

# Operating and service instructions

for contractors

**VIESMANN**

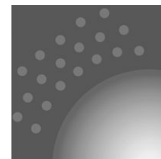
**Vitomax 200-HS**

**Type M75A**

Oil/gas high pressure steam boiler

With and without economiser

Rated steam output 5 to 26 t/h



## VITOMAX 200-HS



## Safety instructions



Please follow these safety instructions closely to prevent accidents and material losses.

### Safety instructions explained



#### Danger

This symbol warns against the risk of injury.



#### Please note

This symbol warns against the risk of material losses and environmental pollution.

#### Note

Details identified by the word "Note" contain additional information.

#### Target group

These instructions are exclusively designed for qualified personnel.

- Work on gas installations must only be carried out by a registered gas fitter.
- Work on electrical equipment must only be carried out by a qualified electrician.
- The system must be commissioned by Viessmann Industrieservice, the system installer or a qualified person authorised by the installer.

#### Regulations

Observe the following when working on this system

- All legal instructions regarding the prevention of accidents
- All legal instructions regarding environmental protection
- Health and Safety at Work Act (BetrSichV) [Germany]

- The Code of Practice of relevant trade associations
- Directive 97/23/EC, as well as the relevant safety regulations of the following countries
  - Ⓓ DVGW, TRGI, TRF and VDE, TRD
  - Ⓐ KG, ABV, LRG-K, LRV-K, DKBG
  - ⒸⒽ SEV, SUVA, SVGW, SVTI, SWKI, VKF and EKAS guideline 1942: LPG, part 2

#### If you notice oil leaks and the smell of gas



#### Danger

Escaping fuel can lead to explosions which may result in very serious injuries.

- Do not smoke. Prevent naked flames and sparks. Do not switch lights or electrical appliances on or off.
- Close the quick-acting fuel valve and shut-off valve.
- Open windows and doors.
- Remove all people from the danger zone.
- Notify your gas or electricity supplier from outside the building.
- Shut off the electricity supply to the building from a safe place (outside the building).

## Safety instructions (cont.)

### If you smell flue gas



#### **Danger**

Flue gas can lead to life-threatening poisoning.

- Shutdown system.
- Ventilate boiler room.

### Working on the system

- Close the fuel shut-off valve and secure against unintentional opening.
- Isolate the system from the power supply and check that it is no longer 'live', e.g. by removing the separate fuse or by means of a main isolator.
- Safeguard the system against unauthorised reconnection.



#### **Please note**

Electronic modules can be damaged by electrostatic discharges.

Before beginning work, touch earthed objects, such as water pipes, to discharge static loads.



#### **Danger**

Risk of burning from hot surfaces so that

- steam line,
  - hot water line,
  - cleaning cover and closures/plugs at the boiler system,
  - boiler doors, as well as components behind the doors,
- can all become very hot. Observe safety in the workplace!

### Repair work



#### **Please note**

Repairing components that fulfil a safety function can compromise the safe operation of your system.

Replace faulty components only with original Viessmann spare parts.

### Auxiliary components, spare and wearing parts



#### **Please note**

Spare and wearing parts that have not been tested together with the system can compromise its function. Installing non-authorised components and making non-approved modifications or conversions can compromise safety and may invalidate our warranty.

For replacements, use only original spare parts supplied or approved by Viessmann.

### Draining hot water



#### **Please note**

The blow-down and T.D.S. water from boiler systems can reach temperatures of 100 °C and higher.

Set up the system so that this water is cooled down to < 35 °C prior to it entering the sewer system. Where necessary, refer to the local water authority.

## Safety instructions (cont.)

### Draining condensate from the flue gas side



#### Please note

When the boiler system starts or under certain conditions, condensate can form in the flues, the flue gas collector and downstream in the flue or chimney.

The system user must provide suitable installations to safely drain such condensate.

Subject to the regulations in the country concerned, this condensate may need to be neutralised. In such cases, consult the local water authority or the relevant body responsible for issuing permits.

## Technical safety information

### Any damage to the boiler that could lead to risks requires an immediate boiler shutdown.

If major damage occurs at the boiler or vessels, notify the authorising supervisory body without delay prior to carrying out repairs.

Observe all technical safety instructions. Steam generators require local permits both for their installation and their operation. This permit must be available prior to commissioning.

In the case of explosions, the user must immediately notify the authorising supervisory body, irrespective of whether anyone was injured or not. Prior to the official investigation, the status created by the accident must not be changed apart from what is necessary to prevent further damage or as required for rescuing personnel.

The boiler house must only be entered by authorised personnel. Always keep the boiler house clean, well lit and free from all objects that do not belong there and that might impair the operation. The use of any part of the system as a drying area is prohibited.

During operation, all required exits must be left unlocked and free from obstructions. The operating personnel must log all events, such as faults, adjustments, consumption of spare parts and repairs. A log must be maintained of all regular readings of the control instruments.

**Technical safety information** (cont.)

Obvious signs at weld seams, leaking damaged areas, severe corrosion, unusual characteristics of operating instruments and system components as well as unusual noise inside the boiler must be notified immediately. Faults and defects on the system that cannot be remedied by experts locally must be notified to the manufacturer. Protect all boiler parts and control equipment from rain, water leaks and expelled steam. Immediately repair all damage and leaks.

Apart from the relevant legal requirements, all practical instructions issued by our technical personnel to the operating personnel are applicable.

It is impossible to clarify and describe all potential cases of indicators and possible faults. These guidelines should therefore, after a reasonable time in operation, be supplemented based on the experiences gained up to that point.

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## Storage of Vitomax boilers prior to the system installation

### Please note:

This information applies to the storage **prior** to the system installation.

1. Vitomax boilers must be stored in enclosed rooms, free from weather influences under dry conditions.
  2. The room temperatures must not fall below or exceed the following values: 0 °C to +50 °C.
  3. In its delivered condition the boiler is protected as standard on the water side with dummy flanges or caps against the ingress of foreign matter.
  4. Remove the shipping packaging to prevent the formation of condensate.
- To prevent corrosion in the non-pressurised state, observe the following if the boiler is stored longer than for 4 weeks:
    - Protect the interior of the boiler on the flue gas and on the water side with a desiccant, e.g. silica gel, against moisture.
    - The amount of desiccant depends on the boiler volume.
    - Check the effectiveness of the desiccant regularly. See the details provided by the desiccant manufacturer.
    - Ensure that the desiccant does not come into contact with the boiler material (e.g. through suspended fixing).
    - Preserve the dry flue gas side with a thin film of graphite or boiled oil.
    - Instead of the moisture extraction on the flue gas side by means of a desiccant, a drier with air circulation can also be connected.

## Operating tips

According to the Steam Boiler Order [Germany], a steam boiler category IV may only be taken into use when the relevant authority has granted permission for the installation of the system, and an authorised expert has tested the system.

According to the Steam Boiler Order [Germany], steam boilers category IV may only be operated, supervised and maintained by a trained boilerman.

The authorised monitoring authority may grant, upon application, permission to operate the boiler without permanent supervision subject to it being equipped in accordance with the TRD 604.

The system must be commissioned by the Viessmann Industrieservice, the system installer or a qualified person authorised by the installer as well as the relevant expert.

### **Operating tips** (cont.)

Within 4 weeks of the combustion equipment being commissioned, the operator must notify the local flue gas inspector accordingly [check local regulations]. Record all actual values in a commissioning/service report. These must be confirmed by the expert and the system user.

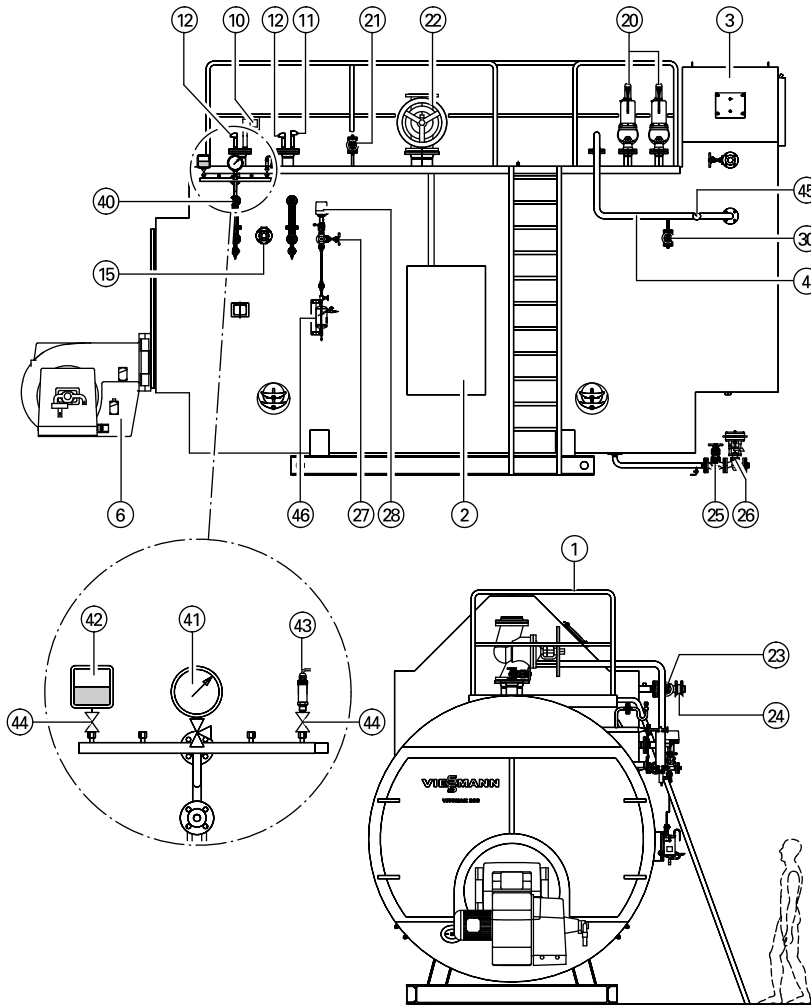
We would recommend that you operate the boiler constantly at the required operating pressure. The operation of the boiler at pressure will still be beneficial, even if no heat demand occurs for a longer period of time.

In systems comprising several boilers, of which one is constantly used as standby boiler, only change the operation over in longer intervals, e.g. during the annual inspection of the total system.



**Functions**

**Installation drawing**



Operation

Example: Order-specific deviations of the standard delivery are possible.



## Functions (cont.)

### Note

*Illustration of the fitting assembly refers to modulating operation. Provide two further pressure regulators for stepped operation; the pressure transducer for the burner control will then not be required.*

- |  |  |
|--|--|
| ① Platform   | ②② Steam shut-off valve                              |
| ② Control panel<br>See separate documentation      | ②③ Feedwater shut-off valve                          |
| ③ Integral economiser                              | ②④ Feedwater non-return valve                        |
| ④ Connection line between economiser and boiler    | ②⑤ Blow-down shut-off valve                          |
| ⑥ Burner   | ②⑥ Blow-down valve                                   |
| ⑩ Level electrode<br>(WR – Water level controller) | ②⑦ T.D.S. shut-off valve                             |
| ⑪ Level electrode<br>(HW – Maximum water level)    | ②⑧ T.D.S. valve                                      |
| ⑫ Level electrode<br>(NW – Minimum water level)    | ③⑩ Economiser drain shut-off valve                   |
| ⑮ Conductivity electrode                           | ④⑩ Water level indicator                             |
| ⑳ Safety valve                                     | ④① Pressure gauge                                    |
| ㉑ Air vent shut-off valve                          | ④② Maximum pressure limiter                          |
|  | ④③ Pressure transducer                               |
|  | ④④ Straight-through shut-off valve with cap (option) |
|  | ④⑤ Feedwater dial thermometer                        |
|  | ④⑥ Sampling cooler                                   |

In the following, selected components of a steam boiler system are described. For details, see the documentation provided by the manufacturer of the individual components.

