tasks are performed by personnel with appropriate qualifications only.

9.10.13 Combustion air fan



Illustration 165
Combustion air fan

The “Combustion air” submenu is activated by tapping on the menu button in the start screen.

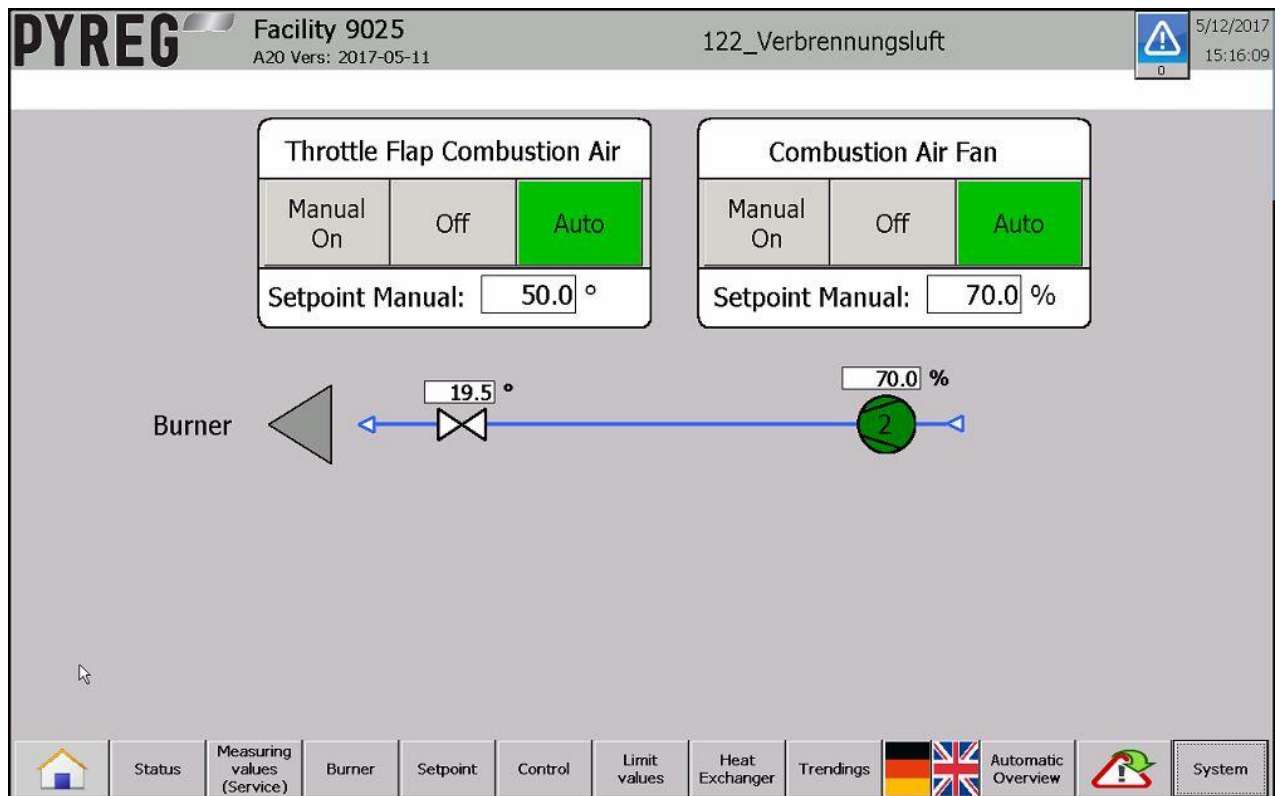


Illustration 166 Combustion air menu screen

This menu may be operated only by employees of PYREG GmbH, their authorised service partners, or other persons authorised by PYREG GmbH.



WARNING

Material damage resulting from inadequate qualifications!

Mishandling can result in significant personal and material damage.

- Ensure that all tasks are performed by personnel with appropriate qualifications only.



WARNING

Material damage due to incorrect selection during operation

If automatic operation of individual actuators is suspended during operation, significant material damage can result.



- Work with the menu only when the unit is not operational. Ensure that all tasks are performed by personnel with appropriate qualifications only.

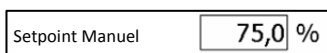


Illustration 167 Set-point Manual

The set-point manual for the combustion air fan can be configured in this menu, regardless of operating mode. This is done under “Combustion air fan 2 Setpoint Manual”.



NOTE

The operating conditions “Manual ON” and “Manual OFF” may not be selected here. Deviation from automatic operation results in emergency shutdown of the unit.



Illustration 168 Open/Closed buttons

The air supply butterfly valve can also be switched to the various operating modes in this menu. The touch surfaces “Open” and “Closed” control the butterfly valve.

9.10.14 Exhaust gas fan

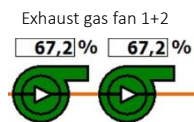


Illustration 169
Exhaust gas fan

The “Exhaust gas fan” submenu is activated by tapping on the menu button in the start screen.

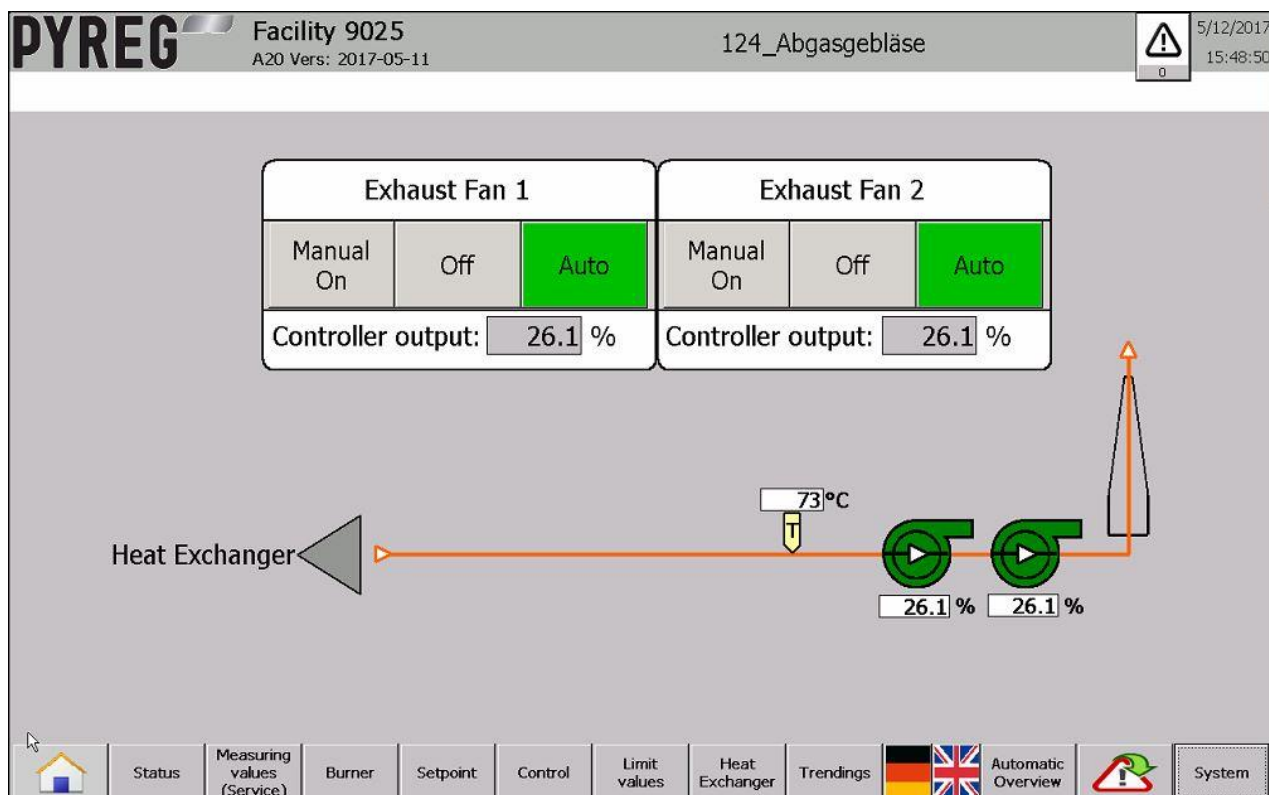


Illustration 170 Exhaust gas fan menu screen

This menu may be operated only by employees of PYREG GmbH, their authorised service partners, or other persons authorised by PYREG GmbH.



WARNING

Material damage resulting from inadequate qualifications!

Mishandling can result in significant personal and material damage.

- Ensure that all tasks are performed by personnel with appropriate qualifications only.



WARNING

Material damage due to incorrect selection during operation

If automatic operation of individual actuators is suspended during operation, significant material damage can result.

- Work with the menu only when the unit is not operational. Ensure that all tasks are performed by personnel with appropriate qualifications only.



Illustration 171
Controller output

The set-point value for the exhaust gas fan can be configured in this menu.



NOTE

The operating conditions "Manual ON" and "Manual OFF" may not be selected here.
Deviation from automatic operation results in emergency shutdown of the unit.

9.10.15 Controller

This menu may be operated by employees of PYREG GmbH and their authorised service partners only.



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.

- This menu may be operated by employees of PYREG GmbH and their authorised service partners only.



CAUTION

Material damage due to incorrectly configured parameters

If parameters are configured by unauthorised personnel, serious personal injury can occur as a result.



- To be operated by employees of PYREG GmbH and their authorised service partners only.

9.10.16 System

This menu may be operated by employees of PYREG GmbH and their authorised service partners only.



WARNING

Danger of injury resulting from inadequate qualifications!

Mishandling can result in significant personal and material damage.

- This menu may be operated by employees of PYREG GmbH and their authorised service partners only.



CAUTION

Material damage due to incorrectly configured parameters

If parameters are configured by unauthorised personnel, serious personal injury can occur as a result.



- This menu may be operated by employees of PYREG GmbH and their authorised service partners only.

9.10.17 Measured Values (Service)

This menu may be operated by employees of PYREG GmbH and their authorised service partners only.



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.

- This menu may be operated by employees of PYREG GmbH and their authorised service partners only.



CAUTION

Material damage due to incorrectly configured parameters

If parameters are configured by unauthorised personnel, serious personal injury can occur as a result.



- This menu may be operated by employees of PYREG GmbH and their authorised service partners only.

9.10.18 Remote Control

The unit can be controlled remotely if there is an Internet connection.



DANGER

Danger to life resulting from unit remote control

If the unit is controlled remotely using an Internet connection, serious personal injury can result.

- If remote control is used to operate the unit, the operator must take appropriate measures to prevent access to the unit.

9.10.19 Remote service

If remote control of the unit for maintenance, inspection and servicing activities (remote service) by PYREG GmbH or its authorised partners is required, the operator must make an appropriately qualified employee available onsite during this period.



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.



- Ensure that all tasks are performed by personnel with appropriate qualifications only.

Such remote service activity must be performed only with concurrent accompanying telephone connection between the operator's employee and the PYREG employee or employee of its authorised service partner.

The operator's employee is responsible for securing the unit during the remote service period.



WARNING

Danger of injury resulting from unsupervised remote service

If remote service is performed without parallel telephone communication, personal injury or major material damage can result as a consequence.

- Provide the option of telephone communication before planned remote maintenance.
- Employ a concurrent telephone connection during remote maintenance.

10 Faults

10.1 General information

All message alerts of faults in the touchscreen (touch panel) of the unit control system must be dealt with in accordance with the list provided below.



CAUTION

Material damage resulting from disregard of fault message alerts

If the fault message alerts are not dealt with promptly according to the guidelines, significant material damage can result.

- Deal with the fault message alerts displayed promptly in accordance with the fault message alerts list.



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.

- Ensure that all tasks are performed by personnel with appropriate qualifications only.

Contact address:

PYREG GmbH
 Trinkbornstrasse 15 – 17
 D- 56281 Dörth
 Tel.: +49 (0) 6747 95388 – 0
 Email: service@pyreg.de
 Service: +49 156 04430414

10.1.1 Consequential faults - definition

Consequential faults are faults which are not displayed due to the reason for the original fault. They occur subsequent to preceding faults.

