Requirements for a burner system provided by the customer or a burner system provided by the customer with boiler control provided by the customer for the operation of oil-, gas- and dual-fired steam, heating and hot water boilers

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1 Firing design of the boiler system

For the use of the steam or hot water boiler in accordance with regulations, the technical data in the order confirmation of the boiler system in question must be complied with.

1.1 Fuels

The fuels used (according to the fuel standards specified in the order confirmation) and the combustion air must not contain any additives other than those specified in the fuel standard which cause corrosion, abrasion or scaling in the boiler or boiler components (superheater, flue gas heat exchanger, etc.), otherwise the boiler manufacturer will not accept any liability for the delivery, and there will be a reduction in boiler availability and service life, as well as an increase in the frequency of cleaning.

1.2 Burner output/back-pressure

Combustion performance and flue gas side resistance of the boiler system appear in the data on the offer or the order confirmation or the technical specifications under Index M in the operating instructions.

The burner fan must not apply a flue gas side pressure of more than 50 mbar.

2 Burner system provided by the customer and boiler control by manufacturer

The following requirements apply in the event that the boiler control is supplied by manufacturer and the burner system is provided by the customer.

2.1 Burner add-on and brick lining

The fitting of the burner system must not impair the functioning, intended design and operation of the boiler.

The following in particular is to be noted:

- Access to the inspection openings, such as for example the reversing chamber door, must be assured, and it must also be possible to swing out the burner and the front door/burner plate.
- In the case of boilers with pivoting doors, the maximum permitted door load must be observed in accordance with the data sheets on "Firebox dimensions and Burner fitting limits".
- When fitting a burner and firing valves to boilers with pivoting doors/burner plates, it must be ensured that it is possible to open and swing the boiler door as easily as possible (oil hoses and cables etc. to be laid with sufficient length, expansion fitting and possibly intermediate piece necessary in the gas line).
- The firing must not transmit any abnormal and excessive vibrations to the boiler at any load point (maximum vibration rate measured at the reversing chamber door or flue gas chamber/flue gas box: 60 mm/s); in boilers equipped with superheaters, the limit for superheater housing components is 30mm/s). The characteristic / dominant frequencies for firing operation are frequencies around approx. 100 Hz and between 400 and 700 Hz). If the vibration rate is higher, it can cause damage to the boiler attachment parts (reversing chamber door, flue gas chamber, flue gas heat exchanger) and to the flue gas line.
- The brick lining of the burner (if provided by the builder) must be designed in such a way, that uncooled areas, particularly the floor-flame tube connection, are protected (minimum overlap of 50 mm).
- All thermally unprotected areas are to be provided with thermal protection. The gap between the brick lining and the burner flame head in particular must be filled with movable insulation material in accordance with the instructions of the burner manufacturer (not to be brick lined!).

- When fitting the burner, the infeed and outfeed lines with their valves must be taken into account
- The data sheets on "Firebox dimensions and Burner fitting limits" for the particular boiler type must generally be observed.

2.2 Operating behaviour of burners

2.2.1 Burn-out

Burnout of the flame must be ensured within the combustion chamber specified in the combustion datasheet, including reversing chamber. In reversing flame boilers, the flame must not reverse early in the reversing chamber at any load point, and instead must burn out completely in the flame tube.

To guarantee full burnout, carbon monoxide-free flue gases must be present at the boiler end (maximum CO content: 50 mg/Nm3 with reference to 3% O2 content).

2.2.2 Requirements for the burner turn-down ratio

Irrespective of the fuel, the following **maximum permitted low loads** must be observed during normal operation, i.e. burner start from a "warm state" (start of automatic mode and release of output control):

Max. **50 %** of the burner output in the case of burner outputs	up to 1,000 kW
(corresponds to an actual burner control ratio of at least 1:2)	
Max. **33 %** of the burner output in the case of burner outputs	$< 1{,}000 \leq 8{,}000$ kW
(corresponds to an actual burner control ratio of at least 1:3)	
Max. **25 %** of the burner output in the case of burner outputs	$< 8{,}000 \leq 20{,}000$ kW
(corresponds to an actual burner control ratio of at least 1:4)	

(These values apply for the main fuel; in the case of the emergency fuel, a maximum permitted low load of **33 %** is required in the range of $< 1{,}000 \leq 20{,}000$ kW) (corresponding to an actual burner control ratio of at least 1:3)

In addition to this, the following conditions apply depending on the type of burner control:

- Stage burners:
  - **Required number of stages = burner output / low load of the burner (rounded to whole numbers)**
  - Equal distribution of the stages
  - At least a two-stage design
- Burners without stages:
  - Maximum permitted **b**urner **o**utput **c**hange **s**peed **BOCS [kW/s]**

    BOCS = 0.025 [1/s] x burner output [kW]

    The BOCS must be observed between low load (LL) and high load (HL), and it applies to both positive and negative changes in the burner output.

    All the above mentioned burner outputs are based on the actual thermal output of the boiler.