**Functions** (cont.)

**Level electrodes** ⑩ to ⑫

**Permanently modulating level monitoring** ⑩

Level electrode for continual and load-dependent boiler filling

| Function   | Function  | Operating info   |
|--|---|--|
| Continual water level control comprising <ul style="list-style-type: none"> <li>■ a level electrode</li> <li>■ an associated level controller</li> </ul> | Water level below or exceeds the selected set value | The controller issues a pulse to the feedwater control valve<br>Boiler is filled continually and subject to load |
| Continual control of the boiler water level via the feedwater control valve  |   |  |

**Level monitoring "excessive" (HW electrode)** ⑪

Level electrode to safeguard against maximum water levels

| Function   | Function                                   | Operating info   |
|--|--|--|
| Self-monitoring overflow protection comprising <ul style="list-style-type: none"> <li>■ a level electrode</li> <li>■ the associated evaluating device</li> </ul> | Standard water level                       | Electrode is not immersed in the conducting boiler water and registers a high resistance |
|  |  | Feedwater pump operation enabled   |
|  |  | Feedwater pump runs  |
|  |  | Boiler is filled continually and subject to load   |
|  | Water level too high                       | Electrode is immersed into the boiler water and registers a low resistance               |
|  |  | The feedwater pump is stopped via the pump relay   |
| The level drops again  | Feedwater supply to the boiler interrupted |  |
|  | Feedwater pump can start subject to demand |  |

## Operating information

### Functions (cont.)

#### Note

See also country-specific regulations.

#### Level monitoring "too low" (NW electrode ⑫)

Level electrode to safeguard against minimum water levels

| Function   | Function  | Operating info   |
|--|---|--|
| Self-monitoring low water indicator comprising <ul style="list-style-type: none"> <li>■ Two level electrodes</li> <li>■ The associated evaluating devices</li> </ul> | Standard water level                                | Electrode is immersed into the conducting boiler water and registers a low resistance<br>Safety chain closed<br>Burner operation enabled |
|  | Water level too low                                 | Electrode is out of the boiler water and reports a high resistance<br>Safety chain and burner operation constantly interrupted           |
|  | The minimum boiler water contents is achieved again | Re-enable safety chain<br>Burner block lifted  |

#### Safety valve ⑳

##### Function

- Physical protection of the boiler against pressures in excess of the design pressure P1
- Valve response pressure = steam boiler design pressure

- At P1, the blow-off output lies 10% higher
- Closing pressure at P1 minus 10-12%

| Function   | Operating info  |
|--|---|
| Operating checks in regular intervals or in accordance with country-specific regulations | Brief cracking open of the lever – do not release the lever fully |
| Regular checking by an authorised contractor or test body                                | Never remove the lead seal  |

**Functions (cont.)**

**Air vent shut-off valve (21)**

| Function  | Function  | Operating info                                    |
|---|---|---|
| Venting the boiler during filling or after a new system start from atmospheric pressure | During heat-up, open the valve and close it again, as soon as visible steam is expelled | Air / steam must be able to be routed away safely |

**Steam shut-off valve (22)**

| Function                                     | Function  | Operating info                      |
|--|---|-------------------------------------|
| Main boiler shut-off towards the steam mains | Enable steam or close boiler with damper valves | Open slowly to prevent water hammer |

**Blow-down (25) and (26)**

Function

- Periodic removal of sludge deposits

| Function  | Operating info  |
|---|---|
| Automatic blow-down via programmable valve at regular intervals                           | The programmable switch opens via the control valve of the blow-down valve and briefly drains off boiler water. The vacuum force thus created removes the sludge from the boiler. |
|   | Manual activation possible at any time.   |
| Manual blow-down at regular intervals or in accordance with country-specific regulations. | Push the locking lever of the blow-down to the side.  |
|   | Push down on the activating lever of the blow-down valve for two to three seconds   |



**Please note**

In case of manual activation observe the lever kickback.

## Operating information

### Functions (cont.)

#### T.D.S. unit (27) and (28)

##### Function

- Continual checking and regulation of the salt content through temperature-compensated conductivity electrode
- Desalination via the T.D.S. valve
- Maintenance of specified limits by opening and closing the valve

| Function  | Operating info                         |
|---|--|
| Conductivity drops                                | Flow rate is reduced                   |
| Conductivity value exceeds the selected set value | Valve is opened further                |
| Conductivity exceeds the highest value            | Safety chain is opened<br>Burner stops |

#### Water level indicator (40)

##### Function

- Optical and direct water level indication

| Function  | Operating info   |
|---|--|
| Optical water level check   | Valve on the steam and water side; shut-off device OPEN<br>Flushing valve, shut-off device CLOSED  |
| When there are no personnel present<br>Carry out operating checks in regular intervals or in accordance with country-specific regulations | Keep valve CLOSED<br>Close the valve on the water and steam side<br>Open blow-down valve, drain and check the valve for tightness<br>Open the valve on the water side; check for blow-off noise<br>Close valve on the water side<br>Open the valve on the steam side; check for blow-off noise<br>Leave the valve on the steam side open<br>Close the flushing valve<br>Open valve on the water side |
| The water column rises quickly to the correct level   | When the water column rises slowly, check that there are no blockages  |

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**Functions (cont.)**

**Pressure monitoring unit (41) to (44)**

| Component   | Function  | Operating info   |
|---|---|--|
| The pressure monitoring unit is directly connected to the boiler via the fitting assembly and comprises <ul style="list-style-type: none"> <li>■ Pressure gauge (41)</li> <li>■ Pressure limiter (42)</li> <li>■ Pressure transducer (43)</li> <li>■ Straight-through shut-off valve with cap (44)</li> </ul> |   |  |
|   | An operating pressure indicator   | Operating checks in regular intervals or in accordance with country-specific regulations |
|   | Protection of the boiler against overpressure when the maximum pressure is exceeded | Checking with a calibrated test pressure gauge by an authorised contractor or test body  |
|   |   | Safety chain opened by opening a contact in the pressure limiter                         |
| Burner stops<br>Safety chain reset by means of the appropriate key in the control panel. Reduce the boiler pressure via the air vent valve or the main steam valve by approx. 1 bar below the switching point of the max. pressure limiter and reset the max. pressure limiter.<br>Burner starts again        |   |  |
| Load-dependent regulation of the boiler combustion subject to the operating pressure  |   |  |
| Enables the replacement of faulty components  | Exclusively by authorised contractors   |  |

Operation

## Functions (cont.)

### Sampling cooler ④⑥

| Function  | Operating info   |
|---|--|
| Removal of water samples to carry out comparative tests | Values to be checked in accordance with country-specific regulations and to be recorded in the boiler log  |
|   | <ul style="list-style-type: none"> <li>■ pH value</li> <li>■ Residual hardness</li> <li>■ p value (value to determine the free alkalinity)</li> <li>■ m value (value to determine the entire alkalinity)</li> <li>■ Phosphate</li> <li>■ Sulphite</li> </ul> |

## Switching OFF

For brief interruption  $\leq 3$  days, maintain the positive pressure in the boiler system incl. all boiler-related drives (thermal water treatment, etc). See also page 37.

In case of long-term interruptions: See chapter "Preservation".

## Preservation

The procedures listed in the following should be considered as preservation options. Further procedures with alternative chemicals should be agreed with their manufacturer. The basis of these instructions is the VdTÜV datasheet TC1465 "Preserving the water side of steam boilers" [Germany].

To prevent corrosion setting in during idle periods, when the boiler is not pressurised, conserve the boiler surfaces on the flue gas and water sides, subject to the length of the period during which the boiler is taken out of use. There is a differentiation between wet preservation during which exposure to oxygen is to be avoided and dry preservation during which moisture levels are to be minimised.



## Preservation (cont.)

### Wet preservation

1. Fill the boiler incl. Eco and super-heater (if installed) up to the highest possible level with treated feedwater. To prevent oxygen corrosion, add an oxygen binder to the boiler water (e.g. sodium sulphite) in accordance with the manufacturer's instructions. For this, ensure a good admixing with the boiler water (thermal or mechanical agitation).
2. If, in multi-boiler systems, only some boilers must be conserved, these can be filled with desalinated boiler water from the boilers that remain in use, which will also maintain the temperature. Ensure that the temperature remains constant.
3. Maintaining pressure in a fully filled boiler using nitrogen (preferably nitrogen 5.0) of 0.1 to 0.2 bar can prevent boiler corrosion.

Chemical wet preservation chemically binds the oxygen thereby protecting the boiler material against corrosion. The chemical wet preservation can be implemented when steam boilers are taken out of use for short or longer periods. An adequate amount of oxygen binders, corresponding putrefaction by alkalis, a thorough mixing of the preservation solution and complete filling of the boiler or system, effectively prevent corrosion due to idle periods whilst giving a great deal of security with a reasonable amount of effort and cost.

#### **Never use this procedure where there is a risk of frost.**

Apart from the chemical wet preservation, physical-technical methods may also be applied. With the wet preservation, the rapid boiler availability is an advantage.

#### **– with sodium sulphite**

For steam boilers, add the sodium sulphite in soluble form to the completely drained steam boiler via the feedwater pump. Drain the steam boiler completely. Also fill any superheaters and flue gas heat exchangers. The pH value should be between 11 and 12.

Keep all valves closed during the preservation process. The preservation solution should be circulated weekly. Initially, check the sulphite excess frequently, then at least monthly. When the content drops and falls below the specified standard values, recirculate again and add agent, as required.

**Preservation** (cont.)

**Sodium sulphite excess**

|   | Idle time           | Sodium sulphite content in the preservation solution mg Na <sub>2</sub> SO <sub>3</sub> /l | Additional sodium sulphite     |                               |
|---|---------------------|--|--------------------------------|-------------------------------|
|   |                     |  | Without water g/m <sup>3</sup> | Crystallised g/m <sup>3</sup> |
| Fill water for steam boilers                                      |                     |  |                                |                               |
| Water of low salt content e.g. fully desalinated water            | 1 Week              | 20 - 50  | 20 - 50                        | 40 - 100                      |
| Condensate  | 1 Month             | 100 - 200  | 100 - 200                      | 200 - 400                     |
|   | Longer than 1 month | 200 - 500  | 200 - 500                      | 500 - 1000                    |
| Water with salt content e.g. fully softened water or boiler water |                     |  |                                |                               |
|   | 1 Week              | 40 - 100   | 40 - 100                       | 80 - 100                      |
|   | Longer than 1 week  | 400 - 1000   | 400 - 1000                     | 800 - 2000                    |

When using cold-prepared water which has not been deaerated, add an additional 80 g (without water) or 160 g (crystallised) sodium sulphite per m<sup>3</sup>.