10.2 List of fault message alerts

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
unknown	not listed	Contact Service	
STM1	Emergency Off activated 830.03	Check if Emergency Off activated	Identify cause
STM2	Control voltage fuse triggered 830.05-Fx	Check fuse	In the event of a triggered fuse, contact a qualified electrician
STM3	Standard power fault 830.01-A21	Identify	Contact electrician
STM5	Fault: low UPS battery capacity 830.01-A31	Inspect the UPS for message alerts and correct wiring	Engage service
STM6	Fault: UPS battery operation 830.01-A31	Inspect the UPS for message alerts and correct wiring	Engage service
STM7	Main switch off 830.01-Q01	Conduct visual inspection as to whether current value corresponds to set-point	Set main switch back to "On"
STM9	Defective surge protection 830.01-F12	Have a qualified electrician conduct inspection	Replace component
STM10	Failure of exhaust gas fan 2 24VDC power supply 830.280.11-G11	Contact service	
STM12	Safety circuit: Burner not cleared for start-up (key switch) 830.05-S25	Check key switch	Bring key switch to correct position
STM13	Safety circuit: Dryer Emergency Off 830.09	Inspect dryer using appropriate measures and establish target state	
STM14	Safety circuit: Sewage gas pressure monitor 834.564.09	Check gas pressure via manometer	Inspect fill level of blowhole/tank
STM15	Safety circuit: Combustion air pressure monitor 834.564.93	Inspect combustion air duct and fans; check pressure monitor	Contact service
STM16	Safety circuit: Unit negative pressure monitor 832.564.19	Check for blockage or foreign air sources	Contact service
STM17	Safety circuit: Rotary valve cam switch 1 830.378.41	Check for blockage due to feed material	Contact service
STM18	Safety circuit: Rotary valve cam switch 2 830.378.42	Check for blockage due to feed material	Contact service

Faults

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM19	Safety circuit: Extinguisher temperature switch 832.547.03	Check temperature on extinguisher	Contact service
STM20	Safety circuit: Fuel temperature switch 831.547.12	Check temperature at storage tank/feeder	Contact service
STM23	Safety circuit: Combustion chamber temperature monitor 1/2 834.547.10	Monitor combustion chamber temperature/	Contact service
STM26	Safety circuit: O2 measurement 834.540.22	Check lambda transmitter for fault message alert	Contact service
STM31	Fuel dosing screw 1 motor protection switch 830.440.31	Check for mechanical blockage or damage	Contact service
STM33	Fuel dosing screw 2 motor protection switch 830.440.32	Check for mechanical blockage or damage	Contact service
STM43	Rotary valve feed 1 motor protection switch 830.378.41	Check for mechanical blockage or damage	Contact service
STM44	Rotary valve feed 2 motor protection switch 830.378.42	Check for mechanical blockage or damage	Contact service
STM46	Discharge screw motor protection switch 830.440.30	Check for mechanical blockage or damage	Contact service
STM47	Sliding floor motor protection switch 830.440.20	Check for mechanical blockage or damage	Contact service
STM49	Exhaust gas recirculation fan motor protection switch 830.290.20	Check for mechanical blockage or damage	Contact service
STM50	Fault at exhaust gas fan 1 830.280.12	Check for mechanical blockage or damage	Contact service
STM51	Fault at exhaust gas fan 2 830.280.11	check for mechanical blockage/contamination.	Contact service
STM52	Combustion air butterfly valve motor protection switch 834.371.01	Check for mechanical blockage	Contact service
STM53	Combustion air butterfly valve does not reach open end position 834.371.01	Check whether current position physically correct	Contact service
STM54	Combustion air butterfly valve does not reach closed end position 834.371.01	Check whether current position physically correct	Contact service
STM55	Combustion air end position implausible 834.371.01	Check whether voltage present and correctly parametered	Contact service
STM56	Burner fault 834.540.03	Burner visual inspection; clean and/or dry	Contact service
STM57	Burner fault: no operation return signal 834.540.03	Inspect wiring	Contact service
STM58	Fault: insufficient negative pressure - blockage reactor 1 832.564.12	Check for blockage or foreign air sources	Contact service
STM59	Fault: insufficient negative pressure - blockage reactor 2 832.564.22	Check for blockage or foreign air sources	Contact service

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM61	Burner safety chain fault => unit shutdown	Check air, gas and cable lines	Contact service
STM62	PG cyclone rotary valve motor protection switch 830.378.15	check for mechanical blockage/contamination.	Contact service
STM63	Rotary valve 1 IMAX 830.378.41	Current limit reached; reverse operation	Contact service
STM64	Rotary valve 2 IMAX 830.378.42	Current limit reached; reverse operation	Contact service
STM65	Fault: rotary valve carbon discharge 830.378.40	Check for mechanical blockage or damage	Contact service
STM66	Fault: conditioning screw 830.440.50	Check for mechanical blockage or damage	Contact service
STM67	Fault: combustion air fan motor protection switch 830.280.90	Check for mechanical blockage/contamination.	Contact service
STM68	Fault: Big Bag (reserve) carbon discharge	undefined	Contact service
STM70	Fault: actual speed measurement of exhaust gas fan 1 830.280.12	Check converter for message alerts	Contact service
STM71	Fault: actual speed measurement of exhaust gas fan 2 830.280.11	Check converter for message alerts	Contact service
STM72	Fault: actual position measurement of combustion air butterfly valve 834.371.01	Contact service	
STM73	Fault: oxygen HG cyclone measurement 834.540.22	Contact service	
STM75	Fault: pressure reactor measurement 1 832.564.12	Check that sensors are functioning properly.	Contact service
STM76	Fault: pressure reactor measurement 2 832.564.22	Check that sensors are functioning properly.	Contact service
STM78	Fault: temperature reactor measurement 1 832.547.13	Check that sensors are functioning properly.	Contact service
STM79	Fault: temperature reactor measurement 2 832.547.23	Check that sensors are functioning properly.	Contact service
STM81	Fault: temperature reactor 1 discharge measurement 832.547.11	Check that sensors are functioning properly.	Contact service
STM82	Fault: temperature reactor 2 discharge measurement 832.547.21	Check that sensors are functioning properly.	Contact service
STM84	Fault: PG cyclone temperature measurement 833.547.01	Check that sensors are functioning properly.	Contact service
STM85	Fault: HG cyclone temperature measurement 833.547.21	Check that sensors are functioning properly.	Contact service
STM88	Fault: combustion chamber temperature measurement 834.547.10	Check that sensors are functioning properly.	Contact service

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM93	Fault: exhaust gas pressure measurement before heat exchanger 832.564.18	Check that sensors are functioning properly.	Contact service
STM94	Fault: carbon monoxide measurement (reserve)	Contact Service	
STM95	Fault: exhaust gas velocity measurement (reserve)	undefined	
STM96	Fault: combustion air fan actual speed measurement 830.280.90	Check converter for message alerts	
STM97	Fault: exhaust gas recirculation fan actual speed measurement 830.280.20	Check converter for message alerts	
STM98	Fault: 24V DC SITOP +F21 cycle time	Contact service	Support from control technician required
STM99	Fault: 24V DC SITOP +F21 signal change	Contact service	Support from control technician required
STM100	Fault: 24V DC SITOP +F21 channel 1	Contact service	Support from control technician required
STM101	Fault: 24V DC SITOP +F21 channel 2	Contact service	Support from control technician required
STM102	Fault: 24V DC SITOP +F21 channel 3	Contact service	Support from control technician required
STM103	Fault: 24V DC SITOP +F21 channel 4	Contact service	Support from control technician required
STM104	Fault: 24V DC SITOP +F22 channel 1	Contact service	Support from control technician required
STM105	Fault: 24V DC SITOP +F22 channel 2	Contact service	Support from control technician required
STM106	Fault: 24V DC SITOP +F22 channel 3	Contact service	Support from control technician required
STM107	Fault: 24V DC SITOP +F22 channel 4	Contact service	Support from control technician required
STM108	Fault: 24V DC SITOP +F22 cycle time	Contact service	Support from control technician required

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM109	Fault: 24V DC SITOP +F22 signal change	Contact service	Support from control technician required
STM110	Fault: exhaust gas fan 1 measurement, current value HH limit value exceeded 830.280.12	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM111	Fault: exhaust gas fan 1 measurement, current value LL limit value fallen below 830.280.12	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM112	Fault: exhaust gas fan 2 measurement, current value HH limit value exceeded 830.280.11	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM113	Fault: exhaust gas fan 2 measurement, current value LL limit value fallen below 830.280.11	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM114	Fault: oxygen HG cyclone measurement, HH limit value exceeded 834.540.22	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM115	Fault: oxygen HG cyclone measurement, LL limit value fallen below 834.540.22	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM118	Fault: pressure reactor 1 measurement, HH limit value exceeded 832.564.12	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM119	Fault: pressure reactor 1 measurement, LL limit value fallen below 832.564.12	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM120	Fault: pressure reactor 2 measurement, HH limit value exceeded 832.564.22	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM121	Fault: pressure reactor 2 measurement, LL limit value fallen below 832.564.22	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM124	Fault: temperature reactor 1 measurement, HH limit value exceeded 832.547.13	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM125	Fault: temperature reactor 1 measurement, LL limit value fallen below 832.547.13	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM126	Fault: temperature reactor 2 measurement, HH limit value exceeded 832.547.23	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM127	Fault: temperature reactor 2 measurement, LL limit value fallen below 832.547.23	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM130	Fault: temperature reactor 1 discharge, HH limit value exceeded 832.547.11	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM131	Fault: temperature reactor 1 discharge LL limit value fallen below 832.547.11	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM132	Fault: temperature reactor 2 discharge, HH limit value exceeded 832.547.21	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM133	Fault: temperature reactor 2 discharge LL limit value fallen below 832.547.21	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM136	Fault: temperature PG cyclone measurement, HH limit value exceeded 833.547.01	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM137	Fault: temperature PG cyclone measurement, LL limit value fallen below 833.547.01	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM138	Fault: temperature HG cyclone measurement, HH limit value exceeded 833.547.21	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM139	Fault: temperature HG cyclone measurement, LL limit value fallen below 833.547.21	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM144	Fault: temperature combustion chamber limit value HH exceeded 834.547.10	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM145	Fault: temperature combustion chamber limit value LL fallen below 834.547.10	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM154	Fault: combustion air butterfly valve position limit value HH exceeded 834.371.01	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM155	Fault: combustion air butterfly valve position limit value LL fallen below 834.371.01	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM156	Fault: combustion air fan actual value limit value HH exceeded 830.280.90	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM157	Fault: combustion air fan actual value limit value LL fallen below 830.280.90	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM158	Fault: exhaust gas recirculation fan current value limit value HH exceeded 830.290.20	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM159	Fault: exhaust gas recirculation fan current value limit value LL fallen below 830.290.20	Several possible causes; support from Service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM242	Coolant circulating pump fuse 830.112.90	Inspect pump for damage and possible dry operation	
STM243	Emergency cooler (reserve) fan 1 fuse	undefined	
STM244	Emergency cooler (reserve) fan 2 fuse	undefined	
STM255	24VDC UV30 = 83-F11 (reserve) fuse	undefined	
STM256	Gas control valve fuse 834.371.02	Inspection of gas control valve for short-circuit by qualified electrician	Contact service if necessary
STM257	Warning: duct fan not in Auto	Check for current status	Set to Auto
STM258	Warning: coolant circulating pump not in Auto 830.112.90	Check for current status	Set to Auto
STM259	Warning: fan 1 emergency cooler not in Auto (reserve)	undefined	
STM260	Warning: fan 2 emergency cooler not in Auto (reserve)	undefined	
STM261	Warning: hose pump not in Auto (reserve)	undefined	
STM262	Warning: exhaust gas recirculation fan actual value GW H exceeded 830.290.20	Contact Service	
STM263	Warning: exhaust gas recirculation fan actual value GW L fallen below 830.290.20	Contact Service	
STM264	Warning: external customer circulating pump not in Auto 823.112.20	Check for current status	Set to Auto
STM265	Warning: backwash filter not in Auto 830.231.20	Check for current status	Set to Auto
STM266	Warning: washing tower washing water pump not in Auto 830.112.20	Check for current status	Set to Auto
STM267	Warning: active carbon filter not in Auto 830.334.10	Check for current status	Set to Auto
STM268	Warning: filler valve not in Auto 830.374.11	Check for current status	Set to Auto
STM269	Warning: flush valve not in Auto 830.361.21	Check for current status	Set to Auto
STM270	Warning: condensate pump not in Auto (reserve)	undefined	
STM271	Warning: dosing pump not in Auto 852.140.30	Check for current status	Set to Auto

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM272	Warning: fuse light =72-F71 (reserve)	undefined	
STM273	Feed temperature measurement fault 836.547.03	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM274	Discharge temperature measurement fault 836.547.21	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM275	Exhaust gas HT temperature measurement fault 836.547.22	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM276	Fault: temperature measurement exhaust gas reactor entrance 1 832.547.14	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM277	Fault: temperature measurement exhaust gas reactor entrance 2 832.547.24	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM278	Fault: forward dryer water temperature measurement 823.547.22	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM279	Fault: heating circuit water temperature measurement 823.547.23	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM280	Fault: heat sink water temperature measurement	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM281	Fault: exhaust gas entrance heat exchanger temperature measurement 835.547.01	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM282	Actual position gas control valve measurement fault 834.371.02	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM289	Fault: inflow temperature measurement limit value HH exceeded 836.547.03	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM290	Fault: inflow temperature measurement limit value LL fallen below 836.547.03	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM291	Fault: discharge temperature measurement limit value HH exceeded 836.547.21	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM292	Fault: discharge temperature measurement limit value LL fallen below 836.547.21	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM293	Fault message temperature WT exhaust gas limit value HH exceeded 836.547.22	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM294	Fault: HT exhaust gas temperature measurement, limit value LL fallen below 836.547.22	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM295	Fault: exhaust gas reactor entrance 1 temperature, limit value HH exceeded 832.547.14	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM296	Fault: exhaust gas reactor entrance 1 temperature, limit value LL fallen below 832.547.14	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM297	Fault: exhaust gas reactor entrance 2 temperature, limit value HH exceeded 832.547.24	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM298	Fault: exhaust gas reactor entrance 2 temperature, limit value LL fallen below 832.547.24	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics

Faults

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM299	Fault: gas control valve, actual position limit value HH exceeded 834.371.02	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM300	Fault: gas control valve, actual position limit value LL fallen below 834.371.02	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM321	Safety circuit: coolant circuit pressure switch 836.564.31	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM322	Safety circuit: "E 460.1"	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM324	Safety circuit: quencher water pressure switch 832.547.09	Check whether there is water pressure or if the pressure switch is defective	Contact service
STM325	Safety circuit: thermal flow protection 836.547.02	Check water pressure, contact service	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM326	Safety circuit: coolant flow controller 836.542.01	Check whether flow is present or examine functioning of flow controller	Contact service
STM330	Safety circuit: pH value measurement 1 too low 838.550.34	Inspect probe and supply of alkaline solution	Contact service
STM331	Fault: washing tower sodium hydroxide leak 838.554.01	Inspect the washing tower for leaks	Contact service
STM332	Safety circuit: alkaline dosing pump fault 852.140.30	Inspect the alkaline dosing pump	Contact service
STM333	Fault: alkaline pump leak 852.554.30	Inspect the alkaline dosing pump	Contact service
STM334	Safety circuit: pH value measurement 2 too low 838.550.34	Inspect probe and supply of alkaline solution	Contact service
STM335	Fault: IBC storage tank leak 852.554.11	Inspect the IBC container for leaks	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM337	Fault: pH value 1 emission control measurement 838.550.34	Inspect probe and supply of alkaline solution	Contact service