    The relevant operating instructions of the boiler manufacturer are to be observed when adjusting the output control of the boiler.

2.3 Interface between boiler control and burner control

If the customer's burner control allows the possibility of on-site manual operation, the appropriate instructions of the burner manufacturer must be observed before using this manual operation mode. The individual operating options are not interlinked or locked in the boiler control system.

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The boiler manufacturer accepts no liability for faults caused by incorrect operation of the burner control unit. Data transfer from a customer's burner to the boiler control system (e.g. transfer to a central process control system) is not possible. The boiler manufacturer accepts no liability for faults arising from the central control system that are caused by tampering with the burner control.

The following points are required for burner regulation at the interface of the boiler control/burner control:

- The burner control unit is fitted to the burner or is built into a control cabinet of the customer.
- All control and power components are fitted on the burner at the respective burner components (fan, burner oil pump station, etc.) or are built into a control cabinet of the customer. Control and power supply with fuse protection for the burner with AC or three-phase is provided by the boiler control cabinet.
- Burner data, notifications and faults regarding the burner are shown at the burner control unit.
- Power control of the burner is provided from the boiler control cabinet.
- Unblocking of the burner control unit takes place at the burner or the control cabinet of the customer.
- With dual fuel burners the gas/oil fuel switch-over takes place via the boiler control (if there are several gaseous or liquid fuels, the switch-over of the various gaseous/liquid fuels is done at the burner control).

The necessary exchange of signals between the burner control and boiler control depends on the fuels used, the number of stages (two-stage, three-stage or infinitely variable) and the type of load request signal (stepped or continuous). For details of signals exchanged, refer to the appendices, the most relevant being Appendix 1 in any case.

Note: *A three-stage burner can only be activated via a continuous signal (4-20mA)!*

Notes on the fuel-related "safe start delay" signals (see Appendix 1):

- The "Burner demand" signal is used for shutting down the burner.
- The signal for "Start delay of gas/oil operation" is used for safe start delay and also for safe shutdown of the burner and fan (value according to the "Safety chain OK" signal). When the burner is operating, discontinuation of the "Start delay" signal must cause the burner to shut down immediately. If the burner is started subsequently, the program sequence must take place in the same way as a previous case with the safety chain.
- In the case of dual burners, the "safe start delay" signals must be evaluated in relation to the specific fuel in the context of the preselection signals for the fuel. This means that a burner that has been preselected for gas may only start if the "safe start delay gas operation" signal has been enabled (if a "safe start delay oil operation" enable signal is present, this must not cause a burner that has been preselected for gas to start). Likewise, this logic applies for a burner that has been preselected for oil.

Annex 2-5 applies depending on the type of burner design. If a dual fuel burner is operated with different control types for gas and oil operation, the respective signals per control type are transferred.

Dependent on the situation of the system, it is necessary to have a signal indicating the burner load level (see appendix), e.g. when combining several boilers via a boiler sequence control. A boiler sequence control is generally not possible for staged burners.

The power supply shown in appendix 7 is provided if the burner requires it.

The connection for the terminals X20/X21 is established via the plug connector system in the boiler control panel. The connection for the terminals X23 is established via a terminal strip in the boiler control panel.

If the cable connection between the boiler control and burner control provided by the builder is included in the boiler manufacturer's scope of delivery, the cable connection on the burner control provided by the builder is executed unplugged.

If the cable connection between the boiler control and burner control provided by the builder is not included in the boiler manufacturer's scope of delivery, the boiler control panel will include a suitable mating connector for the plug-in connection of terminals X20/X21 to allow the cables to be connected by the builder.

3 Burner system provided by customer with boiler control provided by customer

The following requirements apply in the event that both the boiler control and the burner system are provided completely by the customer.

The requirements mentioned in chapters 2.1 and 2.2 apply likewise.

3.1 Performance regulation of boilers

To protect the boiler against overloading and higher cyclical loads, the intended use of the boiler as specified in the relevant operating instructions must be observed (see operating instructions for the C series "shell boilers").

The output control must ensure that the burner is switched to low load before being shut down. If this is not observed, one of the possible effects could be triggering of the safety shut-off valve (SAV) in the gas train.

3.2 Gentle start-up with time delay

The burner and control equipment must be selected so that the boiler is started gently with a time delay from the cold state or from the kept-warm state.

After the burner request, for example, an automatic timer should limit the burner load to low load over a period of approx. 180 seconds. This means that, with a limited heat requirement, any uncontrolled switching on and off of the burner is prevented. This automatic system also prevents unnecessary pre-ventilation losses and protects the boiler and burner components.

3.3 Keeping the boiler warm

To prevent the boiler starting cold, a heat maintenance system for the boiler is recommended. This heat maintenance system must be designed so that the boilers are also gently operated in this case. It is particularly important to ensure that thermal stratification inside the boiler (cold base - hot crown) is avoided.