**– with film forming amines**

A wet preservation with film forming amines is not permissible.

**Note**

- *Observe all conditions for draining waste water into sewer systems or into the main outfall when draining the preserving solution.*
- *When using the preserving agents observe the working instructions and safety datasheets supplied by the product manufacturer.*
- *Also agree the steps for the preservation of the water side with the manufacturer of the preserving agent.*

**– through physical-technical measures**

The following preservation steps through physical-technical processes are also possible, such as

- maintaining a positive steam pressure in the boiler
- flow preservation of steam boilers. These processes require system-specific equipment (valves, pipework, pumps) and should be taken into consideration when designing the system.

## Preservation (cont.)

### Dry preservation

#### Note

*This method is used when longer idle periods are expected and to ensure protection against frost. This method **precludes** a quick return of the system into use.*

#### Complete drying out

After cooling down in the idle stage, the boiler will be quickly drained at a pressure of approx. 3 bar. Observe the maximum permissible temperature for draining into the public sewer system. Where required, catch the water in a collecting tank and drain it after it has sufficiently cooled down.

Flush steam boilers with high salt content in the boiler water (approx. > 5 000 µS/cm) again on the water side. Afterwards, open all man, head and hand holes.

### Preserving the hot gas side

#### Flue gas side

After the boiler has been taken out of use, clean the heating surfaces on their hot gas side. The normal draught ensures that the heating surfaces on the hot gas side are adequately dried. Accelerate the process by means of a fan heater; if required open the flue gas shut-off dampers for this process and then close again.

Dry out components, such as superheaters and flue gas heat exchangers, separately.

Position desiccants (e.g. silica gel, blue gel) in shallow bowls inside the open and drying boiler or hang them inside the boiler so that any contact with the boiler material is safely prevented. Then close the boiler. Check the desiccants at least monthly and replace them, if required.

#### Alternative methods

These include preservation with ammonia or nitrogen. These methods require extensive technical and technological effort. When using these preserving methods, formulate system-specific operating instructions.

It is recommended to treat the combustion chamber and the hot gas flues with preserving oil (graphite or boiled oil).

This can be sprayed on or applied with a brush. The boiler doors remain open. Keep the surfaces dry during the idle periods (by inserting desiccant (e.g. silica gel) or by air changes from a connected dryer).

A dry preservation is not recommended under special installation conditions in areas with high relative humidity (in the tropics, near the sea).

Operating information

## **Preservation** (cont.)

### **Further details**

For further details, see the VdTÜV data-sheets (no. 1465, Oct. 1978) and the VGB (no. R116H, 1981) [or local regulations].

## **Maintenance instructions**

The TRD regulation specifies the maintenance of a steam boiler system, which can be carried out by the Viessmann Industrieservice or by an authorised contractor.

You can contact the Viessmann Industrieservice by phone  
+49 (0)30/6602 389, by fax  
+49 (0)30/6602 136, by email: [Industrieservice@viessmann.com](mailto:Industrieservice@viessmann.com) or via the internet: [www.viessmann-industriekessel.de/Industrie Service](http://www.viessmann-industriekessel.de/Industrie%20Service).

## Water quality for steam boiler systems

### Steam boiler

In its natural state, most untreated water will be unsuitable as boiler feedwater. The type of boiler feedwater treatment should be matched to the raw water quality. As its quality may change, regular checks are required.

The water feed pipe downstream of the boiler feedwater treatment should be equipped with a suitable water meter to record the volume of top-up water added to the return condensate; this also provides an indirect check on the steam draw-off volume.

In all circumstances, it is advisable to return as much condensate as possible to the feedwater tank. The condensate may also have to be treated so it conforms to the requirements of the boiler feedwater (according to table 1).

These requirements, plus those appertaining to the boiler water, mean that – according to the condition of the untreated water and the amount of top-up water – at the very least a suitable chemical or thermal water treatment system must be installed, and there should be a facility for adding oxygen binders (possibly alkalines and phosphates) into the feedwater tank supply line.

The requirements are monitored by measurements made by suitable, preferably uncomplicated devices (either every 24 h or 72 h or in line with national requirements, subject to the mode of operation). These test values, the volume of top-up water, the chemical consumption and the required maintenance should be entered into a boiler log to enable the operating conditions to be checked at any time.

**Table 1: Saline boiler feedwater requirements**

| Permissible operating pressure | bar   | > 0.5 < 20   |  | > 20 |  |
|--------------------------------|-------|--|--|------|--|
|                                |       |  |  |      |  |
| General requirements           |       | Colourless, clear and free of undissolved substances |  |      |  |
| pH value at 25 °C              |       | > 9  |  | > 9  |  |
| Conductivity at 25 °C          | µS/cm | Only standard values applicable to boiler water      |  |      |  |

5692 606 GB



**Water quality for steam boiler systems (cont.)**

| Permissible operating pressure                               | bar        | > 0.5 < 20    | > 20   |
|--|------------|---------------|--------|
| Total alkaline earths (Ca <sup>2+</sup> + Mg <sup>2+</sup> ) | mmol/litre | < 0.01        | < 0.01 |
| Oxygen (O <sub>2</sub> )                                     | mg/litre   | 0.05          | < 0.02 |
| Bound carbon dioxide (CO <sub>2</sub> )                      | mg/litre   | < 25          | < 25   |
| Iron, total (Fe)   | mg/litre   | < 0.2         | < 0.1  |
| Copper, total (Cu)   | mg/litre   | < 0.05        | < 0.01 |
| Oxidability (Mn VII → Mn II) as KMnO <sub>4</sub>            | mg/litre   | < 10          | < 10   |
| Oil, grease  | mg/litre   | < 1           | < 1    |
| Organic substances   | —          | see comment*1 |        |

**Table 2: Boiler water requirements**

| Permissible operating pressure      | bar        | Feedwater conductivity > 30 µS/cm                    |                       | Feedwater conductivity ≤30 µS/cm > 0.5 |
|-------------------------------------|------------|--|-----------------------|--|
|                                     |            | > 0.5 to 20  | > 20                  |  |
| General requirements                |            | Colourless, clear and free of undissolved substances |                       |  |
| pH value at 25 °C                   |            | 10.5 to 12   | 10.5 to 11.8          | 10 to 11 <sup>*2,3</sup>               |
| Acid capacity (K <sub>S 8.2</sub> ) | mmol/litre | 1 to 12 <sup>*4</sup>                                | 1 to 10 <sup>*4</sup> | 0.1 to 1.0 <sup>*2</sup>               |

\*1 Generally organic substances are mixtures of different compounds. The consistency of such mixtures and the characteristics of their components under the operating conditions of the boiler are hard to predict. Organic substances can degrade into carbon dioxide and other acidic products that would increase the conductivity and result in corrosion and deposits. They can also lead to the formation of foam and/or coatings that should be minimised. The TOC content (Total Organic Carbon) should also be kept to a minimum.

\*2 When using demineralised water with mixed bed quality (conductivity < 0.2 µS/cm), a phosphate injection is not required. As alternative, an AVT operation (conditioning with volatile alkalis agents, feedwater pH value ≥ 9.2 and boiler water pH value ≥ 8.0) may be used. In such cases, the conductivity downstream of a severely acidic cation exchanger must be < 5 µS/cm.

\*3 Base level adjustment of the pH value through injection of Na<sub>3</sub>PO<sub>4</sub>; additional NaOH injection only if the pH value is < 10.

\*4 With superheaters, 50% of the specified upper value should be treated as maximum value.

### Water quality for steam boiler systems (cont.)

| Permissible operating pressure                 | bar              | Feedwater conductivity > 30 $\mu\text{S/cm}$              |                                   | Feedwater conductivity $\leq 30 \mu\text{S/cm}$ |
|--|------------------|---|-----------------------------------|---|
|  |                  | > 0.5 to 20   | > 20                              |   |
| Conductivity at 25 °C                          | $\mu\text{S/cm}$ | < 6000 <sup>*4</sup>                                      | see Fig. 1, page 24 <sup>*4</sup> | < 1500  |
| Phosphate (PO <sub>4</sub> )                   | mg/litre         | 10 to 20  | 10 to 20                          | 6 to 15   |
| Silicic acid (SiO <sub>4</sub> ) <sup>*5</sup> | mg/litre         | Subject to pressure; see Fig. 1 (page 24) and 2 (page 25) |                                   |   |

#### Note

The addition of phosphate is recommended, but is not always essential.

Conversion: 1 mol/m<sup>3</sup> = 5.6 °dH; 1 °dH = 0.179 mol/m<sup>3</sup>; 1 mval/kg = 2.8 °dH

Operation with salt-free boiler feedwater is also possible as an alternative to operation with saline boiler feedwater.

<sup>\*4</sup> With superheaters, 50% of the specified upper value should be treated as maximum value.

<sup>\*5</sup> If phosphate is used, higher PO<sub>4</sub> concentrations are permissible, subject to consideration of all other values, e.g. with balanced or coordinated phosphate treatment. (See section "Conditioning").