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM338	Fault: temperature 1 emission control measurement 838.547.56	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM339	Fault: pH value 2 emission control measurement 838.550.34	Inspect probe and supply of alkaline solution	Contact service
STM340	Fault: temperature 2 emission control measurement 838.547.56	Several possible causes; support from service required	An Internet connection and a technician (customer or PYREG) is required for rapid diagnostics
STM341	Washing water flow rate measurement fault 838.547.21	Check flow and flow controller	Contact service
STM342	Fault: washing water conductivity measurement 838.558.42	Inspect probe	Contact service
STM353	Fault: emission control pH value 1 limit value HH exceeded 838.550.34	PH value - basic	Contact service
STM354	Fault: emission control pH value 1 limit value LL fallen below 838.550.34	PH value - acidic	Contact service
STM355	Fault: emission control temperature 1 limit value HH exceeded 838.547.56	Exhaust gas temperature exceeded	Contact service
STM356	Fault: emission control temperature 1 limit value LL fallen below 838.547.56	Exhaust gas temperature fallen below	Contact service
STM357	Fault: emission control pH value 2 limit value HH exceeded 838.550.34	PH value - basic	Contact service
STM358	Fault: emission control pH value 2 limit value HH fallen below 838.550.34	PH value - acidic	Contact service
STM359	Fault: emission control temperature 2 limit value HH exceeded 838.547.56	Exhaust gas temperature exceeded	Contact service
STM360	Fault: emission control temperature 2 limit value HH fallen below 838.547.56	Exhaust gas temperature fallen below	Contact service
STM361	Fault at storage tank level > MAXMAX 838.554.41	Check whether Drain function is given	
STM362	Fault at storage tank level > MINMIN 838.554.41	Check whether Refill function is given	
STM363	Fault: pH values 1 and 2 differential too large 838.550.34	Check suds container fill level and inspect hose for blockage	

Faults

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM364	Fault: washing water flow rate - HH limit value exceeded 838.547.21	Contact service if this fault is not present as a consequential fault.	
STM365	Fault: washing water flow rate - LL limit value fallen below 838.547.21	Contact service if this fault is not present as a consequential fault.	
STM385	Fault: water temp. Flow dryer limit value HH exceeded 823.547.22	Contact service if this fault is not present as a consequential fault.	
STM386	Fault: water temp. Flow dryer limit value LL fallen below 823.547.22	Contact service if this fault is not present as a consequential fault.	
STM387	Fault: water temp. Heating circuit limit value HH exceeded 823.547.23	Contact service if this fault is not present as a consequential fault.	
STM388	Fault: water temp. Heating circuit limit value LL fallen below 823.547.23	Contact service if this fault is not present as a consequential fault.	
STM389	Fault: water temperature measurement heat sink limit value HH exceeded (N.A.)	Contact service if this fault is not present as a consequential fault.	
STM390	Fault: water temperature measurement heat sink limit value LL fallen below (N.A.)	Contact service if this fault is not present as a consequential fault.	
STM391	Fault: heat exchanger inlet exhaust gas temperature - HH limit value exceeded 835.547.01	Contact service if this fault is not present as a consequential fault.	
STM392	Fault: heat exchanger inlet exhaust gas temperature - LL limit value fallen below 835.547.01	Contact service if this fault is not present as a consequential fault.	
STM393	Fault: exhaust gas pressure before heat exchanger limit value HH exceeded 832.564.18	Contact service if this fault is not present as a consequential fault.	
STM394	Fault: exhaust gas pressure before heat exchanger limit value LL fallen below 832.564.18	Contact service if this fault is not present as a consequential fault.	
STM417	Fault: washing water conductivity limit value HH exceeded 838.558.42	Contact service if this fault is not present as a consequential fault.	
STM418	Fault: washing water conductivity limit value LL fallen below 838.558.42	Contact service if this fault is not present as a consequential fault.	
STM419	Fault: exhaust gas measurement O2 limit value HH exceeded 839.540.03	Contact service if this fault is not present as a consequential fault.	

Faults

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM420	Fault: exhaust gas measurement O2 limit value LL fallen below 839.540.03	Contact service if this fault is not present as a consequential fault.	
STM421	Fault: exhaust gas measurement CO limit value HH exceeded 839.540.03	Contact service if this fault is not present as a consequential fault.	
STM422	Fault: exhaust gas measurement CO limit value LL fallen below 839.540.03	Contact service if this fault is not present as a consequential fault.	
STM423	Fault: exhaust gas measurement SO2 limit value HH exceeded 839.540.03	Contact service if this fault is not present as a consequential fault.	
STM424	Fault: exhaust gas measurement SO2 limit value LL fallen below 839.540.03	Contact service if this fault is not present as a consequential fault.	
STM425	Fault: exhaust gas measurement CO2 limit value HH exceeded 839.540.03	Contact service if this fault is not present as a consequential fault.	
STM426	Fault: exhaust gas measurement CO2 limit value LL fallen below 839.540.03	Contact service if this fault is not present as a consequential fault.	
STM427	Fault: exhaust gas measurement NOx limit value HH exceeded 839.540.03	Contact service if this fault is not present as a consequential fault.	
STM428	Fault: exhaust gas measurement NOx limit value LL fallen below 839.540.03	Contact service if this fault is not present as a consequential fault.	
STM429	Fault: exhaust gas measurement flow rate in op. mode limit value HH exceeded 839.542.02	Contact service if this fault is not present as a consequential fault.	
STM430	Fault: exhaust gas measurement flow rate in op. mode limit value LL fallen below 839.542.02	Contact service if this fault is not present as a consequential fault.	
STM431	Fault: exhaust gas measurement flow rate in normal mode limit value HH exceeded 839.542.02	Contact service if this fault is not present as a consequential fault.	
STM432	Fault: exhaust gas measurement flow rate in normal mode limit value LL fallen below 839.542.02	Contact service if this fault is not present as a consequential fault.	
STM433	Fault: exhaust gas measurement temperature limit value HH exceeded 839.542.02	Contact service if this fault is not present as a consequential fault.	
STM434	Fault: exhaust gas measurement temperature limit value LL fallen below 839.542.02	Contact service if this fault is not present as a consequential fault.	

Faults

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM481	Fault: temperature measurement heating circuit return flow increase 823.547.24	Contact service if this fault is not present as a consequential fault.	
STM482	Fault: temperature measurement return flow HT HE 823.547.45	Contact service if this fault is not present as a consequential fault.	
STM483	Fault: temperature measurement hot water flow dryer 823.547.46	Contact service if this fault is not present as a consequential fault.	
STM484	Fault: pressure measurement HT HE circuit 823.564.01	Contact service if this fault is not present as a consequential fault.	
STM485	Fault: temperature measurement HE expiry 836.547.24	Contact service if this fault is not present as a consequential fault.	
STM486	Fault: temperature measurement LT heat exchanger 836.547.32	Contact service if this fault is not present as a consequential fault.	
STM487	Fault: pressure measurement before washer tower 836.564.01	Contact service if this fault is not present as a consequential fault.	
STM488	Fault: pressure measurement between washer tower and active carbon filter 838.564.01	Contact service if this fault is not present as a consequential fault.	
STM489	Fault: pressure measurement after active carbon filter 838.564.02	Contact service if this fault is not present as a consequential fault.	
STM497	Fault: temperature measurement heating circuit limit value HH exceeded 823.547.24	Contact service if this fault is not present as a consequential fault.	
STM498	Fault: temperature measurement heating circuit temperature limit value LL fallen below 823.547.24	Contact service if this fault is not present as a consequential fault.	
STM499	Fault: temperature return flow HT HE limit value HH exceeded 823.547.45	Contact service if this fault is not present as a consequential fault.	
STM500	Fault: temperature return flow HT HE limit value LL fallen below 823.547.45	Contact service if this fault is not present as a consequential fault.	
STM501	Fault: temperature hot water flow dryer limit value HH exceeded 823.547.46	Contact service if this fault is not present as a consequential fault.	
STM502	Fault: temperature hot water flow dryer limit value LL fallen below 823.547.46	Contact service if this fault is not present as a consequential fault.	

Faults

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM503	Fault: pressure HT HE circuit limit value HH exceeded 823.564.01	Contact service if this fault is not present as a consequential fault.	
STM504	Fault: pressure HT HE circuit limit value LL fallen below 823.564.01	Contact service if this fault is not present as a consequential fault.	
STM505	Fault: temperature HE expiry limit value HH exceeded 836.547.24	Contact service if this fault is not present as a consequential fault.	
STM506	Fault: temperature HE expiry limit value LL fallen below 836.547.24	Contact service if this fault is not present as a consequential fault.	
STM507	Fault: temperature LT heat exchanger limit value HH exceeded 836.547.32	Contact service if this fault is not present as a consequential fault.	
STM508	Fault: temperature LT heat exchanger limit value LL fallen below 836.547.32	Contact service if this fault is not present as a consequential fault.	
STM509	Fault: pressure before washer tower limit value HH exceeded 836.564.01	Contact service if this fault is not present as a consequential fault.	
STM510	Fault: pressure before washer tower limit value LL fallen below 836.564.01	Contact service if this fault is not present as a consequential fault.	
STM511	Fault: pressure between washer tower and active carbon filter limit value HH exceeded 838.564.01	Contact service if this fault is not present as a consequential fault.	
STM512	Fault: pressure between washer tower and active carbon filter limit value LL fallen below 838.564.01	Contact service if this fault is not present as a consequential fault.	
STM513	Fault: pressure after active carbon filter limit value HH exceeded 838.564.02	Contact service if this fault is not present as a consequential fault.	
STM514	Fault: pressure after active carbon filter limit value LL fallen below 838.564.02	Contact service if this fault is not present as a consequential fault.	
STM561	Mixer1 fuse 823.340.22	Several possible causes; support from service required	
STM562	Mixer2 fuse 823.340.32	Several possible causes; support from service required	
STM563	Mixer3 fuse 823.340.39	Several possible causes; support from service required	

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM564	Mixer4 fuse 823.340.49	Several possible causes; support from service required	
STM565	Mixer5 fuse 823.340.50	Several possible causes; support from service required	
STM566	Safety temperature switch 1 HT HE 823.547.42	Check temperature, reset switch if at set-point	
STM567	Safety temperature switch 2 HT HE 823.547.43	Check temperature, reset switch if at set-point	
STM568	Safety temperature switch 823.547.44	Check temperature, reset switch if at set-point	
STM569	Safety circuit: Safety circuit: Level HT HE < MIN1 823.554.01	HT heat exchanger water level min fallen below prealarm	
STM570	Safety circuit: Safety circuit: Level HT HE < MIN2 823.554.01	HT heat exchanger water level min min fallen below alarm	
STM571	Safety circuit: Differential pressure flow monitoring HT HE < MIN1 823.564.02	Flow water HT heat exchanger water flow min prealarm	
STM572	Safety circuit: Differential pressure flow monitoring HT HE < MIN2 823.564.02	Flow water HT heat exchanger water flow min min alarm	
STM573	Safety circuit: Maximum pressure limiter 1 HT HE 823.564.03	Water pressure HT heat exchanger too high prealarm	
STM574	Safety circuit: Maximum pressure limiter 2 HT HE 823.564.04	Water pressure HT heat exchanger too high alarm	
STM575	Safety circuit: Minimum pressure limiter 1 HT HE 823.564.05	Prealarm - HT heat exchanger water pressure too low	
STM576	Safety circuit: Minimum pressure limiter 2 HT HE 823.564.06	Alarm - water pressure HAT heat exchanger too low	
STM595	Safety circuit: Temperature switch LT heat exchanger 836.547.23	Alarm - HT water circuit water temperature too high	
STM596	Circulating pump2 fuse, hot water PYREG 823.112.30	Inspect for damage and running dry	
STM597	PYREG hot water circulating pump fuse 823.112.40	Inspect for damage and running dry	
STM602	Coolant pump fuse table cooler 836.112.31	Inspect for damage and running dry	

Faults

Fault code	Plain text message	Resolution step 1: determine current status/fault	Resolution step 2: fault clearance/recommendation
STM605	Fault: conveyor screw 1 carbon discharge motor protection switch	Check for mechanical blockage/damage	Clear the blockage, return bearings and screws to good working order (if required)
STM606	Fault: conveyor screw 2 carbon discharge motor protection switch	Check for mechanical blockage/damage	Clear the blockage, return bearings and screws to good working order (if required)

11 Upkeep

11.1 Service Address

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11.2 General information on upkeep

According to the DIN EN 13306 definition, upkeep can be divided into the areas of maintenance and repair.

This division requires that the PYREG unit have different procedures for shutdown and starting periods for works.

Upkeep work may be performed only by employees of PYREG GmbH, their authorised service partners, or other persons authorised by PYREG GmbH.



CAUTION

Material damage resulting from improper upkeep

If upkeep work is not carried out properly and correctly, further material damage or personal injury can occur as a result.

- Upkeep work may be performed only by employees of PYREG GmbH, their authorised service partners, or other persons authorised by PYREG GmbH.

Maintenance work may be performed by PYREG GmbH or its authorised service partners. It may be performed by trained and instructed employees of the operator only.



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.

- Ensure that all tasks are performed by personnel with appropriate qualifications only.

PYREG GmbH accepts liability for damage and operational faults due to operating error, failure to comply with this operating manual or improper repair in accordance with the General Business Terms and Conditions only. We explicitly state that only original, replacement and accessory parts approved by us are permitted for use. This also applies, logically, to the use of components from other manufacturers. For safety reasons, installation or use of unauthorised replacement and accessory parts is not permitted and excludes any liability on the part of PYREG GmbH for resultant damages.



NOTE

The unit operator is advised to prepare and manage the corresponding documents in accordance with normative provisions for proof of maintenance work undertaken.