If the heat in the system is maintained by the burner, a time limit of maximum 72 hours is required, unless the scope of delivery includes an automatic start-up and shut-down facility. When the heat is maintained by the burner, the heat input must be limited to the low load of the burner.

4 Approval of boiler and burner system

Insofar as the burner system and possibly the boiler control is provided by the customer, any requisite CE certification and CE acceptance procedures and/or requisite certification and acceptance procedures according to national and/or regional regulations must be performed by the parties ordering these components. Due consideration must also be given to the respective interfaces.

5 Liability

If the above points and the requirements given in the corresponding operating instructions are not followed, damage may be caused to the boiler and boiler components, as the boiler manufacturer, will accept no liability in such cases.

If the boiler control is not supplied by the manufacturer, any liability for damages which are caused by incorrect connection of the boiler technology is excluded.

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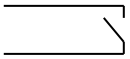
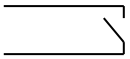
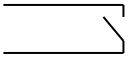
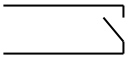
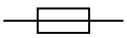
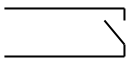
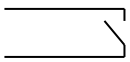
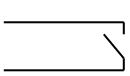
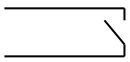
Appendix 1: Signals independent of the type of regulation (basic signals)

Control signals							
Boiler Control						Burner	
Designation	**Terminal designation**	**Terminal connection**	**Input signal**	**Output signal**	**Technical data**	**Input signal**	**Output signal**
Safety chain OK	**-X20**	1/2			230VAC/50-60HZ max. 4A		
Burner demand	**-X20**	3/4			230VAC/50-60HZ max. 4A		
Burner fault	**-X20**	5/6			230VAC/50-60HZ max. 4A		
Burner operation	**-X20**	7/8			230VAC/50-60HZ max. 4A		
Control voltage On	**-X20**	9		X	230VAC/50-60Hz max. 6A	X	
Neutral conductor	**-X20**	10		X	230VAC/50-60Hz max. 6A	X	
Preselection gas operation [1]	**-X20**	11/12			230VAC/50-60HZ max. 4A		
Preselection oil operation [1]	**-X20**	13/14			230VAC/50-60HZ max. 4A		
Safe start prevention gas-fuelled [2]	**-X20**	15/16			230VAC/50-60HZ max. 4A		
Safe start prevention oil-fuelled [3]	**-X20**	17/18			230VAC/50-60HZ max. 4A		
Earth conductor (PE)	**-X20**	25			230VAC/50-60HZ max. 4A		

[1] Signal only exists in dual burners.

[2] Signal only exists if burner is designed for gas-fuelled operation.

[3] Signal only exists if burner is designed for oil-fuelled operation.

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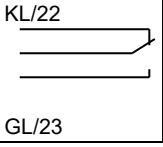
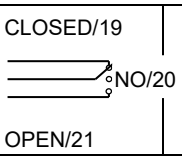
Appendix 2: Type of regulation: two-stage

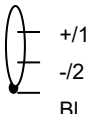
Control signals							
Boiler Control						Burner	
Designation	**Terminal designation**	**Terminal connection**	**Input signal**	**Output signal**	**Technical data**	**Input signal**	**Output signal**
High load request	**-X20**	22/23/24			230VAC/50-60HZ max. 4A		

Appendix 3: Type of regulation: infinitely variable (load request via 3-step signal)

Control signals							
Boiler Control						Burner	
Designation	**Terminal designation**	**Terminal connection**	**Input signal**	**Output signal**	**Technical data**	**Input signal**	**Output signal**
Load request	**-X20**	19/20/21			230VAC/50-60HZ max. 4A		

NO: no control

Appendix 4: Control type: infinitely variable or stepped (load request via continuous signal)

Control signals							
Boiler Control						Burner	
Designation	**Terminal designation**	**Terminal connection**	**Input signal**	**Output signal**	**Technical data**	**Input signal**	**Output signal**
Load request	**-X21**	1/2			4- 20mA Burden: max. 500 Ω		

The shielded cables in the burner control panel must be connected to an earthed shielding bus by the burner manufacturer.

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Appendix 5: Load position feedback (optional signal)

Control signals							
Boiler Control						Burner	
Designation	**Terminal desig-nation**	**Terminal conn-ection**	**Input signal**	**Output signal**	**Technical data**	**Input signal**	**Output signal**
Load position feedback	**-X21**	3/4	+/3 -/4 Bl.		4- 20mA Burden: max. 500 Ω		

The shielded cables in the burner control panel must be connected to an earthed shielding bus by the burner manufacturer.

Appendix 6: Total power supply, burner

Boiler Control					Burner	
Designation	**Terminal desig-nation**	**Terminal conn-ection**	**Input signal**	**Output signal**	**Input signal**	**Output signal**
Power supply 400V/AC L1	**-X23**	1		X	X	
Power supply 400V/AC L2	**-X23**	2		X	X	
Power supply 400V/AC L3	**-X23**	3		X	X	
Power supply 400V/AC PE	**-X23**	PE		X	X (PEN)	