**Water quality for steam boiler systems (cont.)**

**Maximum permissible direct boiler water conductivity, subject to pressure**

Feedwater conductivity >30  $\mu\text{S/cm}$

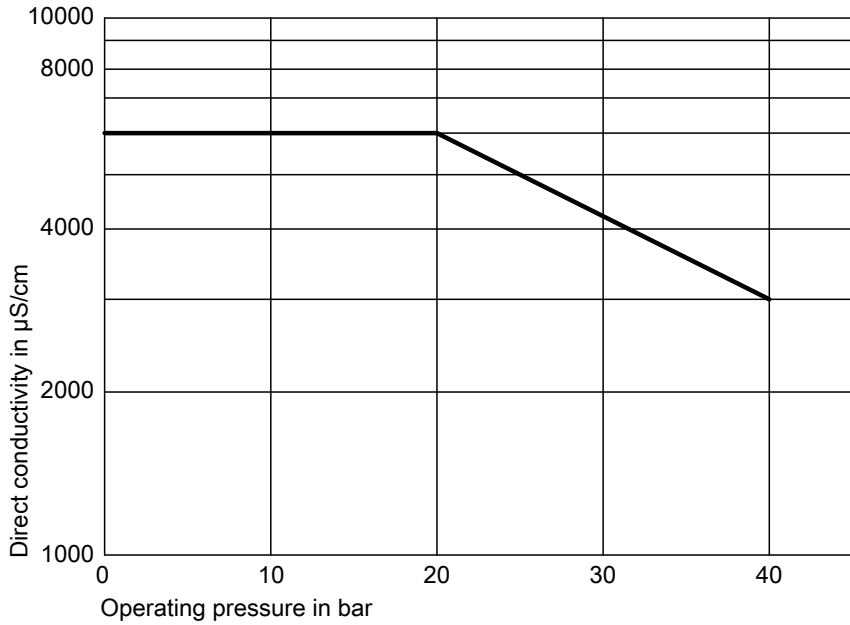


Figure 1



## Water quality for steam boiler systems (cont.)

### Maximum permissible boiler water silicic acid content ( $\text{SiO}_2$ ), subject to pressure

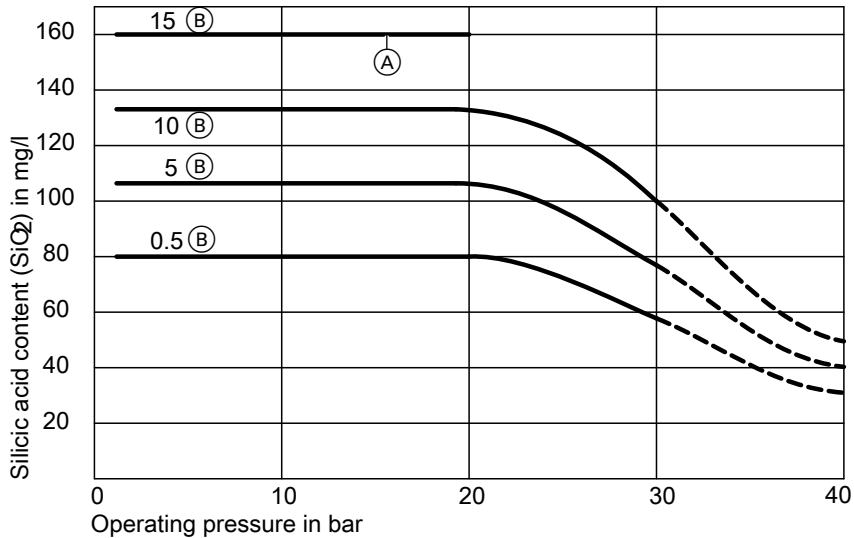


Figure 2

- (A) This level of alkalinity is no longer permissible > 20 bar  
 (B)  $K_{S\ 8.2}$  - value in mmol/l

### Conditioning

Certain feedwater and boiler water characteristics must be improved through chemical treatment.

This conditioning may contribute to:

- support for the formation of magnetic layers or other protective oxidation layers,
- a reduction of corrosion through optimisation of the pH value,

- stabilising the hardness and preventing or reducing scaling and deposits,
- achieving chemical binding of residual oxygen.

Conventional conditioning agents may, for example, contain sodium and potassium hydroxide, sodium phosphate, sodium sulphite, ammonia and diamide.

## Water quality for steam boiler systems (cont.)

### Note

*In some countries or production processes, the use of some of these chemicals may be restricted.*

## General information regarding conditioning

### ■ Conductivity

- With salt content  
This means feedwater with electrical conductivity of  $> 30 \mu\text{S}/\text{cm}$  (e.g. downstream of a softening system).
- Low salt content  
This means feedwater with electrical conductivity of  $0.2\text{-}30 \mu\text{S}/\text{cm}$  (e.g. downstream of a T.D.S. system).
- Free of salt  
This means feedwater with electrical conductivity of  $< 0.2 \mu\text{S}/\text{cm}$  and silicic acid concentration  $< 0.02 \text{ mg/l}$ , as well as condensate with electrical conductivity  $< 5 \mu\text{S}/\text{cm}$  (e.g. downstream of full T.D.S. systems with mixed bed quality).

### ■ Acid capacity $K_{\text{S } 8.2}$

A higher acid capacity in feedwater would indicate an excess of bound carbon dioxide. This results in a higher putrefaction by alkalis of the boiler water, which leads to an increased risk of corrosion on the steam boiler, and also on the steam network downstream of the boiler through separation of vapour-volatile carbon dioxide.

### ■ Adjusting the alkalinity

The selection of the alkalisating agent depends, amongst other things, on the use of the steam, the steam pressure and the type of water treatment. There are solid and volatile alkalisating agents.

A balanced conditioning with phosphate or its derivatives can also be beneficial through regulating the pH value of the boiler water. However, organic conditioning agents have also been in use for years.

If organic conditioning agents are used, the amounts and processes to be used as well as the required analyses must be specified by the supplier of these chemical products.

### ■ Oxygen and carbon dioxide or oxygen binders

Carbon dioxide and oxygen are expelled from the feedwater through full thermal deaeration. The use of oxygen binders is required if it proves impossible in practical use, e.g. through repeated idle periods, to keep the oxygen content of the feedwater below the permissible values. This "correcting chemical" is admixed with the feedwater through the dosing facility.

### **Please note:**

*Amines that form a film are not oxygen binders.*

## Water quality for steam boiler systems (cont.)

### Note

*In case of damage, evaporation can lead to a concentration of the solute non-volatile boiler water constituents (salts, solid conditioning agents). Such conditions can lead to local alkali concentrations that result in stress fracture corrosion. Therefore, with only mildly buffered feedwater with conductivity < 30 µS/cm, sodium hydroxide as an alkalising agent is only permissible if the recommended pH range cannot be achieved with sodium phosphate alone. With this method, sudden fluctuations in pH value result in low sodium hydroxide content.*

### Deviation during conditioning

Actual values deviating during constant operation from those specified may be the result of the following:

- inadequate treatment of the top-up water,
- inadequate feedwater conditioning,
- advancing corrosion on some system components,
- water contamination through ingress of contaminants from other systems, e.g. condensate tank, heat exchangers.

Carry out immediate changes to reinstate the correct operation. For example, feeding in returned condensate must not influence the feedwater quality and may have to be treated.

The chemical consistency of the boiler water can be monitored by dosing specific chemicals as well as through continual or intermittent blow-down of a part of the water volume. This must be done in such a way that solute as well as suspended contaminants can be removed.

### Conditioning/Warranty

#### **Please note:**

*The warranty will be void:*

- if film forming amines are used,
- if dosing agents are used that are not listed in the guidelines.

## Water quality for steam boiler systems (cont.)

### Sampling

Sampling of water and steam from the boiler system should comply with ISO 5667-1; the treatment and handling of samples should comply with ISO 5667-3.

Samples are taken via a sampling cooler. This cools down the water sample to a temperature of approx. 25 °C. To be able to draw off a useful sample, flush the sampling line for an appropriate time.

The sample should be analysed immediately after drawing as values might change as a result of prolonged settling.

Opaque or contaminated sample water should be filtered prior to testing.

See also the "Operating instructions of the sample cooler".

### Sampling ports

Provide sampling ports at representative points in the system.

Typical sampling ports are:

- boiler feedwater entry valve,
- boiler water from a downpipe or a continuous T.D.S. line,
- top-up water downstream of the top-up water treatment system or the storage tanks,
- condensate at the condensate tank outlet, if installed; otherwise draw the sample off as near to the feedwater tank as possible.

### Analysis

#### General

Verify compliance with the values specified in **table 1** (page 21) and **table 2** (page 22) through analyses.

If the analyses are carried out in accordance with different standards or by indirect means, calibrate such methods. A clean surface with water supply and drainage facility should be made available for carrying out the analyses. The required equipment should also be available in a cupboard at this workplace.

#### Note

*For some types of water, the amount of solute matter can be estimated by means of the conductivity. In addition there is a correlation between the pH value and both conductivities.*

*Viessmann offers components for water analyses to aid continual monitoring of the O<sub>2</sub> and pH values as well as water hardness levels.*

## Water quality for steam boiler systems (cont.)

### Analysis procedure/test equipment

In continuous boiler operation, the boiler values can be checked adequately with the test equipment. In case of severe deviations, confirm the actual values through correspondingly standardised analysis procedures and remedy the problem.

Parameters should be checked in accordance with the following standards:

|                              |               |
|------------------------------|---------------|
| Acid capacity                | EN ISO 9963-1 |
| Conductivity                 | ISO 7888      |
| Copper                       | ISO 8288      |
| Iron                         | ISO 6332      |
| Oxygen                       | ISO 5814      |
| pH value                     | ISO 10523     |
| Phosphate                    | ISO 6878-1    |
| Potassium                    | ISO 9964-2    |
| Silicic acid <sup>*6</sup>   |               |
| Sodium                       | ISO 9964-1    |
| TOC <sup>*7</sup>            | ISO 8245      |
| Total hardness as<br>Ca + Mg | ISO 6059      |

Measure the acid conductivity in the form of the hydrogen ion concentration continuously in the same manner as the conductivity in hydrogen form, after the sample has gone through a severely acidic cation exchanger with a volume of 1.5 l.

The exchanger is inserted into a cylinder with a diameter:height ratio of 1:3 or less, whereby the exchanger medium takes up at least three quarters of the cylinder volume.

Regenerate the ion exchanger when it has been exhausted by two thirds. This can be recognised when using an exchanger with colour indicator and transparent cylinder.

<sup>\*6</sup> *There is currently no European or international standard; see for example DIN 38405-21 standardised German procedure for water, waste water and sludge examination : anions (group D); photometric determination of solute silicic acid (D 21).*

<sup>\*7</sup> *As an alternative, the permanganate index can be checked in accordance with ISO 8467, if these values are specified.*

### Preamble

This manual contains general information regarding the installation, commissioning, operation, maintenance and inspection. It must be supplemented and specifically adapted by country-specific regulations. In addition, any instructions for the equipment and auxiliary systems that are part of the boiler system must be incorporated into the manual supplied with the system. Only technically trained and instructed personnel must operate this system.

### Installation

Requirements for structural systems are always subject to the regulations applicable in the installation country. The following represent some fundamental requirements:

#### Installation requirements

Steam boiler systems must be installed so that all parts can be correctly operated, maintained, repaired and monitored. The Health & Safety at Work of employees must be safeguarded at all times.

Steam boilers and ancillary equipment that form part of the steam boiler system must be installed with regard to the prevention of shock, vibrations and sound emissions as well as the protection against any other risks, so that the systems are compliant with all technical safety aspects.

Valves and fittings of the steam boiler and the steam boiler system together with any safety and pressure relief facilities fitted to them must be installed, so that these can safely blow-off or can be safely activated, and that the relief process can be clearly recognised.

## Installation (cont.)

### Clearances for operation and maintenance

Areas that must be accessed for control and maintenance of the steam boiler system must offer a head clearance of at least 2 m and a clear width of at least 1 m. Individual boiler fittings may restrict the clear width to 0.8 m.

In all other areas, a passage width of 0.5 m will suffice.

In case of cylindrical boiler bodies, the passage width on one side can be reduced to 0.3 m.

The clearance between the boiler top and the ceiling above must be at least 0.75 m, when access to that area is required for operation and maintenance.

All inspection apertures of the steam boiler system must be freely accessible or must be able to be made accessible easily.

### Access to boiler rooms

The boiler room must not include installation to which personnel requires access that is not charged with working on the steam boiler system or that might prevent the boilerman from carrying out his work.

Unauthorised personnel must not be given access to the steam boiler system. Affix prohibition notices on all entries to the boiler room so that they are clearly legible at any time. The boiler user must determine the authorised circle of personnel.

### Rescue routes, emergency exits

Rapid unhindered access to and from the steam boiler rooms must be ensured at all times through the number, location, type and condition of escape routes.

Escape routes must lead away from the danger area by a short and direct route. Exits must be identified.