11.3 Control procedures and inspection devices

Visual inspection and the measures and inspection devices integrated at the unit are sufficient for routine monitoring of unit components.

11.4 Specialised tools, equipment and materials

Lubrication gun, bearing grease, high temperature bearing grease for exhaust fans, copper paste for all screw threads and connections at maintenance openings.

11.6 Warning and prohibition signage

11.6.1 Position of identification plate

The identification plate is located at the top of the free side of the switch cabinet.



Illustration 172 Identification plate

11.6.2 Position of warning and prohibition signage

The warning and prohibition signs must be clearly visible and undamaged. If they are badly damaged or misplaced the operator must ensure that they are replaced immediately.

The same applies for the identification plate. In this case, the replacement must be made via the manufacturer.



WARNING

Risk of Injury

If the warning and prohibition signs are not clearly visible or are removed, significant bodily injury can result.

- Badly damaged, faded, misplaced or removed warning and information signs must be replaced immediately.

Individual locations of warning and prohibition signs at and in the unit:



Illustration 176 Front of unit



Illustration 175 Left corner post



Illustration 174 Central corner post



Illustration 173 Right corner post



Illustration 177 Rear post; right-hand side



On all drive engines.

Illustration 178 Drive engines



Illustration 179 Outer equipment container door



Illustration 181 Equipment container pipeline



Illustration 180 At pipe heat exchanger



This sign can be obtained from the unit manufacturer.

Illustration 182 Under main switch



Illustration 184 Heating



Illustration 185
Equipment container
subdistribution



Illustration 183
Switch cabinet

11.7 Maintenance

11.7.1 General information

The entire unit must be labelled before beginning maintenance work in accordance with occupational safety.



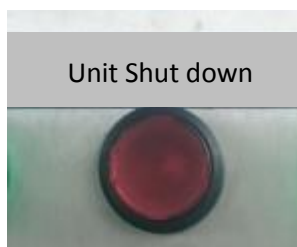
NOTE

The operator can use signs similar to those in Illustration 186 Warning sign in order to make it known that maintenance works are being carried out at the unit.



Illustration 186 Warning sign

The unit must be shut down in a controlled manner.



The “SHUT DOWN UNIT” button must be activated on the switch cabinet in order to shut down the unit.

This results in operational shutdown (see [8.3 Operational shutdown](#)) of the unit.

Illustration 187 “Unit Shut down” button

For personal occupational safety reasons, the unit must cool down for at least 12 hours (for outdoor installation) at ambient temperature before commencement of maintenance work.

This period is 36 hours in the case of maintenance work on the combustion chamber.



CAUTION

Danger of injury from hot surfaces

In the event of unit shutdown, there remain unit surfaces with a temperature in excess of +65°C.

Burn injuries can occur as a consequence.

- Assembly, dismantling and maintenance work may not be performed in the immediate aftermath of a shutdown.
- The unit must cool down for a minimum of 12 hours.
- Protective clothing and gloves should be worn to avoid injury.



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.

- Ensure that all tasks are performed by personnel with the appropriate qualifications only.



NOTE

It is recommended that the operator makes a surface thermometer available to his employees. The thermometer should provide contact-free measurement if possible. It should cover a temperature range of at least 0°C to +1000°C.

It should be used before commencement of work to measure the temperature at the areas at which maintenance work will be performed.

If repair work is carried out inside the combustion chamber, the cover of the chamber must be opened, observing personal occupational safety, after the prescribed cool-down time. Loosen the union nuts and



Illustration 188 Front side of combustion chamber

screws for this purpose.

The combustion chamber must then cool down for another 24 hours. Only then, and after a new temperature measurement, can repair work be performed inside the combustion chamber.



Illustration 189 Combustion chamber with door open

When carrying out repair works in the equipment container, it is important to note that acid condensate is accrued in the exhaust gas condensation unit.



DANGER

Danger of injury from corrosive liquids

Improper handling of corrosive liquids can result in severe injury.

- The operator must ensure that only trained personnel come into contact with such liquids.
- The operator must keep the necessary protective equipment at hand for employees and must make it available to them.
- Observe the safety data sheet.



11.7.2 Maintenance Intervals

Component	Position	Number	Frequency	Maintenance to be performed
General information 11.7.3.1	1 pressure sensor x HT heat exchanger per 1x reactor	3	6 months	Set to 0 during unit shutdown
Reactor 11.7.3.2	Exhaust gas piping	2	1 week	Cleaning + visual inspection
	Process gas piping	2	1 week	Cleaning + visual inspection
	Outer shell	4	3 months	Visual inspection
	Screw conveyors	4	2 weeks	Visual inspection
	Drive gears	4	2 weeks	Visual inspection/ lubrication
Discharge 11.7.3.3	Cyclone - rotary valve cleaning opening	1	2 weeks	Cleaning + visual inspection
Rotary valves 11.7.3.7	At feed At discharge Under process gas cyclone	4	1 month	Cleaning as necessary Visual inspection/ lubrication
Combustion chamber 11.7.3.8	Slag pot	1	1 week	Empty; replace insulation and seal Visual inspection of the interior hot gas pipe using inspection glasses
Process gas cyclone 11.7.3.10	Dust collector in cyclone from outside		2 to 3 times daily	
	Dust collector in cyclone - complete	1	1 week	Cleaning
Exhaust gas-driven compressor	Pedestal bearing	4	1 month	Lubricate
	Belts	4	1 month	Check / tension / exchange

Feed 11.7.3.11	Feeding screw	2	6 months	Visual inspection
	Check sliding floor storage routing	4	2 weeks	Visual inspection
	Manometer	1	1 month	Inspect gas pressure
Burner	Igniter	1	6 months	Clean electrodes
Hot gas cyclone	Oxygen probe	1	1 month	Visual inspection/change filter
Heating circuit	Tube heat exchanger	1	1 month	Cleaning of exhaust system
	Bomat heat exchanger	1	2 weeks	Cleaning of ceramic tubes
Electronics Switch cabinet	Air conditioner	1	annually	in accordance with manufacturer operating manual in appendix
	Sensors			in accordance with manufacturer specifications in appendix
Pressure, measurement and control technology	Emergency Off, UPS, FI, switch cabinet lighting, feed end switch (access protection), check TAS		6 months	
Water circuit	Generally, in the entire unit		3 months	For leakage, corrosion, external residue
	Frost protection		depending on time of year	Measure amounts of anti-freeze
	Pressure tightness during downtime		3 months	Pressure testing
Compressor	Maintenance as per manufacturer			
	if present in the unit		daily	

11.7.3 Maintenance work in the unit platform

11.7.3.1 General information

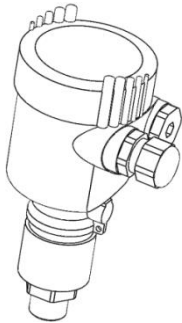


Illustration 190 Pressure sensor

The pressure sensors are located at the respective reactors underneath the feed shaft and above the HT heat exchanger. They are calibrated with the aid of a support instrument. Please refer to the manufacturer's operating manual in the appendix for details of the calibration procedure.

11.7.3.2 Reactors

Use of an industrial vacuum cleaner is recommended for cleaning of pipework. This can be used to suck combustion residues out of the pipework.

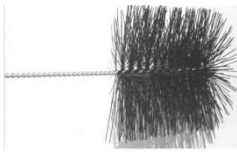


Illustration 191 Stove pipe scrubber

Adhesive residues are removed with a steel wire circular brush (stove pipe scrubber or smokestack scrubber) with a diameter of 10 or 15 cm.



WARNING

Danger of injury from dust and soot particles

The dust and soot particles that escape during cleaning can, if they enter the eyes and respiratory tract, result in impairment of sight and to respiratory symptoms.

- Wear appropriate personal protective equipment during cleaning.

The areas to be cleaned are the exhaust gas and process gas pipework.

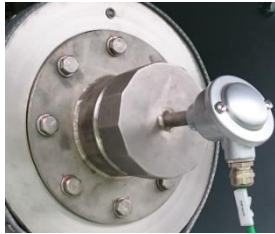


Illustration 193 Maintenance area 1



Illustration 192 Maintenance area 2



Illustration 195 Maintenance area 1 open



Illustration 194 Maintenance area 2 open

Opening of maintenance areas with a temperature measurement device is described in the following:



Illustration 196 Clamping screws

Clamping screws on the underside of the protective tube must be loosened in order to remove thermal elements from the tube. The thermal element can then be lifted carefully out of the protective tube. It is important to make sure that the thermal element is neither broken nor damaged in another way during this process. The connected cables are so long that the thermal element in proximity can be set down on an appropriate underlay.



CAUTION

Material damage resulting from improper disassembly

In the event of damage to the thermal element, material damage may result during operation of the unit due to incorrect measurement values.

- Avoid causing damage during assembly and disassembly.
- Read the manufacturer's assembly instructions.

The butterfly valve can then be unscrewed. The interior insulation pack secured to the top must be noted. Conduct a visual inspection for damage here.



Illustration 197 Insulation pack

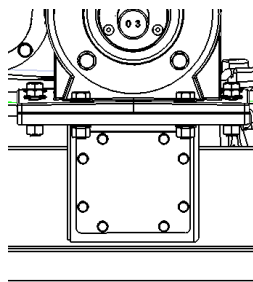
After cleaning, assembly is carried out in the reverse sequence. It is important to ensure that all clamping screws (see Illustration 196 Clamping screws) are tightly fastened.



NOTE

After cleaning with an industrial vacuum cleaner, particles of dirt must be disposed of in accordance with local environmental and waste disposal regulations.

11.7.3.3 Cleaning opening



The cleaning opening is removed by loosening the screws. Then clean accessible areas as needed.

Illustration 198 Cleaning opening

11.7.3.4 Screw conveyors

There are 4 different screw conveyors in the unit. Visual inspection of these is described below.

The discharge (see Illustration 2 Unit platform. [page - 21 -](#)):

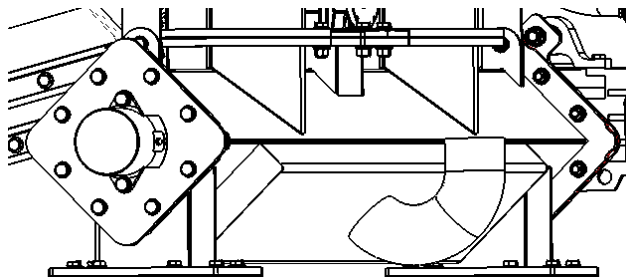


Illustration 199 Discharge

The visual inspection should check for damage or leaks or loose fastening elements.



CAUTION

Material damage resulting from operation with defective machinery parts

Operation with defective machinery parts may result in significant additional damage.

- If the unit has defective machinery parts, it must be shut down/must not be put into operation.
- The defective machinery parts must be replaced immediately.

If visible defects are identified at these areas, PYREG GmbH's Service department must be contacted immediately.

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Particular attention must be paid to the following areas:

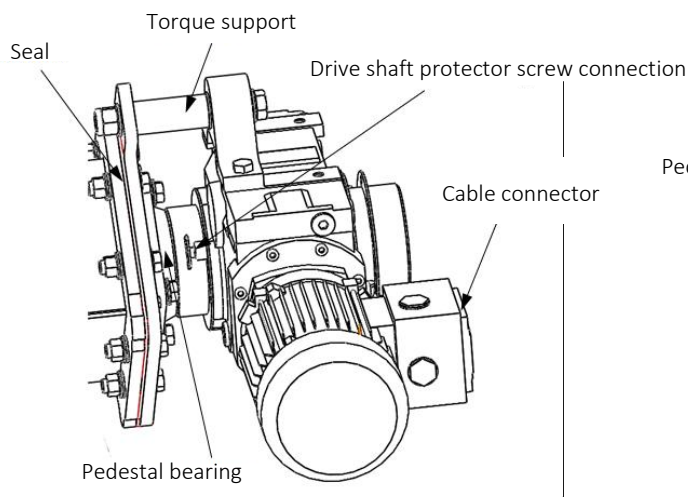


Illustration 200 Motor-side conveyor screws

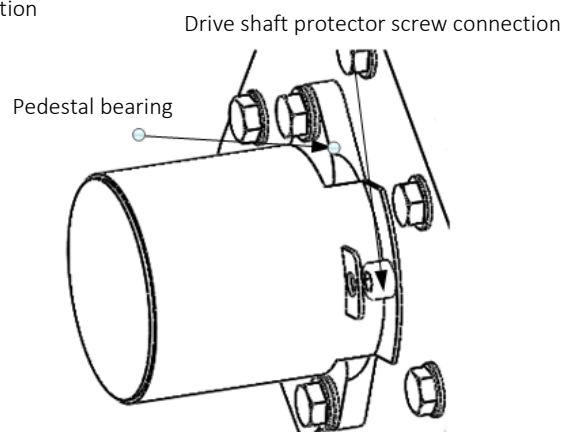


Illustration 201 Discharge-side conveyor screws

The drive shaft protector on the discharge side must be removed and screwed on again after the visual inspection.