Boiler rooms should have two exits opposite each other, one of which should be designed as an emergency exit.

Escape routes and their exit points must have a clear width of at least 0.6 m and a clear head height of at least 2 m; they must always be kept free and unobstructed.

Doors in the way of escape routes must be able to be opened easily from the inside and must open in the direction of escape.

The boiler room must be able to be adequately ventilated. For this, openings must be provided at suitable points. If the combustion air is drawn from the boiler room, ensure that the boiler room is never subjected to more than 0.5 mbar negative pressure.

## Installation (cont.)

### Platforms and handrails

To be able to safely operate fittings/valves that must be activated or tested daily or every three days, provide steps, lean-to ladders with platform and protruding handrails or platforms with steps, fixed ladders or lean-to ladders. Reference is made to the associated UVV "Ladders and steps".

Walk-on platforms or boiler covers higher than 1 m above floor level and stairs with more than five steps require a handrail.

Access and working platforms and similar must not restrict the ventilation in the boiler room.

### Flue gas routing

Flue gases from steam boiler systems must be routed so that they represent no risk to personnel and third parties.

### Lighting

Adequate lighting is required for the steam boiler system, in particular in the area of valves/fittings, controls and safety equipment as well as in access and escape routes.

Emergency lighting must be provided for the escape routes and their exits. The lighting installation must be maintained in good working order at all times.

## Commissioning

### Commissioning

Generally, commissioning is carried out by Viessmann Industrieservice, the system installer or a contractor authorised by them.

### Commissioning preparations

Prior to commissioning the boiler, at least the following steps are required, the execution of which are the installer's responsibility:



## Commissioning (cont.)

- Checking the pipework for implementation according to design (e.g. retainers, expansion joints, dewatering, draining, venting).
- Checking the fittings/valves for correct selection and installation (e.g. correct pressure stage and materials, flow direction, controls, correct flange connection).
- Ensuring the safe operation of all boiler house facilities (equipment, working and access platforms, hand-rails, insulation, heating, ventilation).
- Testing the lighting system.
- Checking the availability of fire fighting and "First Aid" equipment.
- Opening the front cleaning apertures of the boiler and checking the turbulators (if part of the standard delivery) and removing shipping brackets.
- Operational telephone system.

## Starting the boiler

**The commissioning steps are subject to the respective boiler equipment and the type of ancillary systems. The specific sequences must be determined individually for each specific case.**

**The following details a sample sequence for a system requiring no supervision for 72 hours acc. to TRD 604/BI.**

### Steps

- Commissioning the chemical water treatment system in accordance with the manufacturer's operating instructions; adjustment of the safety equipment for monitoring the required water quality
- Filling the feedwater tank with treated water and flushing the feedwater lines
- Commissioning the dosing equipment for feedwater conditioning
- Commissioning the control panel See page 34
- Commissioning the feed pumps (see also the commissioning instructions of the pump manufacturer with reference to the required operating conditions) See page 34
- Filling the boiler with feedwater until the water level is visible in the sight glass See page 34
- Adjusting the water level control See page 34
- Checking the water level limiting equipment See page 35
- Commissioning the burner See page 35
- Function check of the safety pressure limiter See page 35
- Safety valve function check See page 36
- T.D.S. controller adjustment See page 36



## Commissioning (cont.)

- Boilout  
See page 36
- Plugs/closures on the water side  
See page 36

### Commissioning the control panel

- Visual inspection
- Switch ON the main isolator
- Setting the individual control MCBs
- Checking individual functions
- Checking the display/indicator functions
- Checking the rotational direction of motors and actuators
- Function test "EMERGENCY STOP".

### Commissioning the feed pumps

- Filling the pumps with medium
- Starting the pumps and checking the rotational direction
- Adjusting the operating pressure of the pumps during the first filling of the boiler
- Supply pressure must be lower than the max. operating pressure
- Checking whether the boil-dry protection device is active and operates.

### Filling the boiler with feedwater

For this check that

- the drain (blow-down valve) is closed
- the T.D.S. valve is set to "CLOSED"
- the air vent valve is open
- the steam valve is closed
- the sight apertures in the water area are tight; replace gaskets if required
- if an ECO is installed, the ventilation and drain valves are closed
- the water level sight glasses are open; flush the water side if required.

### Adjusting the water level control

- 1. Stepped control
  - Checking the switching points for pump ON and pump OFF via the water level indicator
- 2. Constant control
  - After the water level has reached the NW level, adjust the zero point
  - Fill the boiler up to the top edge of the sight glass and adjust the 100% point at the controller
  - Set the feedwater valve to CLOSED via the controller and adjust the zero point of the valve at the controller
  - Set the feedwater valve to OPEN via the controller and adjust the 100 % point of the valve at the controller
  - Set the limit switch at the straight-through feedwater valve for pump OFF
  - Preset the switching points for pump ON and pump OFF at the controller, whilst the boiler starts with the steam valve closed
  - Set feed pump switch to automatic at the control panel and check the function of the water level control
- Repeat this process after the burner commissioning and when the boiler has been pressurised. As the boiler water heats up and consequently expands, check the NW and HW levels again.
- Let the water level return to the zero point by opening the blow-down valve and readjust at the controller
- Bring the boiler to the required water level and adjust at the controller

## Commissioning (cont.)

### Checking the water level limiting equipment

- When the NW (LWL) level has been reached, reset the water level limiter in the control panel by resetting the boiler safety chain.
- Check the response of the water level limiter under operating conditions in accordance with the manufacturer's operating instructions. For this, take the feed system out of use and reduce the water level in the boiler to the NW level by drawing steam or by means of a blow-down. Observe that both limiters must respond.

### Commissioning the burner

Commission the burner in accordance with the operating instructions issued by the burner manufacturer. A prerequisite for the commissioning is that the fuel supply is enabled and that, in case of an oil boiler, the quick-acting oil shut-off valve at the tank operates correctly. In case of gas combustion, a healthy gas supply from the local gas supply utility must be enabled and the gas line inside the boiler house must be tested and certified in writing by the system installer as suitable prior to commissioning. The quick-acting gas shut-off valve at the entry into the building must function correctly. Any required gas warning equipment must function correctly. No unauthorised personnel must be in the boiler house when the burner is being commissioned.

Once the combustion is steady, raise the operating pressure to approx. 3 bar under partial burner load or at burner stage 1. After that value has been reached, the burner load up to rated output is enabled. Now slowly open the steam valve and close the air vent valve.

Clean the steam lines in accordance with the specification provided by the user (blow-through). Ensure the adequate dewatering of the steam systems. Subject to a steady steam draw-off the combustion can be fine adjusted. Agree the operating pressure subject to the safety pressure with the system user.

### Function check of the safety pressure limiter

Adjust the safety pressure limiter so that, just before the safety valve responds, it switches the boiler to fault status. The setting pressure depends on the individual system and must be adjusted with reference to the safety and operating pressures. It must lie below the response pressure of the safety valve. Make the function check with a closed steam valve and by bypassing the pressure controller (key switch or test button on the control panel). The burner may be operated with partial load. After the safety pressure limiter has responded and caused the boiler to perform a fault shutdown, seal the safety pressure limiter to prevent unauthorised adjustment. Reset the safety pressure limiter following a pressure reduction in the boiler, and return the boiler into standard operation.

## Commissioning (cont.)

### Safety valve function check

This function check serves to check the set pressure and to verify that the safety valve is capable of blowing off the amount of steam occurring at full load. Prior to implementing the function check, verify that the blow-off line has been correctly routed and secured, that the dewatering line has been connected to the safety valve and that its outlet is unobstructed and that no personnel are anywhere near this area.

To check the safety valve, take the following steps:

- close the steam valve,
- bypass the pressure controller (key switch or test button at the control panel),
- bypass the safety pressure limiter inside the control panel,
- set the burner to full load.

The safety valve must open when the set pressure has been reached; this must be  $\approx$ / $<$  of the permissible operating pressure of the boiler. The boiler pressure can rise up to 10% above the permissible operating pressure before the safety valve opens. If the pressure inside the boiler remains below this value, then the valve functions correctly and the boiler can be shut down.

The function check must only be carried out with a trained supervisor. For this ensure that the boiler can be shut down immediately and at any time via the "EMERGENCY STOP".

### T.D.S. controller adjustment

This adjustment must also be made in accordance with the manufacturer's instructions. The maximum permissible boiler water conductivity is specified in the water standards (e.g. EN 12953, part 10 or page 22); these may differ. Never exceed maximum values of 6000  $\mu\text{S}/\text{cm}$  to 20 bar. Agree the control value with the user. Test the limit switch function regarding the max. conductivity by reducing the set value.

### Boilout

For technical or safety reasons, a boilout prior to commissioning the boiler is not required for boilers with large water chambers.

### Plugs/closures on the water side

During commissioning, check all plugs/closures and flanges on the water side for tightness and retighten in accordance with page 45 point 17.

## Commissioning (cont.)

### Verification

Create a commissioning report regarding the commissioning, where you record the established and set values. This report must be signed by the customer.

### Instructions

Instruct the operating personnel after the first commissioning. Create a report about these instructions.

### Returning the boiler into use after idle periods

Generally, the local operators would return the boiler into use after an idle period. Starting the boiler from the external control room is not permissible. The boiler must be returned into use in the following sequence:

- Walk around the system to visually check its correct condition
- Commissioning the control panel – circuit breaker ON
- Commissioning the feed
- Checking the water level and the function of the water level indicator as well as that of the water level control
- Commissioning the combustion with a closed steam valve
- Controlling the output to partial load or stage 1
- Check the water level and, upon reaching HW, reduce the water level by means of a blow-down.
- When the boiler pressure has risen to 3 bar below the permissible operating pressure, slowly open the steam valve.
- Further checks as described in chapter "Utilisation and operation".
- For one hour after starting the boiler the system should be supervised by an operator (only applicable to systems without temporary supervision).

### Shutdown

Taking the boiler out of use means the shutting down of the system via the circuit breaker at the control panel.

## Commissioning (cont.)

The length of the shutdown period also determines the preservation measures described in chapter "Preservation". A short-term shutdown is not recommended, as every start-up process subjects the boiler to additional stresses. For a period up to 24 hours or over a weekend, the boiler should continue in operation. If pressure can be reduced via an additional pressure regulator or via the PLC, then the boiler can be operated with reduced pressure (approx. 2 bar). Only close the steam valve downstream of tee TWA.

### **Note**

*For this ensure that the thermal water treatment (TWA) is not closed off by damper valves, i.e. that it is not isolated from the system pressure. Keep the TWA – just like the boiler – under pressure when taking the system briefly out of use.*

### **Steps to take the boiler out of use**

- Shut down combustion and close the fuel valve
- Feed the boiler up to the controlled water level
- Close the steam (see information regarding the TWA above) and feed valves
- Switch off the circuit breaker

## Supervision

### Utilisation and operation

The supervision intervals are subject to the user specification and the national regulations applicable in the country of installation. The operating, maintenance and checking tasks as listed from page 58 are suggested by the operator. These tasks are suggested as minimum requirements.

Checks are differentiated according to:  
per shift/day/week/month:

Execution by the operators

The period "Day" for systems with operation for 72 hours without supervision means every three days.

every 6 months/12 months:

These checks should be carried out by a specialist contractor, e.g. the Viessmann Industrieservice or the manufacturers of the boiler system, combustion equipment and water treatment.

All checks and their results must be recorded with traceability.

### Boiler log

This boiler log should be presented to the authorised supervisory body during every inspection. Make the following entries in the boiler log:

- confirmation by the boilerman with signature of the inspection tasks carried out,
- confirmation by a trained person regarding the inspection and maintenance work carried out at the control and limiting equipment every six months,

- result of the regular water checks carried out as part of standard operation,
- all fault cases and special findings during inspections and maintenance of/on the steam boiler system.

## What to do in case of operating faults

### Note

See *technical safety information on page 4*.

Generally, the operating instructions should be observed regarding action in case of operating faults. The following highlights some aspects that are the result of general operating experience.

If steam lines, fittings/valves and other operating equipment on the steam boiler system leak, and these leaks cannot be remedied immediately, limit their effect, identify and monitor them.

Areas at risk must only be entered if this is requested by the authorised person and the safety measures required for work inside the areas at risk have been implemented.

System parts that have been shut down as a result of a fault must only be started following the expressed instructions of the person with the appropriate responsibility, once the cause for the shutdown has been removed and the system components have been tested locally prior to the new start.

Immediately shut down the steam boiler system and inform the supervisor as quickly as possible if a boiler condition is suspected that could cause a dangerous condition. This applies particularly if, for example

- a boiler wall shows signs of glowing red hot or of a deformation anywhere,
- the safety valve cannot be made to respond correctly,
- a correct operation of the controllers, the limiters or flame monitors cannot be ensured,
- a fuel leak is recognised,

- irregularities in the combustion operation or a deflagration have/has occurred,
- medium is leaking from the pressure part of the boiler.

If dangerous conditions for boilers exist, shut off such conditions from boilers connected in parallel.

If an emergency operation should be enabled for operational reasons, agree the required measures with the authorised supervisory body and the manufacturer.



## Repairs

### General requirements

Repair work may only commence after the person responsible for such repairs has determined the required safety measures, has inspected their implementation and has declared the place of work as safe to proceed. Following the completion of the work, safety measures may only be removed on the instruction of the person, whose responsibility they are.

Keep all gaskets in the closure systems clean and dry. Consumables, such as sealing compounds or separating agents must generally not be used. Exceptions require the agreement of the gasket manufacturer. Only use gaskets in their original condition and in accordance with the manufacturer's installation and operating instructions.

### Working on hot pressurised medium

Work by personnel on systems or parts of systems that carry hot pressurised medium (e.g. valves in steam lines) is not permitted, if during such work the risk of releasing the medium cannot be totally excluded.

Work in areas at risk may only commence if the system or parts of the system have previously been reliably depressurised and are also not under negative pressure, that this state has been secured and a person authorised by the user has checked the implementation of this measure and has certified in writing that the area of work is safe. (This also applies if line sections have been isolated for the purpose of a shutdown.)

These required measures that depend on the individual system must be laid down in writing by the user in the form of operating instructions.

## Inspection

### Entering the steam boiler

Prior to entering the steam boiler, pipe connections (steam, feed and drain facilities) to the operational boiler must be securely and visibly separated by means of adequately strong dummy flanges or by removing pipe sections. If on pipework with welded-in or seal-welded fittings the break is made by in-line shut-off facilities, the intermediate connecting device that connects to the outside air, must be opened. These shut-off devices must be locked and secured against unauthorised activation. Removing the hand wheels from these shut-off devices is not enough. Warning signs: "Danger! Persons inside the steam boiler" must be affixed to the shut-off devices in a clearly visible location, so that the signs cannot be easily removed. Removing the warning signs is only permitted with the agreement of the works manager. Steam boiler and flues must be well ventilated.

The entry into the steam boiler must be explicitly requested by the person with the appropriate authority. The entry must be supervised. Prior to the safety measures being removed, a person with appropriate authority must ensure that no one is left inside the above parts of the system.

During the entry into the steam boiler and flues, electrical equipment may only be used if, including its cables and leads, it complies with the relevant safety regulations and has been provided by the user or their agents for work inside the steam boiler. Lamps must only be operated with safety voltage up to 42 V. The same regulation applies to electrical tools, these may, however, be operated with higher voltages of up to 380 V, subject to their supply being routed through an isolating transformer. LV and isolating transformers must be located outside the steam boiler.

### Inspections

The type and interval of inspections depends on the regulations that apply in the country of installation.

The following periods are suggested in the declaration of conformity:

|                                    |   |
|------------------------------------|---|
| External inspection of the system: | annually  |
| Internal inspection of the system: | every three years   |
| Repeated pressure test:            | every nine years<br>(max. test pressure in accordance with the initial pressure test) |

## Steps - commissioning, inspection and maintenance

For further information regarding the individual steps, see the page indicated

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Service

## Further details regarding the individual steps

### Starting the system



Details provided by the burner manufacturer and regarding accessories

1. Check that the turbulators (if installed) are fully pushed into the hot gas flues (open the boiler doors).
2. Check that the boiler doors and cleaning apertures at the back of the boiler are closed.
3. Check that the installation room ventilation is unobstructed.
4. Check the function of the water treatment system.
5. Fill the steam boiler with treated water higher than the NW level.

#### Note

*In accordance with the TRD 611, only suitable water must be used with the steam boiler.*



See "Standard values for water quality" from page 21.

6. Check all fitted components, such as pipework, valves, controllers, pumps etc. for function and tightness.
7. Check the fuel.
8. Open the flue gas damper (if installed).
9. Open the gas or oil line shut-off valves.

10. Switch ON the main isolator, the switch for the boiler drives and the burner control switch in this order (observe the burner manufacturer's operating instructions).
11. Start the boiler at a low output and gradually heat up to a pressure of approx. 3 bar below operating pressure.  
Version with integral economiser:  
To prevent steam hammer during heat-up, initiate a feedwater flow through the economiser several times, for example by manually activating the blow-down valve.
12. Vent the boiler at the air vent valve during heat-up until steam is expelled. Then close the valve.



#### Danger

Expelled medium can lead to scalding.  
Ensure the medium is drained off safely.

13. Slowly open the steam valve after the required steam pressure has been reached, otherwise there is a risk of steam hammer.
14. While the system heats up, check the correct function of all control and safety equipment.
15. Observe the pressure and temperature test equipment.
16. If required, dewater and vent the connection lines.

**Further details regarding the individual steps** (cont.)

- 17.** Check the plugs/closures for leaks and retighten, if required.  
Retighten all plugs/closures again at max. permissible operating pressure. Torque values under cold and hot conditions:
- 18.** Check the boiler doors and cleaning covers for leaks after approx. 50 hours and retighten all screws (torque approx. 5 to 10 Nm).

| Closure   | Dimensions        | Torque |
|-----------|-------------------|--------|
| Hand hole | 100 x 150,<br>M16 | 100 Nm |
| Head hole | 220 x 320,<br>M20 | 200 Nm |
| Manhole   | 320 x 420,<br>M24 | 350 Nm |

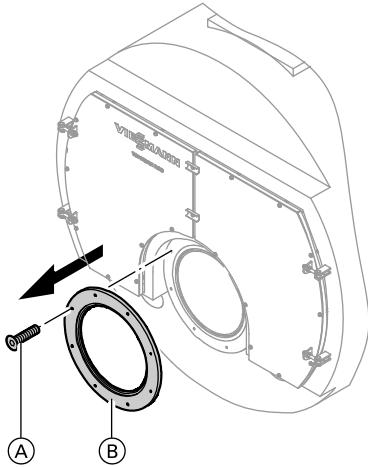
**Shutting down the system****Danger**

Opening the boiler connections and openings whilst the boiler is under pressure can lead to a high risk of severe personal injury. Only open the connections on the water and steam side and inspection apertures after the boiler has been completely de-pressurised.

1. Shut down the burner.
2. Close the shut-off valves in the oil lines (at the oil tank and filter) or the gas shut-off valve.
3. Isolate the system from the power supply.
4. Close all valves.

**Further details regarding the individual steps (cont.)**

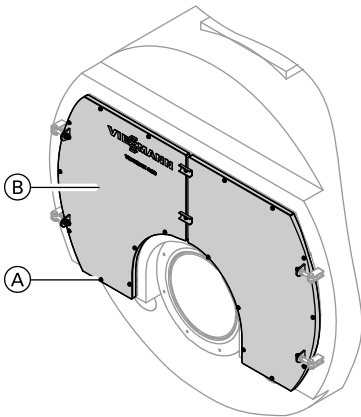
**Removing the burner (if required)**



1. Remove the fuel supply line.
2. Undo screws (A) and remove burner with burner plate (B).

**!** **Please note**  
Ensure the burner and burner plate are flush fitting.  
Use a suitable tool/lifting apparatus.

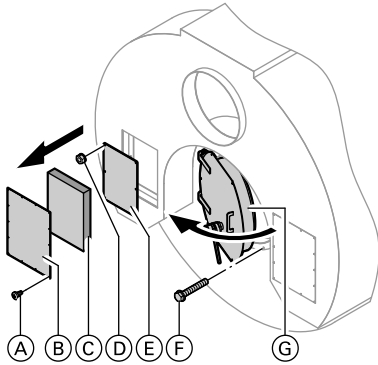
**Open the boiler doors**



Undo screws (A) and swing open boiler doors (B).

**Further details regarding the individual steps (cont.)**

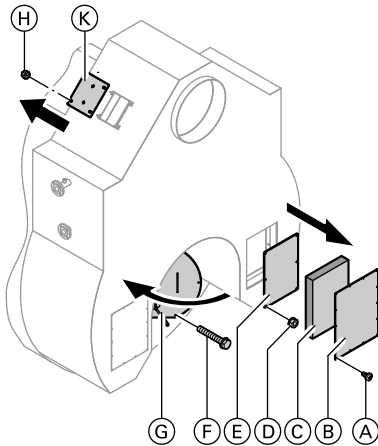
**Open the clean-out cover**



1. Flue gas collector
  - Undo screws (A) from insulating fascia (B) and remove together with thermal insulating mat (C).
  - Undo screws (D) and remove cleaning cover (E).

2. Flame tube entry
  - Remove screws (F) and swing open the cleaning aperture (G).

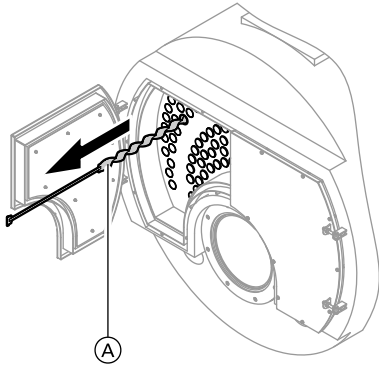
3. Economiser
  - Remove nuts (H) and remove cover (K).