11.7.3.5 Reactor screw conveyor

Without the handling protection shown above

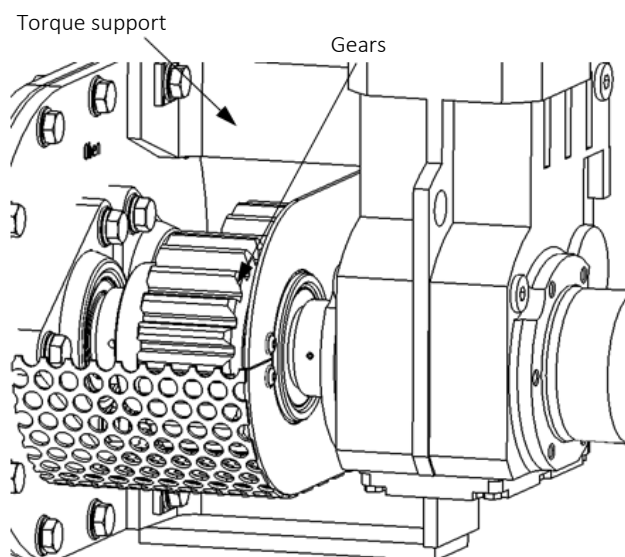
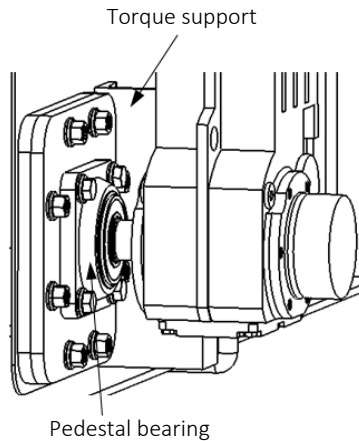


Illustration 202 Reactor drive gears

The gears can be lubricated as needed.
Application of a sprayable lubricant through one of the contact protectors from above to one of the cellular wheels is recommended.
The lubricant used should be a high-temperature lubricant.
PYREG uses Würth HHS LUBE.

11.7.3.6 Storage tank screw conveyors



The visual inspection should check for damage or leaks or loose fastening elements.

Illustration 203 Storage tank screw conveyors

11.7.3.7 Rotary valves

There are 4 rotary valves in the unit. (see Illustration 2 Unit platform- 25 -); one each between the storage tank and the reactors. There is one underneath the process gas cyclone and one between discharge and conditioning screw.



CAUTION

Material damage resulting from operation with defective machinery parts

Operation with defective machinery parts may result in significant additional damage.

- If the unit has defective machinery parts, it must be shut down/must not be put into operation.
- The defective machinery parts must be replaced immediately.

If visible defects are identified at these areas, PYREG GmbH's Service department must be contacted immediately.

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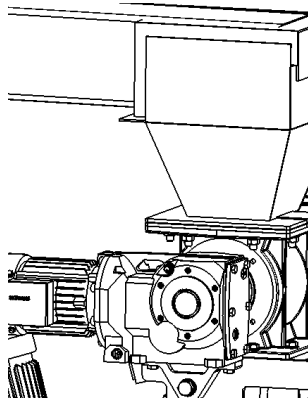


Illustration 206 Feed rotary screws

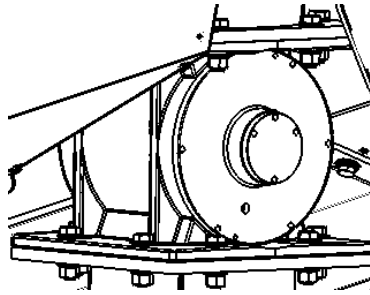


Illustration 204 Process gas cyclone rotary screw (discharge)

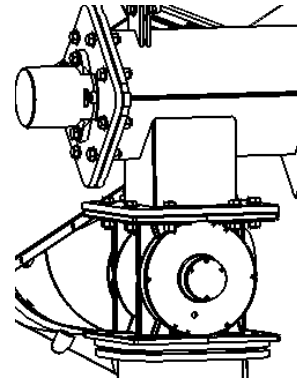
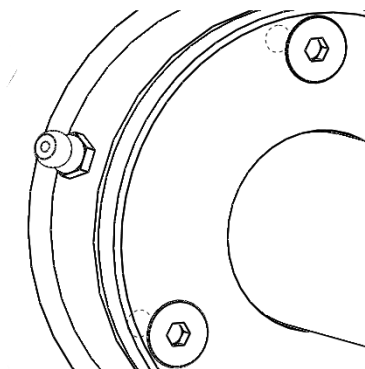


Illustration 205 Discharge rotary screw

The rotary valves on the feed side differ from the valves on the discharge side in terms of their design.



There is a grease nipple located between the flanged motor and the rotary valve's casing. It is recommended that the bearing station be filled with high temperature lubricant (PEERLESS LLG) once a month. A standard lubrication gun with the option to connect to a conical grease nipple can be used for this purpose in accordance with DIN 71412.

Illustration 207 Rotary valve lubrication point

It is recommended that the rotary valves on the discharge side undergo cleaning once per month in accordance with the maintenance schedule. The rotary valves on the feed side can be cleaned as necessary.

Cleaning a rotary valve requires that the cellular wheel be removed.



CAUTION

Danger of injury from sharp angles

Failure to observe can result in lacerations.

- Wear appropriate protective clothing.





WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.

- Ensure that all tasks are performed by personnel with the appropriate qualifications only.

The following procedure is used to remove the cellular wheel:

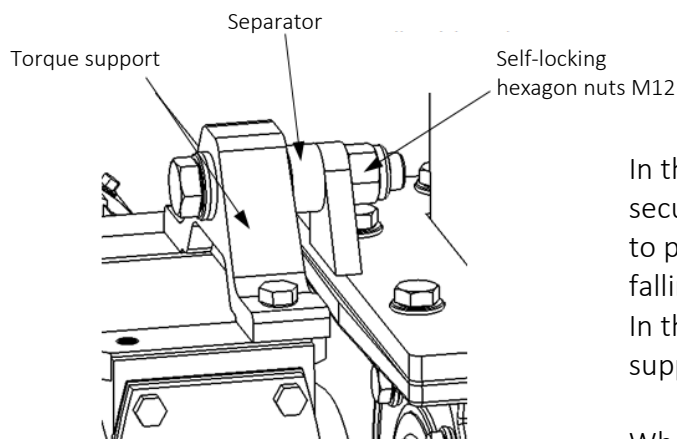


Illustration 208 Torque support

In the first step, the motor should be secured by means of a suitable resource to protect it from rotating downwards and falling off during disassembly. In the second step, the motor's torque support must be removed.

When the hexagon screw is pulled out, the separator must be secured so that it cannot fall down using a suitable tool.



WARNING

Danger of injury due to crushing

If the motor is not secured against rotation and falling, crushing and shearing may result.

- Secure the motor against rotation and falling.



NOTE

Self-locking hexagon nuts should be used only once with a plastic clamping component, in accordance with DIN ISO 10511.

Finally, the motor must be extracted from the drive shaft. Avoid causing damage to the power supply cable in this process. The motor between discharge and the conditioning screw can be placed on the ground.

For the motor of the rotary valve under the process gas cyclone, the power supply's plug connection must be separated at the upper cable duct. Otherwise, the power supply may be corrupted.



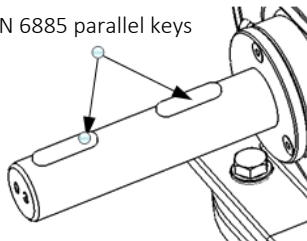
CAUTION

Material damage resulting from improper disassembly

In the event of corruption of power supply, material damage may be caused during operation of the unit.

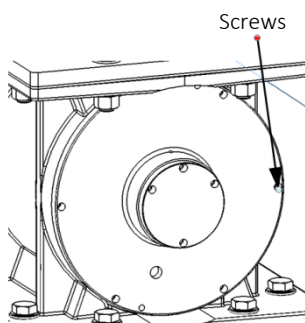
- Avoid causing damage during assembly and disassembly.
- Read the manufacturer's assembly instructions.

DIN 6885 parallel keys



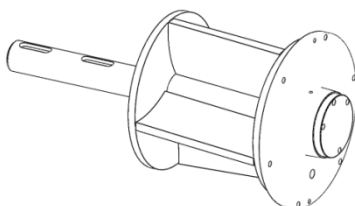
The cleared fitting keys can now be removed from the shaft and set down.

Illustration 209 Fitting keys



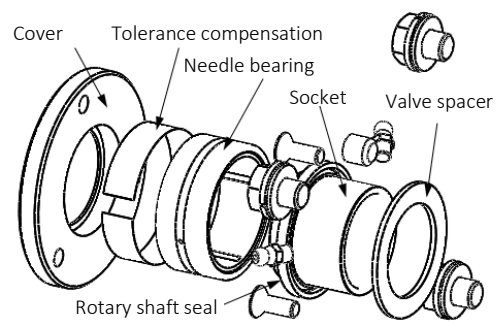
Then, unfasten the 6 screws on the cover. The cover can then be removed carefully with the rotary wheel.

Illustration 210 Rotary valve cover



The interior space and rotary wheel can now be cleaned. The drive shaft should be inspected for damage.

Illustration 211 Rotary wheel with cover



The position of the rotary valve on the driven side must be inspected for damage, particularly the needle bearing and the socket.

Illustration 212 Rotary valve position

Assembly is carried out in the reverse sequence.

11.7.3.8 Combustion chamber



The slag pot under the combustion chamber should only be disassembled by means of an appropriate hoist. In the first step, the hoist is positioned centrally under the slag pot and set up in such a way that the slag pot cannot fall down. The 3 tension levers are then opened. The slag pot can now be lowered and removed.

Illustration 213 Combustion chamber slag pot



WARNING

Danger of injury from falling objects

If a hoist is not used to disassemble the slag pot, personal injury can result.



- Only use suitable hoists for disassembly.
- Wear personal protective equipment.



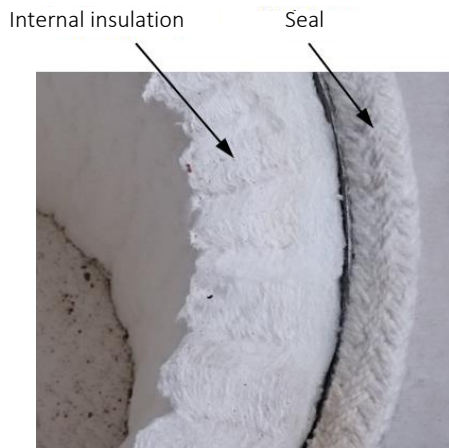
WARNING

Danger of injury from dust and soot particles

The dust and soot particles that escape during cleaning can, if they enter the eyes and respiratory tract, result in impairment of sight and to respiratory symptoms.



- Wear appropriate personal protective equipment during cleaning.



It should be cleaned at a suitable location using an industrial vacuum cleaner. At the same time, inspect sealing and internally-located insulation for damage. If damage to components is detected, they can be obtained as spare parts.

Illustration 214 Slag pot insulation



CAUTION

Material damage resulting from operation with defective machinery parts

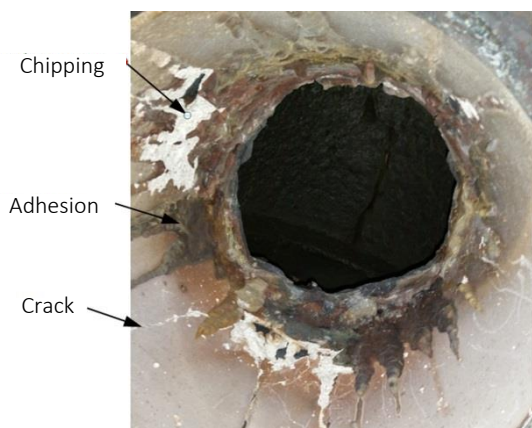
Operation with defective machinery parts may result in significant additional damage.

- If the unit has defective machinery parts, it must be shut down/must not be put into operation.
- The defective machinery parts must be replaced immediately.



NOTE

After cleaning with an industrial vacuum cleaner, particles of dirt must be disposed of in accordance with local environmental and waste disposal regulations.



The combustion chamber's ceramic insulation must be visually inspected for damage before the slag pot is reassembled.

PYREG's Service department must be contacted if significant damage, e.g. cracks, bursts, chipping, adhesions or similar, is detected.

Illustration 215 Combustion chamber damage

Slag pot assembly is carried out in the reverse sequence.

In this process, it is important to make sure that the round cord seal is assembled correctly.



In addition, a visual inspection should be undertaken on the front side of the interior area using the inspection glasses.

Illustration 216 Inspection glasses

11.7.3.9 Hot gas cyclone



Illustration 217 Hot gas cyclone slag pot

The slag pot under the hot gas cyclone should only be disassembled by means of an appropriate hoist. In the first step, the hoist is positioned centrally under the slag pot and set up in such a way that the slag pot cannot fall down. The 3 tension levers are then opened. The slag pot can now be lowered and removed.



WARNING

Danger of injury from falling objects

If a hoist is not used to disassemble the slag pot, personal injury can result.



- Only use suitable hoists for disassembly.
- Wear personal protective equipment.



WARNING

Danger of injury from dust and soot particles

The dust and soot particles that escape during cleaning can, if they enter the eyes and respiratory tract, result in impairment of sight and to respiratory symptoms.



- Wear appropriate personal protective equipment during cleaning.



It should be cleaned at a suitable location using an industrial vacuum cleaner. At the same time, inspect sealing and internally-located insulation for damage.

Illustration 218 HG cyclone slag pot insulation



CAUTION

Material damage resulting from operation with defective machinery parts

Operation with defective machinery parts may result in significant additional damage.

- If the unit has defective machinery parts, it must be shut down/must not be put into operation.
- The defective machinery parts must be replaced immediately.



The individual chambers of the radial element can then be vacuumed with an industrial vacuum cleaner. Following this, careful lifting of the element from the pot and cleaning of the floor of the slag pot is recommended.

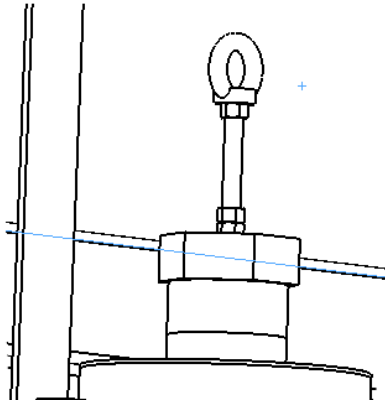


NOTE

After cleaning with an industrial vacuum cleaner, particles of dirt must be disposed of in accordance with local environmental and waste disposal regulations.

Assembly is performed in the reverse sequence.

11.7.3.10 Process gas cyclone



The inside of the dust collector must be cleaned 2 or 3 times a day. Raise the dust collector to the ring screw vertically, by about 5 cm, and release.

Illustration 219 Dust collector



CAUTION

Danger of injury from hot surfaces

The dust collector is cleaned while in operation.

Burn injuries can occur as a consequence.

- Protective clothing and gloves must be worn to avoid injury; this is a mandatory requirement.

11.7.3.11 Storage tank, feed worms, sliding door frame

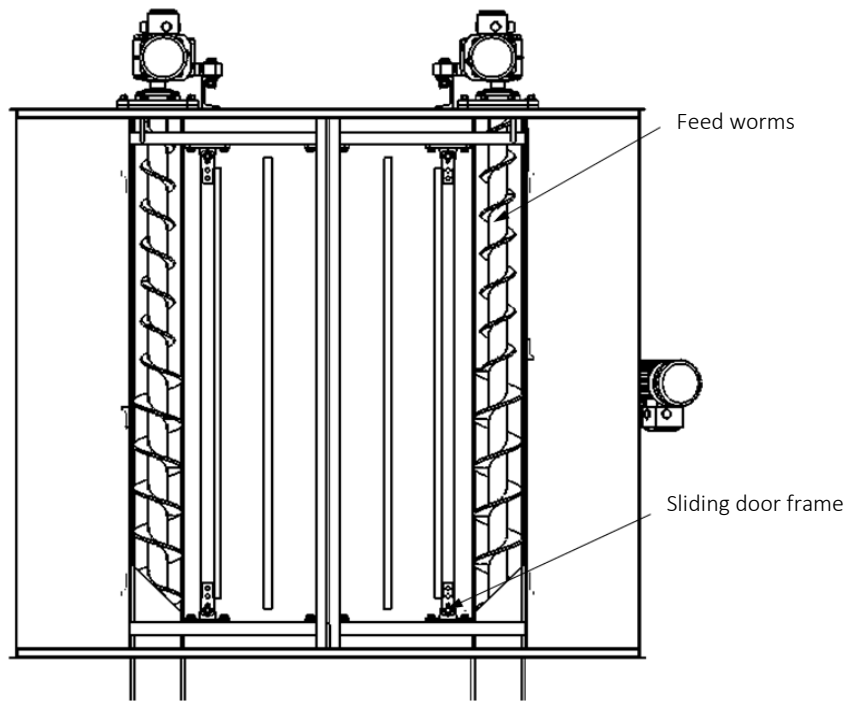


Illustration 220 Feed worms

The storage tank should be run dry for visual inspection of the feed worms in the process. The feed worms should be inspected visually for noticeable damage only.



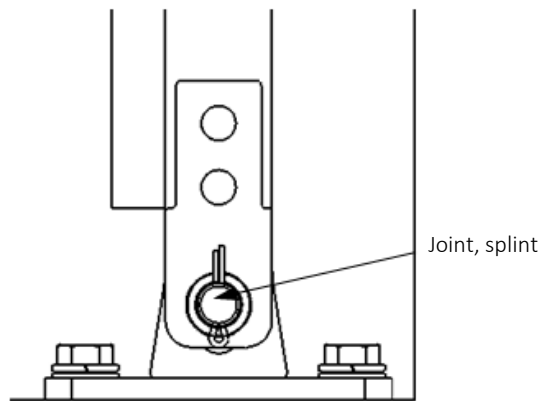
WARNING

Danger of injury resulting from climbing into the tank

Climbing into the tank can result in significant bodily injury.

- Enter the tank only for necessary repair works.

If it is necessary to enter the tank for repair work, however, a second employee must be present. This person can provide assistance for entry and exit. He also ensures that no other persons can put the unit into operation while work is being performed on it.



The sliding door frame joints must also be inspected, particularly the splint.

Illustration 221 Joint and splint

11.7.4 Maintenance work in the equipment container

The equipment container can be entered during unit operation for monitoring and inspection purposes with the recommended personal protective equipment. However, performance of maintenance and upkeep work in the equipment container is prohibited while the unit is in operation.



CAUTION

Danger of injury from hot surfaces

There are pipelines and elements with temperatures in excess of 65°C in the equipment container.

Burn injuries can occur as a consequence.

- Protective clothing and gloves must be worn to avoid injury; this is a mandatory requirement.

In general, look out for unsealed pipelines and damage to such pipelines in the equipment container.

11.7.4.1 The pipe heat exchanger



Illustration 222 Cleaning cover

In order to perform maintenance work on the pipe heat exchanger in the equipment container, the cleaning cover on the right-hand side must be opened.



Illustration 223 Pipe heat exchanger internal area

The entire inner space should then be flushed and cleaned.

11.7.4.2 The fans

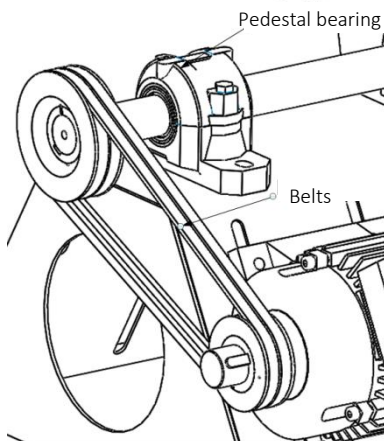


Illustration 224 Exhaust gas fan

The pedestal block is filled using standard lubricant and a grease gun.

The fan belts must be manually inspected for voltage. A visual inspection to check for any kind of damage is sufficient. If damage is detected at one of the fan belts, both fan belts must be replaced with new ones immediately.

11.7.5 Description of repair intervals for electrical components

Electrical units must be inspected every 4 years in accordance with DIN VDE 0100.



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.

- Ensure that all tasks are performed by personnel with the appropriate qualifications only.



DANGER

Danger to life from electric current

Contact with live lines or components presents a danger to life. Observe the following safety instructions in order to avoid electrical hazards:

- Work on electrical equipment may only be performed by a qualified electrician or trained staff under the management and supervision of a qualified electrician, in accordance with electrical engineering standards.
- Defects identified on electrical units/components/equipment must be rectified immediately. In the meantime, in the event of immediate danger, the P500 may not be operated in a defective condition.
- Unit components requiring inspection, maintenance and repair work must be disconnected from the mains supply if specified. Parts which have been disconnected must first be checked for voltage, then earthed and short-circuited and isolated from live neighbouring parts.
- If works are required on live parts, make sure a second person is present who can switch off the main switch in the event of an emergency. Cordon off the work area with a red and white safety chain and a warning sign. Use voltage-isolated tools only.

Component	Maintenance interval	Measures
UPS	Annual inspection	Cleaning, functional test, check battery
Surge protection	Annually and after all lightning events	
Fault-current circuit breaker	Activate test button every 6 months; every 4 years according to VDE 0100	
Switch cabinet ventilator	Every six months	For contamination/ change filter pad
Switch cabinet heating	Every 4 years in accordance with VDE0100	
Semi-conductor relays	Annually	Check settings
Frequency converter	Annually	Clean cooler housing, ventilator
Automatic gas firing	Maintenance-free; self-monitoring	
Lambda controller	Inspection every 5,000 operating hours	
Lambda sensor	Weekly cleaning; inspection every 5,000 operating hours	
Pressure sensors	Every 2 years	Recalibration
Emergency Stop	Annually - VDE 0113	Depending on hazard category; can be specified up to daily inspection

12 Disassembly

12.1 General information on disassembly

The Machinery Directive 2006/42/EC (as of 07/2016) contains no requirements in respect of disposal, reuse or recycling of machinery components or materials if the machinery is scrapped.

Thus, the subject is not treated in this operating manual.

The measures to be taken in order to prevent risks during decommissioning and disposal of the machinery at its end of life can, for example, include: ensuring that components containing hazardous substances are continuously and appropriately labelled; ensuring that hazardous substances contained in the machinery can be discharged safely, and ensuring that all stored energy can be removed safely if the machinery is put out of operation, so that disposal hazards can be avoided.



NOTE

The applicable national, regional and local regulations must be observed with regard to the disposal of all materials and liquids.

Possible hazards during disassembly:



DANGER

Danger to life from electric current

Contact with live lines or components presents a danger to life. Observe the following safety instructions in order to avoid electrical hazards:

- Work on electrical equipment may only be performed by a qualified electrician or trained staff under the management and supervision of a qualified electrician, in accordance with electrical engineering standards.
- The unit must be completely isolated from the power supply before disassembly commences. Parts which have been disconnected must first be checked for voltage, then earthed and short-circuited.
- If works are first required on live parts, make sure a second person is present who can switch off the main switch in the event of an emergency. Cordon off the work area with a red and white safety chain and a warning sign. Use voltage-isolated tools only.



WARNING

Danger of injury from dust and soot particles

The dust and soot particles that escape during disassembly can, if they enter the eyes and respiratory tract, result in impairment of sight and to respiratory symptoms.

- Wear appropriate personal protective equipment during disassembly.



You can also avail of support during disassembly from PYREG GmbH, its authorised service partners or other persons authorised by PYREG GmbH.

12.2 Prerequisites for Disassembly

After operational shutdown (see 8.3 Operational shutdown), the unit must undergo a cooling-down period of at least 36 hours.

The water and gas supply connections must be closed off at the nearest possible shut-off elements outside of and in the feeding lines of the unit. Shut-off options within the unit should then be set in motion.



DANGER

Danger to life from escaping gas

Defective disconnection from the gas supply can result in explosion or fatal injury.

- Separation of the pilot gas burner from the gas supply must be performed by appropriately qualified personnel or an authorised specialist company.



Illustration 225 Gas supply disconnection point 01

12.3 Other disconnection points

The unit platform and equipment container must be disconnected from energy supply and feed lines before transportation.

The two main component groups may only be transported individually.

Observe the handbook [6.4 Handling during transportation](#).



Illustration 226 Disconnection point 02



Illustration 227 Disconnection point 03

Work on electrical equipment may only be performed by a qualified electrician or instructed staff under the management and supervision of a qualified electrician, in accordance with electrical engineering standards.



Illustration 228 Disconnection point 04



Illustration 229 Disconnection point 05

After disconnecting all connections, the fixing screws between the equipment container and the unit platform must be unscrewed.



Altogether, there are 4 such disconnection points at the pillars.

Illustration 230 Equipment container -
Unit platform screw connection

The unit platform and the equipment container are equipped with floor anchoring at various points. It is imperative that these are undone before lifting. The locations of the floor anchorings are based on the particulars of the installation site. Hence, the base plates must be disassembled at the accessible points in the unit platform and the equipment container.



Illustration 231 Floor anchoring



DANGER

Danger to life resulting from floor anchoring that has not been detached

If all floor anchorings are not completely detached, significant material damage to the means of transport and the installation surface at the installation site can result during the attempt to transport the unit, and significant injury to persons and material damage can also result as a consequence.

- All floor anchorings must be undone before transportation is attempted.
- An inspection should be performed by at least 2 independent persons.

13 Additional technical information

13.1 Emission measurement technology instrumentation

The PYREG unit's exhaust gas emissions can be divided into two groups:
Emissions caused by the fuel's concomitant substances (e.g. heavy metals, SO₂, HCL, HF, etc.).

These emissions cannot be influenced significantly by primary measures such as adjustment of combustion parameters (lambda).

These emissions must be reduced by means of secondary measures such as, for example, downstream exhaust emission treatment (washer, filter) or indeed be prevented by means of a prescreening process (fuel analysis) of the material to be treated. A fuel analysis facilitates an advance material flow forecast for estimation of the emission levels to be expected. If an excess is forecast, the appropriate secondary measures should be provided.

Emissions that can be controlled by the influence of furnace parameters (air-fuel ratio, lambda value).

In the PYREG unit, emission of NO_x, CO and also residual C_xH_y, dioxin, benzopyrene, etc. is dependent on maintenance of the required furnace temperature of > 850°C by lambda and on the fuel composition. At constant temperatures in the combustion chamber (> 1100°), emissions strictly follow the fuel-air ratio (lambda).

When waste material is used for mineralisation, reduced instrumentation with reference to the requirements of the 17th BImSchV (Federal Emissions Protection Act (Germany)) for safe control of low exhaust gas emissions is technically viable in combination with the fuel analyses to be conducted as described above (composition, heating value, noxious substances).