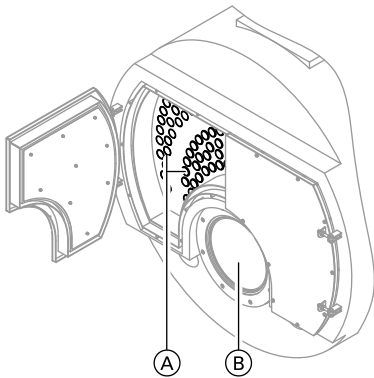
**Further details regarding the individual steps (cont.)**

**Removing and cleaning the turbulators (if installed)**

Remove turbulators (A) without force.



**Clean heating surface and flue gas collector**

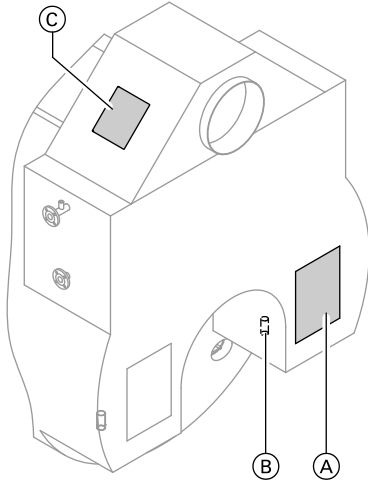


1. Clean flues (A), flame tube (B) and reversing chamber with pneumatic cleaner and remove combustion residues.
2. Remove combustion residues from the flue pipe and the flue outlet.



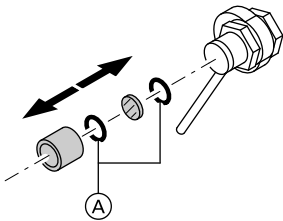
## Further details regarding the individual steps (cont.)

### Cleaning the economiser heating surfaces



1. Remove combustion residues through cleaning apertures (A) or allow cleaning water to drain off through drain connector (B) on the flue gas collector.
2. Clean the heat exchanger surfaces through cleaning apertures (C) with pressure lances or, in case of severe contamination with feedwater. In case of wet cleaning always ensure that the exchanger surfaces are at almost identical temperatures to the feedwater to prevent thermal stresses and thermal shocks.

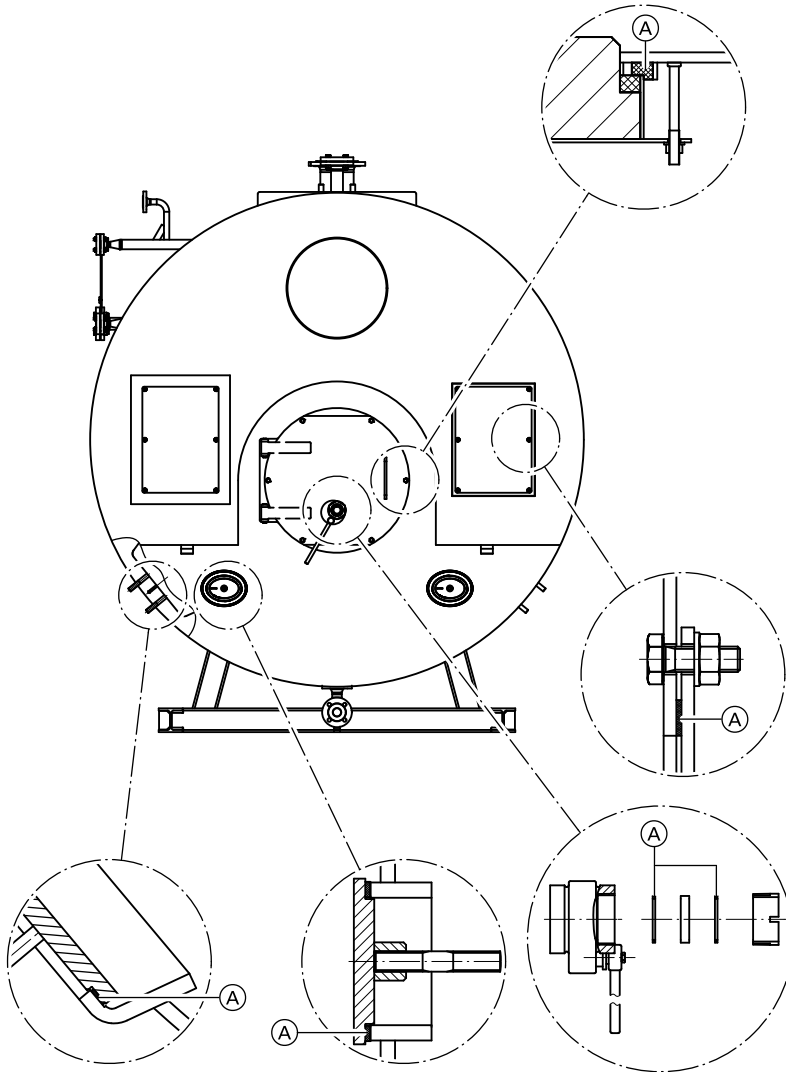
### Clean the sight glass in the cleaning aperture



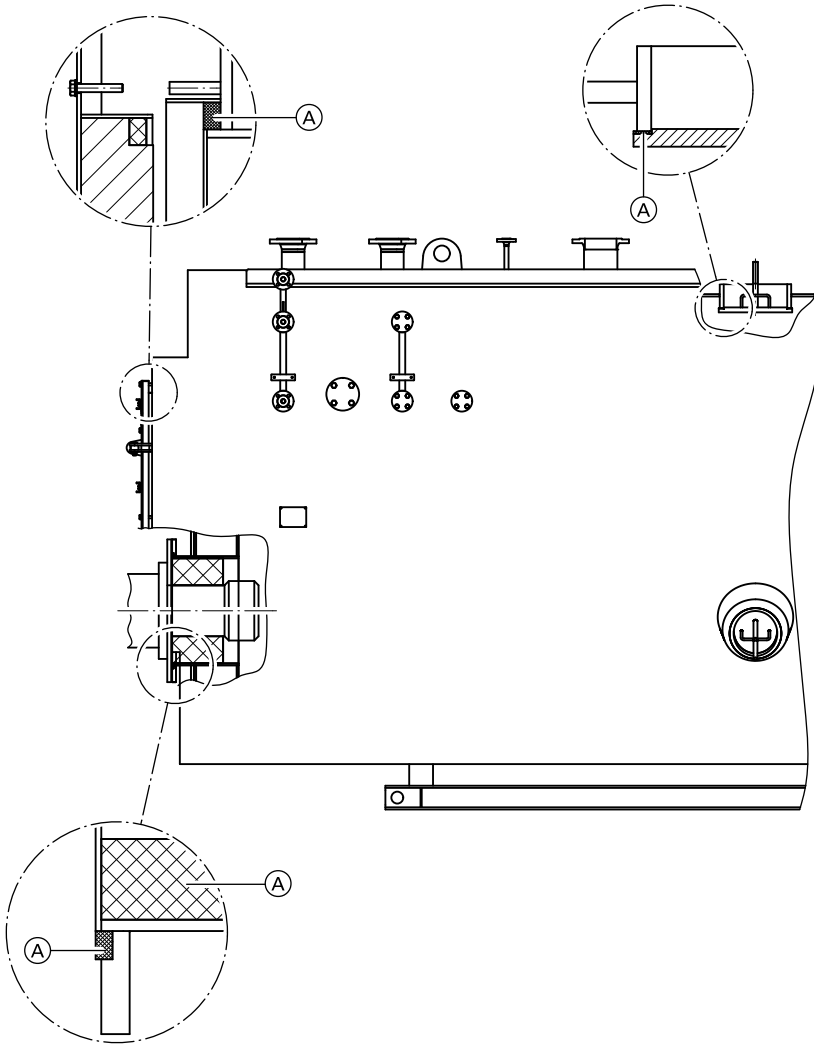
Check the sight glass with gaskets (A) for leaks and clean.

**Further details regarding the individual steps (cont.)**

**Check thermal insulation components and gaskets**



**Further details regarding the individual steps (cont.)**



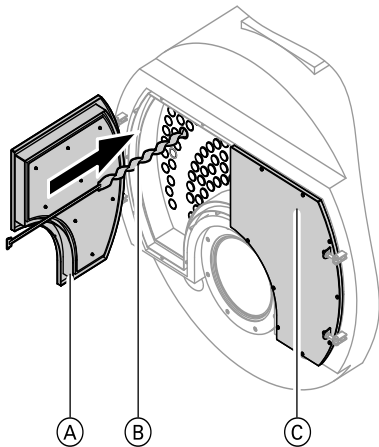
### Further details regarding the individual steps (cont.)

Check all gaskets (A) and insulating parts for damage and a firm seat.

**Note**

*Only perfect and fixed material protects against the egress of gas and overheating, and consequently against material damage and injury/risk of death.*

### Insert turbulators (if appropriate) and close the boiler doors

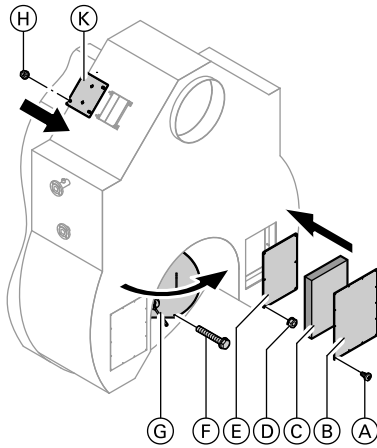
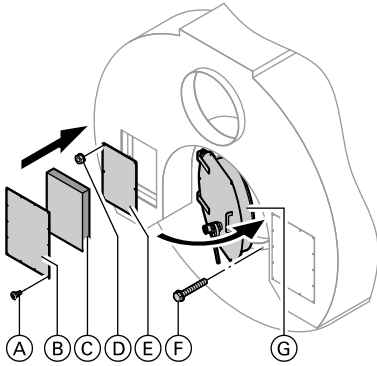


1. Push turbulators (B) (only in the external pipe array) as far as they will go.
2. Close boiler door (A); tighten screws (C) evenly and diagonally (torque approx. 5 to 10 Nm).

**Further details regarding the individual steps (cont.)**

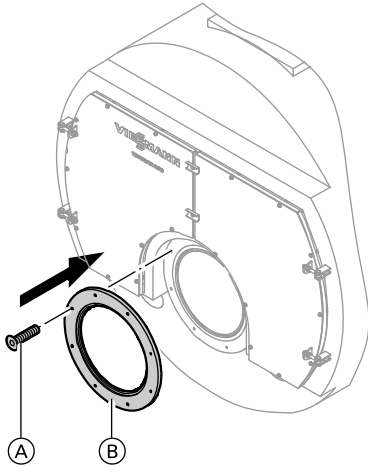
**Fitting the cleaning cover**

**Fitting in reverse order as shown on page 47.**



## Further details regarding the individual steps (cont.)

### Burner installation



1. Fit burner plate (B) with screws (A) to the burner flange.
2. Thermally insulate the space between the flame head (burner) and the burner opening (boiler).
3. For pressure-jet gas burner:  
Fit the gas supply pipe.



#### **Danger**

Escaping gas leads to a risk of explosion.

Test the tightness of all gas connections.

### Checking the inspection ports for leaks

#### **Note**

*Replace the gaskets every time a connection has been opened.*

*Insert only gaskets approved in accordance with TRD 401, appendix 1, VdTÜV [or local regulations].*



Installation instructions of the gasket manufacturer.