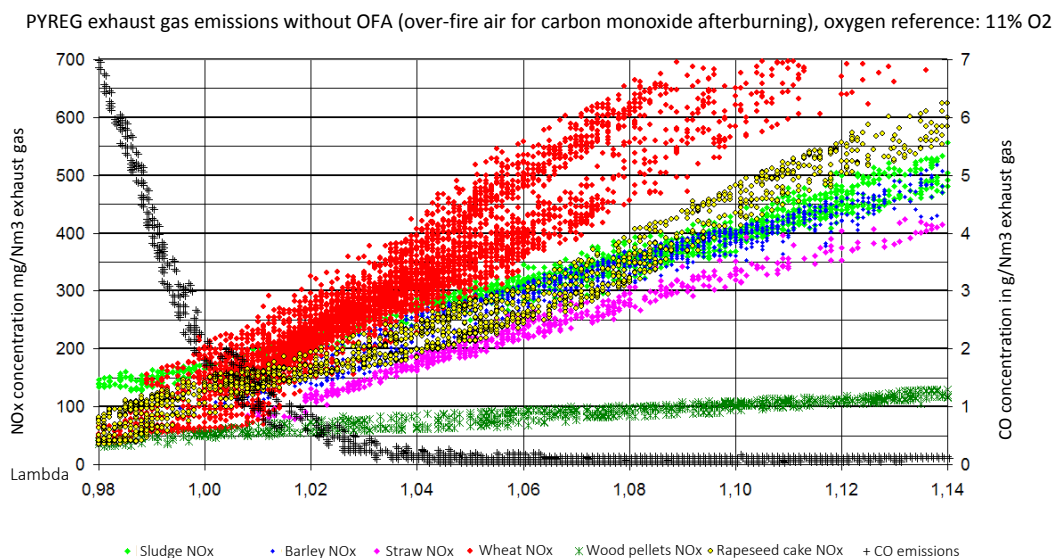
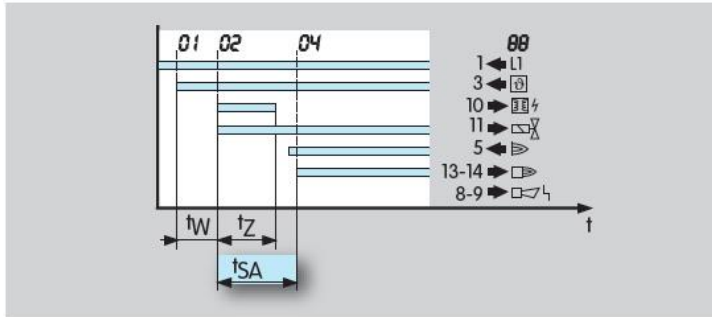
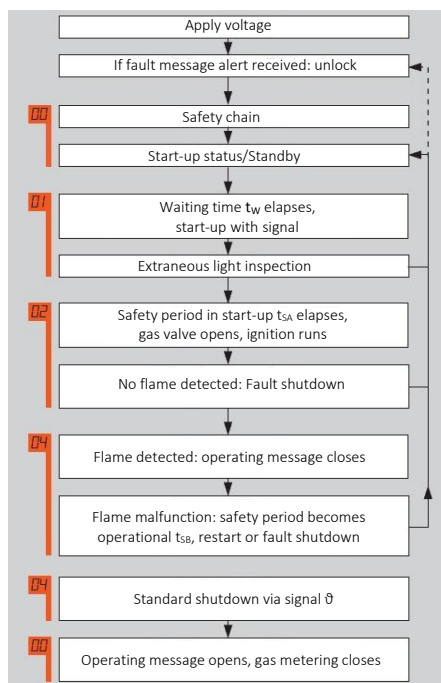


Illustration 232 Exhaust gas emissions

13.2 Pilot burner starting procedure



After applying the start-up signal (0), the burner is monitored for extraneous light by the automatic gas firing system during the waiting period t_w . If no extraneous light is detected during this period, the safety period is started up t_{SA} (3, 5 or 10 seconds). This is the minimum operating time of the automatic gas firing system and the burner. The gas valve and ignition transformer are supplied with voltage. After the safety period start-up t_{SA} and the flame message, the operation signalling contact between clamps 13 and 14 is closed. The display shows the current program status.



Source: *Kromschröder Docuthek* (document library)

13.3 Definition of unit parameters

13.3.1 General information

The entire unit must be labelled before beginning the work in accordance with occupational safety.



NOTE

The operator can use signs similar to those in Illustration 233 Warning sign in order to make it known that works are being carried out at the unit.



Illustration 233 Warning sign

13.3.2 12.4.2 Calculation of feeding screw' conveying capacity

The feeding screw' conveying capacity is calculated, without exception, for the fuel being used only.

The feeding screw' theoretical conveying capacity must be calculated for the fuel employed (9.2 Initial start-up) before initial start-up. This is to be performed by PYREG GmbH at the unit's place of manufacture only.

Calculation of the conveying capacity of the feeding screw following major modifications or change in fuel can be performed by PYREG GmbH or by its authorised service partner.

It **must** be performed by trained and instructed personnel.



WARNING

Danger of injury resulting from inadequate qualifications

Mishandling can result in significant personal and material damage.



- Ensure that all tasks are performed by personnel with the appropriate qualifications only.

Calculation of the conveying capacity of the feeding screw following major modifications or change in fuel can be performed only when the unit is in a cold state.

Under no circumstances can it be performed while the unit is in operation.



WARNING

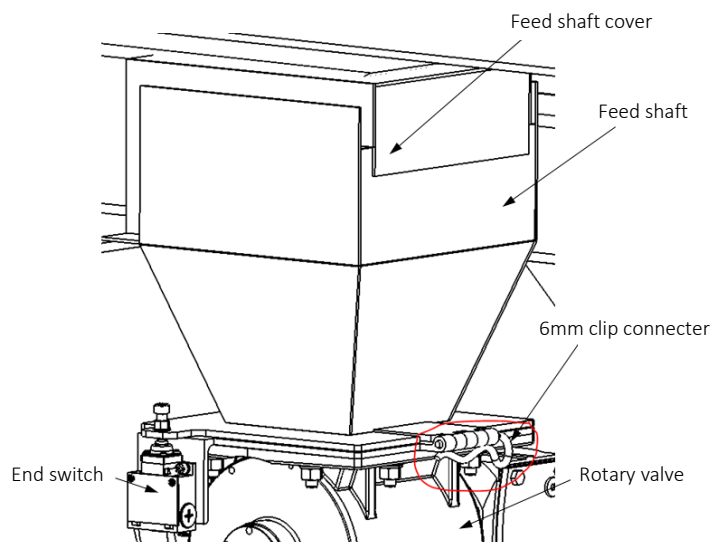
Bodily injury resulting from calculation of conveying capacity in operation

If calculation of the feeding screw' conveying capacity is performed during operation of the unit or directly after shutdown, serious injuries may result due to burns.

- After shutting down the unit, sufficient time (12 hours) must be provided in order for the unit to cool down.
- Temperature measurements on the reactors' feedings screw can prevent burns.

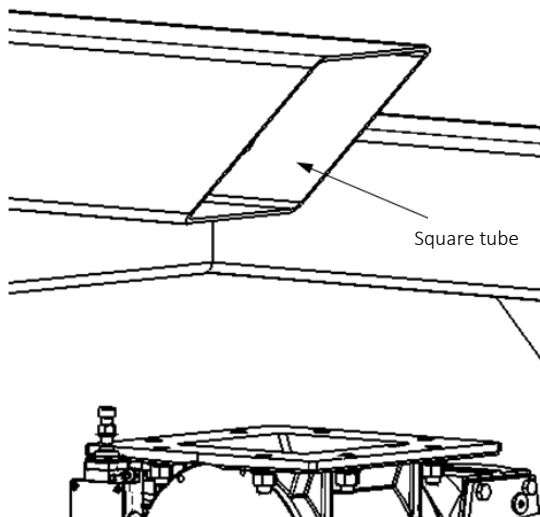
As a preparatory measure, it should be ensured that the storage tank and both of its conveyor pipes are completely filled with the fuel.
The sliding floor and the feeding screw must be completely filled via manual operation.

In the first step, the feed shaft must be disassembled.



The feed shaft's loose overlaying cover must be removed.
The clip connector (red circle) should then be extracted carefully.
The feed shaft can then be lifted out by the rotary valve.
Damage to the end switch must be avoided.

Illustration 234 Entry hopper



In the second step, fabric sacks must be placed over the square tube and fastened.
The sacks should have at least 100 litres of holding capacity.

Illustration 235 Square tube



CAUTION

Danger of injury from sharp angles

Failure to observe can result in lacerations.

- Wear appropriate protective clothing.



Under the “Feed” menu item in the operating panel, for both reactors, “cycle time” must be set to 500 and “pulse time” to 360 seconds, respectively, in fields “A”, “B” and “C”.



NOTE

The operator is advised to capture the adjusted values in written form before the modification.

This can be done as follows:

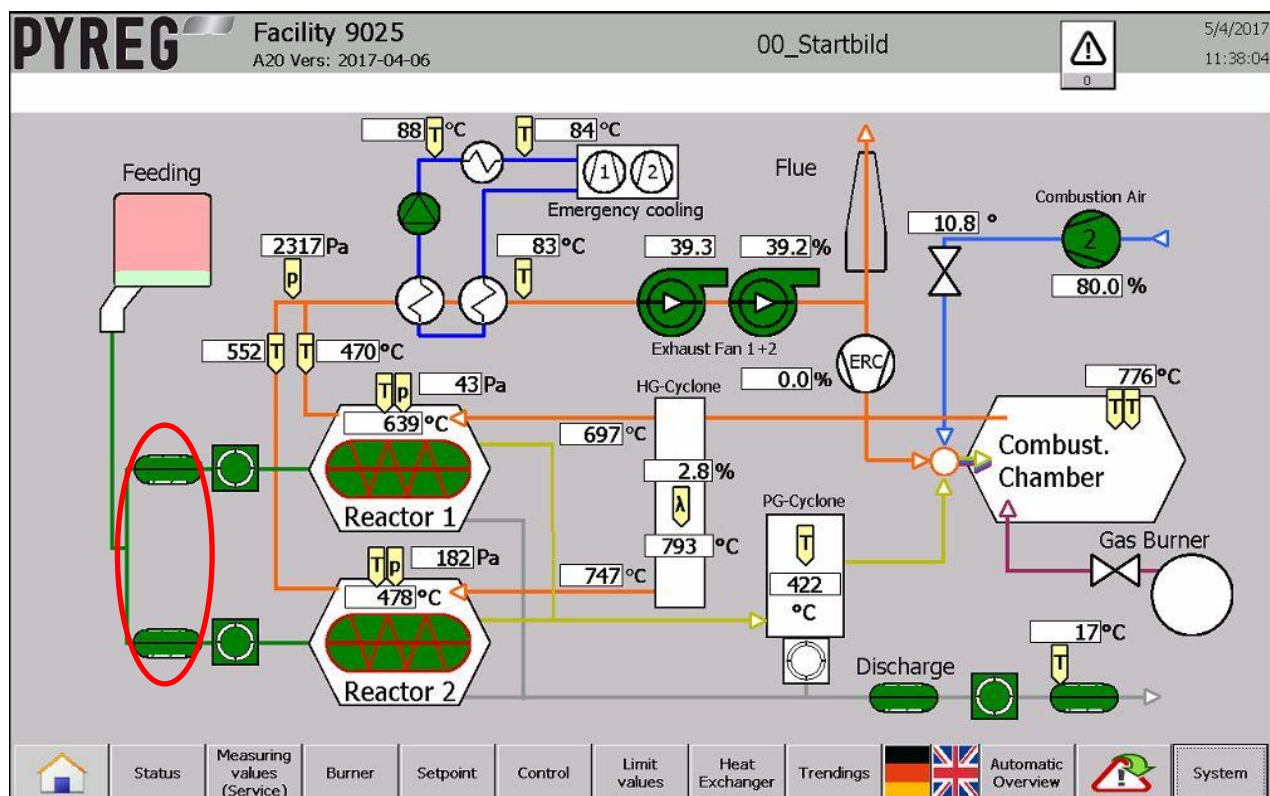
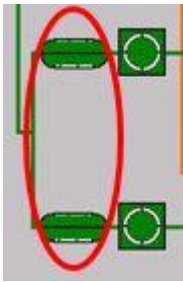


Illustration 236 Start screen



Tap the feeding screw highlighted here in red.

Illustration 237 Feeding Screw

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Feeding Screw 1

On Delay	4 s Act.		
Overrun time	4 s	Stop time	0.3 s
Imax reverse time	1.0 s	ON Time	0.0 s
	A ○	B ○	C ●
Cycle time	10.0 s	10.0 s	10.0 s
ON Time	3.0 s	5.5 s	2.0 s

Feeding Screw 2

On Delay	4 s Act.		
Overrun time	4 s	Stop time	0.3 s
Imax reverse time	1.0 s	ON Time	0.0 s
	A ○	B ○	C ●
Cycle time	10.0 s	10.0 s	10.0 s
ON Time	3.0 s	5.5 s	2.0 s

Feeding Screw 1

Manual On Off **Auto**

Feeding Screw 2

Manual On Off **Auto**

Feeding → Rotary Airlocks 1+2

Navigation bar: Status, Measuring values (Service), Burner, Setpoint, Control, Limit values, Heat Exchanger, Trendings, Automatic Overview, System

Illustration 238 Feeding screw menu

	A ○	B ○	C ●
Cycle time	10.0 s	10.0 s	10.0 s
ON Time	3.0 s	5.5 s	2.0 s

Configure "cycle time" to 500 and "pulse time" to 360 seconds for both feeding screws.

Illustration 239 Feed times

Because start-up of the reactors and their entry into operation is not programatically desirable in advance of a minimum temperature being reached in the combustion chamber, this safety monitoring must be actively avoided during performance measurement.

To this end, the switch cabinet may be opened by qualified personnel only.



WARNING

Material damage resulting from inadequate qualifications

Improper interaction with the power supply can lead to significant personal and material damage.

- Ensure that all tasks are performed by personnel with the appropriate qualifications only.



DANGER

Danger to life from electric current

Contact with live lines or components presents a danger to life. Observe the following safety instructions in order to avoid electrical hazards:

- Work on electrical equipment may only be performed by a qualified electrician or trained staff under the management and supervision of a qualified electrician, in accordance with electrical engineering standards.



Before activating the key switch, the operator must ascertain by means of a visual inspection that there are no other individuals in the unit platform or inside the storage tank.



CAUTION

Personal injury resulting from manual unit control

If the operator has not established that there are no longer any other individuals in the unit, injury to such persons may result.

- The operator must perform a visual inspection of the unit at the feeding screw and the interior of the storage tank to ascertain the presence of other persons.



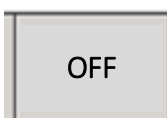
The feeding screw must be configured to “MANUAL ON” via the icon.

Illustration 240 Manual On icon



The pipes can then be filled.
The key switch must be activated for the entire period during which the pipes are filled.

Illustration 241 Key switch



Then, activate the “OFF” icon. Finally, empty the fabric sacks and place them once again over the feed shafts.

Now touch the “MANUAL ON” icon, activate the key switch and wait until the 360 second pulse time has elapsed. When the screws become idle, activate the “OFF” icon.

This completes the process.

Finally, the values for the “cycle time” and the “pulse time” are reset to the previously noted values.

The cycle time is a factory-set value and must be reset to 10 seconds.