### Checking the water quality



Standard values for water quality

### Adjusting the burner

By the burner manufacturer or authorised heating contractor.

## Wearing parts, gaskets

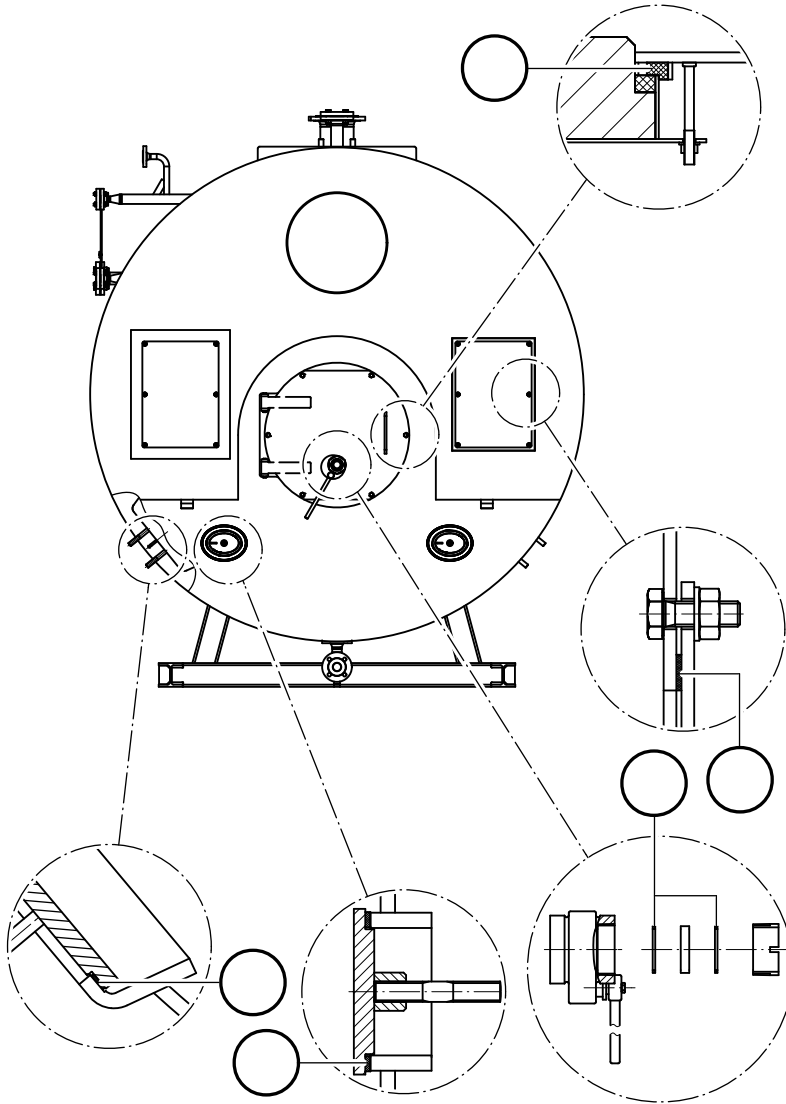
**Note**

*When ordering spare parts, please quote the serial number and the boiler type (see type plate).*

*Quote required number of spare parts.*

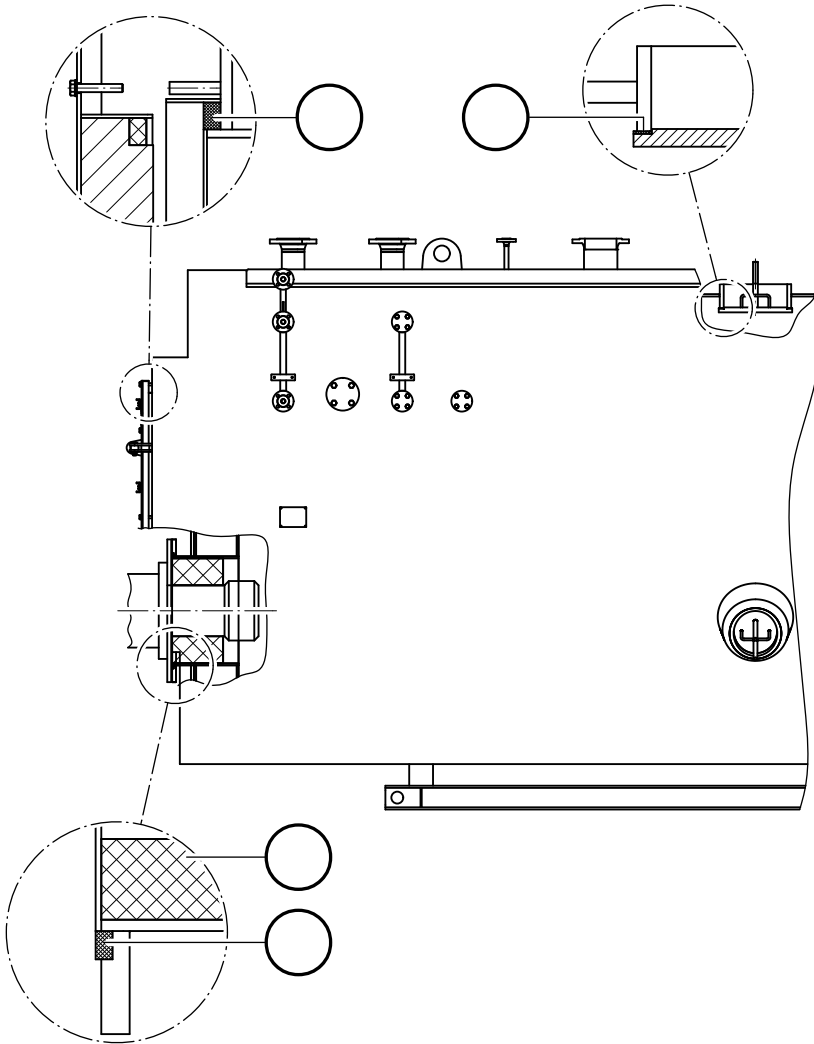
*Obtain standard parts from your local trade supplier.*

**Wearing parts, gaskets (cont.)**





**Wearing parts, gaskets (cont.)**



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**Operating, maintenance and inspection tasks**

| Operation of steam boiler systems<br>Part 1- General instructions for users<br>of steam boiler systems<br>For steam boilers category IV<br>Issue June 1983 (unchanged 8/93) |  | TRD 601<br>Operation<br>Appendix 1 |  | Checklist for a steam boiler system (steam and hot water boiler)<br>(S = Visual inspection; F = Function test; F* - at six monthly inspection (to TRD)) |     |          |      |       |          |   | Type of tests (examples) |
|---|--|------------------------------------|--|---|-----|----------|------|-------|----------|---|--------------------------|
|   |  |                                    |  | Shift   | Day | 72 hours | Week | Month | 6 months | 12 months   |                          |
| See Section TRD 601 Sheet 2   | Tasks comprising operation, maintenance and inspections/tests per: |                                    |  |   |     |          |      |       |          |   |                          |
| 3.2.1   | Safety valves  | S                                  |  |   |     |          |      |       | F*       | Vent  |                          |
| 3.2.2   | Water level - display equipment                                    | F                                  |  |   |     |          |      |       | F*       | Blow through and for boilers with p < 32 bar                  |                          |
| 3.2.3   | Remote water levels  | S                                  |  |   |     |          |      |       |          | Comparison of display with the directly indicated water level |                          |
| 3.2.4   | Sampling facility  | F                                  |  |   |     |          |      |       |          | Operation and clear passage                                   |                          |
| 3.2.5   | Water level controller   | S                                  |  |   |     |          |      |       | F*       | Blow through and operation                                    |                          |
| 3.2.6   | Water level limiter  |                                    |  |   |     |          |      |       | F*       | Blow through or reduction to switching point                  |                          |
| 3.2.7   | Flow limiter   |                                    |  |   |     |          |      |       |          | Flow reducer  |                          |
| 3.2.9/12  | Thermostat or pressure switches                                    | S                                  |  |   |     |          |      |       | F*       | Carry our comparative test                                    |                          |
| 3.2.10/13   | Temperature or pressure limiter                                    | S                                  |  |   |     |          |      |       | F*       | Change in set value / test keys                               |                          |
| 3.2.8/11  | Temperature or pressure indicators (pressure gauge)                | S                                  |  |   |     |          |      |       |          | Checking with precision thermometer / Zero point test         |                          |
| 3.2.14  | Drain and T.D.S. facilities  | F                                  |  |   |     |          |      |       | F*       | By activation   |                          |
| 3.2.15  | Boiler - fittings  | S                                  |  |   |     |          |      |       |          | By activation   |                          |

## Operating, maintenance and inspection tasks (cont.)

|        |   |   |  |  |  |    |    |   |
|--------|---|---|--|--|--|----|----|---|
| 3.3.1  | Feedwater and circulation facilities  |   |  |  |  |    |    | The alternate operation                           |
| 3.3.2  | Feedwater and boiler water testing  | X |  |  |  |    |    | Through analytical monitoring acc. to TRD 611     |
| 3.3.3  | Devices for monitoring boiler water regarding ingress of foreign matter                           | S |  |  |  | F  |    | Activation of test key                            |
| 3.4.1  | Flue gas dampers - limit switch   |   |  |  |  | F* |    | Closing and re-opening of the damper              |
| 3.4.2  | Burner control (servomotors for air and fuel)   |   |  |  |  | F* |    | Operation   |
| 3.4.3  | Combustion air fan, ignition and/or cooling air fan   | S |  |  |  | F* |    | Quite running, transfer of power (e.g. Vee-belts) |
| 3.4.4  | Air pressure-volume display and air pressure switch   |   |  |  |  | F* |    | Interruption of the pulse line                    |
| 3.4.5  | Fuel shut-off facility  | S |  |  |  | F  |    | Operation   |
| 3.4.6  | Fuel store and lines/valves/fittings  | S |  |  |  |    |    | Operation, leaks                                  |
| 3.4.7  | Fuel indicator  | S |  |  |  | F  |    |   |
| 3.4.8  | Safety shut-off facility upstream of the burner (for a 72-hour-operation also in the return line) | S |  |  |  | F  |    | Operation, leaks                                  |
| 3.4.9  | Tightness checking facility or intermediate air vent valve  | S |  |  |  | F  |    |   |
| 3.4.10 | Burner limit switch   |   |  |  |  |    |    | Pivoting the burner, pulling the burner lance     |
| 3.4.11 | Emergency stop switch   |   |  |  |  | F  | F* | Activation  |
| 3.4.12 | Ignition  | S |  |  |  |    |    |   |
| 3.4.13 | Ventilation   | S |  |  |  |    | F* |   |
| 3.4.14 | Flame monitor   | S |  |  |  | F  |    | Through covering the sensor                       |
| 3.4.15 | Assessment of combustion  | S |  |  |  |    |    |   |
| 3.4.16 | Assessment of combustion chambers and flues   |   |  |  |  |    | F* |   |
| 3.4.17 | Emergency stop switch   |   |  |  |  | F  |    |   |

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