CAUTION

Material damage resulting from incorrectly configured parameters

If the parameters configured here are set too high without consulting with the manufacturer, significant material damage to the unit can result. It is also possible that personal injury may occur as a consequence.



- It is imperative that the preset values are adhered to.
- Change the values only after consultation with the manufacturer.

The switch cabinet must be closed properly again and the feed hopper must be reassembled. It is important to ensure that the end switch is not damaged in this process.



WARNING

Material damage resulting from improper assembly

Improper assembly of the entry hopper and damage to the end switch can result in significant material damage.

- Ensure that all tasks are performed by personnel with the appropriate qualifications only.

The conveying capacity can then be calculated as follows:

t_{pz} : configured pulse time [s]

m_{gew} : weighed mass from the fabric sacks [kg]

$$\dot{m}_{F0} = \frac{m}{t} \left[\frac{kg}{s} \right]$$

13.3.3 Calorific value determination

Weigh the material in the sacks individually and measure moisture.

The biofuel's calorific value in its present condition can then be calculated as follows:

$$H = \frac{H_t * (100 - w) - 2,443 * w}{100} \left[\frac{MJ}{kg} \right]$$

Declaration of variables:

H: The biomass's calorific value [$\frac{MJ}{kg}$] at a specified water content

H_t: Calorific value of completely dry biomass [$\frac{MJ}{kg}$]

w: Biomass water content [%]

2,443: Constants resulting from the water's evaporation heat at 25°C

13.3.4 Performance determination

The performance of the conveyed material can be calculated as follows:

$$P = \frac{m_{gew} * H * 1000}{3600} \left[\frac{kg}{h} * \frac{MJ}{kg} \right]$$

Declaration of variables:

P: Performance of the unit during continuous throughput [kW]

m_{gew}: Calculated feed rate [kg/h]

H: The biomass's calorific value with the water content defined previously [$\frac{MJ}{kg}$]

13.3.5 Performance settings

The performance specified in the preceding chapter must be aligned with the unit using the rule of three:

$$t_{pz} = \frac{100 * P_g}{P * t_{zyk}} \left[\frac{KW}{KW} * s \right]$$

Declaration of variables:

t_{pz}: Pulse time to be configured at the panel [s]

P: Performance of the unit during continuous throughput [kW]

P_g: required performance [kW]

T_{zyk}: The defined cycle time

This time for the cycle (T_{Zyk}) is preset to 10 seconds at the factory. It can be modified only after consultation with the manufacturer.

	A ○	B ●	C ○
Cycle time	10,0 s	10,0 s	10,0 s
Pulse time	0,4 s	0,4 s	0,4 s

Under the “Feed” menu item in the panel, for both reactors, the cycle time must be set to 10 seconds and the pulse time to the time calculated above.

Illustration 242 Feed times



CAUTION

Material damage resulting from incorrectly configured parameters

If the parameters configured here are set too high without consulting with the manufacturer, significant material damage to the unit can result. It is also possible that personal injury may occur as a consequence.

- It is imperative that the preset values are adhered to.
- Change the values only after consultation with the manufacturer.



13.3.7 Example calculation

The values used for the example calculation are illustrated here in blue:

Calculation of output:

t_{pz} : configured pulse time [s]

here: 360 s

m_{gew} : weighed mass from the fabric sacks [kg]

here: 26 kg

$$P_{F\ddot{o}} = \frac{m}{t} \left[\frac{kg}{s} \right]$$

$$\frac{26}{3600} = 0,07 \left[\frac{kg}{s} \right] \text{ oder } 0,07 * 3600 \left[\frac{kg * s}{s * h} \right] \approx 252 \left[\frac{kg}{h} \right]$$

Calculation of the biomass's calorific value at a specified water content:

H: The biomass's calorific value [MJ/kg] at a specified water content

H_t : Calorific value of completely dry biomass [MJ/kg]

here: 18 MJ/kg

w: Biomass water content [%]

here: 20%

2,443: Constants resulting from the water's evaporation heat at 25°C

$$H = \frac{H_t * (100 - w) - 2,443 * w}{100} \left[\frac{MJ}{kg} \right]$$

$$\frac{18 * (100 - 20) - 2,443 * 20}{100} = 13,9114 \left[\frac{MJ}{kg} \right]$$

Calculation of unit output during continuous throughput:

P: Performance of the unit during continuous throughput [kW]

m_{gew} : Calculated feed rate [kg]

H: The biomass's calorific value with the water content defined previously [$\frac{MJ}{kg}$]

$$P = \frac{m_{gew} * H * 1000}{3600} \left[\frac{kg}{h} * \frac{MJ}{kg} \right]$$

$$\frac{25 * 13,9114 * 1000}{3600} \left[\frac{kg}{h} * \frac{MJ}{kg} \right] = 973,8 [KW]$$

Calculation of pulse time:

P: Performance of the unit during continuous throughput [kW]

t_{pz} : Pulse time to be configured at the panel [s]

T_{zyk} : The defined cycle time

here: 10 s

m_{gew} : Calculated feed rate [kg]

here: 26 kg

P_g : Required performance [kW]

here: 500 kW

$$t_{pz} = \frac{100 * P_g}{P * t_{zyk}} \left[\frac{KW}{KW} * s \right]$$

$$\frac{100 * 500}{973,8 * 10} \left[\frac{KW}{KW} * s \right] = 5,1 s$$

In this example, a pulse time of 5.1 seconds would need to be configured at the panel if the required cycle time is 10 seconds and the required output is 500 kW.



CAUTION

Material damage resulting from incorrectly configured parameters

If the parameters configured here are set too high without consulting with the manufacturer, significant material damage to the unit can result. It is also possible that personal injury may occur as a consequence.



- It is imperative that the preset values are adhered to.
- Change the values only after consultation with the manufacturer.

14 Appendix

14.1 Additional documents

If additional documents to this operating manual have been provided, e.g. component drawings, parts list, pneumatic, hydraulic, circuit diagram, pipeline and instrument flow sheets, the following information applies:

All plans, lists and drawings are provided for information purposes only and do not underlie a change service of any kind.

The dissemination or reproduction of these plans, lists and drawings, as well as use and disclosure to third parties, is unauthorised without the express permission of the manufacturer.

Violation shall represent an explicit violation and shall result in obligation to pay compensation.

All rights reserved in the event of a patent being granted or registration of an industrial design.

14.2 Spare parts ordering

Spare parts can be ordered from the manufacturer using the pipeline and instrument flow sheets.

Components and individual parts not listed in the pipeline and instrument flow sheets can be found in the spare parts list. You will find both of these on the enclosed data carrier.

We draw attention to the fact that delivery times of up to 8 weeks should be allowed for.

When sending a request or order, please specify the component number as well as the product number and item designation.

Contact address:

PYREG GmbH
Trinkbornstrasse 15 – 17
D- 56281 Dörth
Tel.: +49 (0) 6747 95388 – 0
Email: service@pyreg.de
Service: +49 152 04430414

14.3 Data sheets and third-party documents

PYREG GmbH accepts no liability for warranty claims for the accuracy of suppliers' and third-party documents.

Suppliers' documentation can be found on the memory device provided.

The file format is PDF.

14.4 Declaration of conformity

EC Declaration of Conformity in accordance with Machinery Directive 2006/42/EC

Name and address of the manufacturer placing the product on the market	PYREG GmbH
	Trinkbornstraße 15 - 17
	56281 Dörth

We declare that the product

Model	P500
Serial number	46 R0 025 21
Year of manufacture	2016

complies with the essential requirements of EC directive 2006/42/EC as well as all of the provisions of the following directives:

EC directive 2006/95/EC	Electrical equipment designed for use within certain voltage limits
EC directive 2004/108/EC	Electromagnetic compatibility
EC directive 2014/35/EC	Low Voltage Directive
EC directive 2014/34/EU	ATEX explosion protection

The following harmonised standards have been applied in part or in full:

DIN EN 60204-1	Safety of machinery - electrical equipment of machines Part 1: General requirements
DIN EN 12100-	General design principles, risk assessment and risk reduction
DIN EN 61508	Functional safety of safety-related electrical, electronic and programmable electronic control systems
DIN EN 50241:2000-04 Parts 1 and 2	Specification for open path apparatus for the detection of combustible or toxic gases and vapours
EN 60079-29-4:2011-02	Part 29-4: Gas detectors - performance requirements for open path detectors for the measurement of combustible gas
EN 61310-1:2008-09 Parts 1 to 3	Safety of machinery - Indication, marking and actuation
EN 62061:2016-05	Safety of machinery - functional safety of safety-related electrical, electronic and programmable electronic control systems

EN ISO 14123-1:2016-03	Safety of machinery - reduction of health risks associated with hazardous substance emissions from machinery
EN 676:2008-11	Automatic forced draught burners for gaseous fuels
EN 746-2:2011 Parts 1 and 3	Industrial thermoprocessing equipment
EN 13732-1:2008-12	Ergonomics of the thermal environment - methods for the assessment of human responses to contact with surfaces
EN 13849-1:2008-12	Safety of machinery - safety-related parts of control systems - Part 1: General principles for design
EN ISO 12100:2011-03	Safety of machinery - general principles for design - risk assessment and risk reduction
EN 1037:2008-11	Safety of machinery - prevention of unexpected start-up
EN ISO 19353:2016-07	Safety of machinery - preventive and defensive fire protection
EN 1127-1:2011-10	Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology
EN 13821:2003-03	Explosive atmospheres - Explosion prevention and protection - determination of minimum ignition energy of dust/air mixtures
EN 14034-1:2011-04	Determination of explosion characteristics of dust clouds - Part 1: Determination of the maximum explosion pressure p_{max} of dust clouds
EN 14034-2:2011-04	Determination of explosion characteristics of dust clouds - Part 2: Determination of the maximum rate of explosion pressure rise $(dp/dt)_{max}$ of dust clouds
EN 14034-3:2011-04	Determination of explosion characteristics of dust clouds - Part 3: Determination of lower explosion limit values of dust clouds
EN 14034-4:2011-04	Determination of explosion characteristics of dust clouds - Part 4: Determination of limiting oxygen concentration of dust clouds
EN 14522:2005-12	Determination of the auto ignition temperature of gases and vapours

EN 14756:2007-02	Determination of the limiting oxygen concentration (LOC) for flammable gases and vapours
EN 15061:2009-05	Safety of machinery - safety requirements for strip processing line machinery and equipment
EN 15188:2007-11	Determination of the spontaneous ignition behaviour of dust accumulations
EN 1837:2009-12	Safety of machinery - Integral lighting of machines

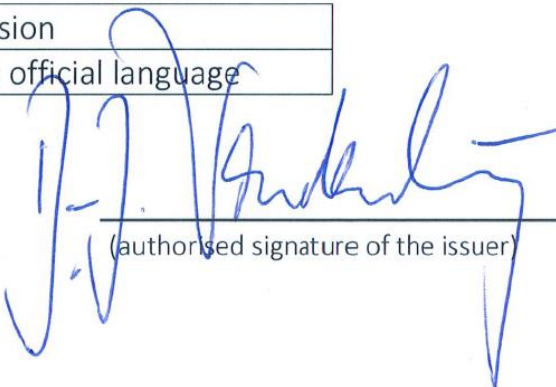
The manufacturer is committed to providing the special documents for this machinery electronically to any national institution on request. The technical documentation is fully complete.

Sebastian Klein  was responsible for the documentation.

The original manual associated with the product is:

<input checked="" type="checkbox"/>	in its original version
<input checked="" type="checkbox"/>	in the operator's official language

Dörth, 27.7.17 (date)


(authorised signature of the issuer)

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- 2 Honeywell pressure monitor SDBAMBC water-quenching carbon discharge
- 3 Frost monitor Jumo Heattherm AT 603070 water quenching carbon discharge
- 4 Kromschröder double solenoid valve VAS125R/NW
- 5 Kromschröder remote setting valve VMV 125
- 6 PYREG pilot burner
- 7 Combustion chamber
- 8 PYREG FLOX®burner
- 9 PYREG reactor
- 10 JUMO 40 4304 differential pressure gauge
- 11 Operator
- 12 STW Jumo heattherm AT 603070 reactor manhole
- 13 STW Jumo heattherm AT 603070 fuel distributor
- 14 STW Jumo heattherm AT 603070 carbon discharge
- 15 1 x per reactor
- 16 Pilot burner operating outlet
- 17 Kromschröder burner control unit IFD 454
- 18 Kromschröder air butterfly valve IC20-15W3E BVA80Z05
- 19 Kromschröder air pressure monitor DG50UG-3
- 20 Combustion air fan
- 21 Reactor drive safety relay
- 22 1 x per reactor
- 23 Start Reactors >
- 24 PLC S7/300
- 25 < Burner start
- 26 Key switch
- 27 Igniter
- 28 Air
- 29 STW Jumo Heattherm AT 603070 heat exchanger return flow
- 30 Heat exchanger bypass monitoring safety shaft contact
- 31 Möller easy Safety SIL-3 safety chain compact safety controller
- 32 Preflush time
- 33 EMERGENCY-OFF
- 34 Kromschröder air pressure monitor DG50UG-3
- 35 Exhaust gas fan
- 36 UT
- 37 HT
- 38 Kromschröder manometer DH15R50, KFM100RB100 with pushbutton valve
- 39 Kromschröder measuring aperture
- 40 Kromschröder double solenoid valve VAS125R/NW
- 41 Lambda transmitter Lamtec LS1/LT1 O2 sensor
- 42 Combustion chamber
- 43 STW Juno 701150
- High temperature (HT)
- Excess temperature (ÜT)

	Type S double thermal element	
44	Kromschröder ball valve	AKT25R50B
45	Kromschröder gas filter GFK40R10-6	
46	Kromschröder max. pressure monitor DG 150UG3	
47	Kromschröder ZSI 300/50 igniter flame ionisation detection	
48	Kromschröder ignition transformer TZI7.5-20/33W	