

# Pyronox

LR, LR-NT	21 – 32
LRK, LRK-NT	21 – 32

## Installation and operating instructions



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## Table of Contents

<b>1.</b>	<b>Precautions</b>	<b>2</b>
<b>2.</b>	<b>Description</b>	<b>3</b>
	2.1. General information	3
	2.2. Conformity and certificates	4
<b>3.</b>	<b>Scope of supply</b>	<b>4</b>
<b>4.</b>	<b>Technical data</b>	<b>5</b>
	4.1. Main data / operating conditions	5
	4.2. Minimum operating pressure	5
	4.3. Required water quality	5
	4.4. Dimensions	6
	4.5. Dimensions of custom made models	8
	4.6. Technical data	10
	4.7. Additional data for Pyronox LRK and LRK-NT	22
	4.8. Correction values for different operating conditions	28
<b>5.</b>	<b>Boiler control panel</b>	<b>31</b>
	5.1. Description	31
	5.2. Basic equipment	31
	5.3. Optional features	31
	5.4. Governor types	31
	5.5. Cable sets	31
<b>6.</b>	<b>Installation guide</b>	<b>32</b>
	6.1. Boiler room and boiler room ventilation	32
	6.2. Planning dimensions	32
	6.3. Hydraulic connection	34
	6.4. Electrical installation	35
	6.5. Turbulators	35
	6.6. Boiler control panel and casing assembly	36
	6.7. Connecting the burner and ARF-blower	36
	6.8. Flue gas system	38
<b>7.</b>	<b>Operating conditions</b>	<b>39</b>
	7.1. Fuels	39
	7.2. Combustion air	39
	7.3. Filling the installation and water quality	39
	7.4. Protection against corrosion	39
	7.5. Requirements for operation	39
<b>8.</b>	<b>Operation</b>	<b>40</b>
	8.1. Commission	40
	8.2. Decommission	40
	8.3. First steps to take in case of failure	41
<b>9.</b>	<b>Maintenance</b>	<b>42</b>
	9.1. Periodical checks and maintenance operations	42
	9.2. Boiler cleaning	42
	9.3. Burner maintenance	42
<b>10.</b>	<b>Spare parts</b>	<b>43</b>
	10.1. Pyronox LR 21-26	43
	10.2. Pyronox LRK 21-26	44
	10.3. Pyronox LR 27-32	45
	10.4. Pyronox LRK 27-32	46

## 1. Precautions

### STEPS TO BE TAKEN IN CASE OF DANGER

- Close fuel supply, disconnect unit from mains using emergency stop or main switch (outside of the boiler room).
- Use suitable fire extinguishers to extinguish flames.
- Occurrence of gas smell (gas units)
  - Ventilate the affected rooms thoroughly by opening doors and windows.
  - Do not use any electronic devices (mobile phone, etc.).
  - Do not activate any electrical contacts (light, motor, lift, door bell, etc.).
  - Do not ignite matches or lighters, and do not smoke.
  - Call the gas board or heating engineer.

### PACKAGING

- After removing all packaging materials, check the contents to make sure that no damage has occurred during shipping. When in doubt, do not use the apparatus and contact the supplier.
- The packaging materials are to be disposed of properly.

### THE BOILER UNIT

- Smooth boiler performance and manufacturer's guarantee are dependent upon adherence to the boiler installation, operation and maintenance instructions contained in this booklet.
- Never permit children or unauthorized persons to tamper with the equipment.
- The unit must be used only for its expressed application. All other uses are considered dangerous.
- The burner's minimum and maximum delivery settings, all pressures and temperatures must all be contained in the range stipulated in this manual.
- Modification of the equipment in order to alter its performance or applications prohibited.
- Do not open or tamper with components of the unit other than those parts of the unit that are subject to maintenance operations.
- Never touch the hot parts of the unit; these parts (flue gas conduit, sight glass, burner parts, etc) may remain hot for quite some time after the burner has switched off.
- Never touch the unit with wet parts of the body or without wearing shoes.
- When the unit is not to be used for a longer period, the main power switch on the electrical control panel must be switched off and the manual valve on the unit fuel supply line must be closed.
- The device contains components made of synthetic silicon mineral fibres (ceramic and glass fibres, insulation wool). These components must be disposed of appropriately at the end of their life cycle. Local regulations must be observed.

### INSTALLATION AND SETTINGS

- The installation and calibration of the unit must be performed exclusively by qualified personnel in conformity with existing regulations and the indications provided in this Manual.

### THE BOILER ROOM

- The boiler room must be lockable and its external air openings must conform to the norms prevailing locally. When in doubt regarding air circulation, measure the CO<sub>2</sub> count with the burner operating at its maximum delivery and the room ventilated only by the burner ventilation air openings and a second time with the door open. The CO<sub>2</sub> count measured in both cases must not differ. Should there be more than one unit in the same room, this test must be performed with all the equipment operating simultaneously.
- Never obstruct the boiler room's air openings, the burner fan suction opening, and any air ducts and ventilation.
- The equipment must always be protected against rain, snow, and freezing conditions.
- The boiler room must be kept clean and free of volatile substances that may be sucked into the fan and clog the inner burner or combustion head air ducts.
- The combustion air must be free of halogens (chlorine and fluorine compounds). If there is any doubt, the quality of the combustion air must be ensured with an external air intake.

### ELECTRICAL INSTALLATION

- Electrical connections must be made exclusively by qualified personnel and all prevailing electrical regulations must be scrupulously observed.
- Make sure that the electrical power supply used for connection conforms to the specifications indicated on the rating plate and in this manual.

- The unit must be correctly connected to an efficient ground system in conformity to the prevailing norms and checked and controlled for efficiency by qualified personnel when in doubt.
- Never confuse neutral wires with phase wires.
- The unit must be hooked up to the electrical network with a plug-socket connection that is such as to prevent inversion of phase and neutral. Install a master switch for the heating plant as requested by existing legislation.
- The entire electrical system, and all cable sections in particular, must be adequate to deliver the maximum absorbed power value indicated on the equipment's rating plate and in this manual.
- If the mains power cable is found to be defective, it must be replaced only by qualified personnel.
- Never stretch power supply cables and keep them well away from sources of heat.

### FUEL

- The unit must be fed with the type of fuel for which it has been preset as indicated on the rating plate.
- The fuel pressure must be according to the values listed in the burner manual.
- The fuel line that feeds the unit must be sized according to the requirements of local regulations and the prescriptions in the burner manual. The line must be perfectly sealed. The fuel supply line must also be equipped with all the control and safety mechanisms required by local regulations in force. The line must be free from all impurities; take particular care that foreign matter does not enter the line during installation.
- Oil:
  - The light oil storage tank must be adequately protected against penetration of impurities and water. The fuel tank must be kept full of fuel during the summer in order to avoid the condensation of humidity. Clean the tank carefully before filling. Beware not to overfill the tank.
  - Both the tank and the unit fuel supply line must be protected from frost.
  - Oil consumption and tank unit must be checked regularly, in order for leaks to be detected in good time.
- Gas:
  - The gas line must be checked for leakage during commissioning and after each disconnection.

### MALFUNCTION

- If the unit stops working and goes into lock-out and does not resume operation after two or three manual lock-out reset attempts, disconnect the power supply, do not attempt to repair, and contact a qualified specialist.
- All repairs required must be performed exclusively at a technical servicing and/or technician centre authorized by the manufacturer using original spare parts only. Failure to observe the above may compromise the reliability and safety of the equipment.
- Any failure or damage resulting from improper use or intentional damage will relieve the manufacturer from any guarantee obligation.

### MAINTENANCE

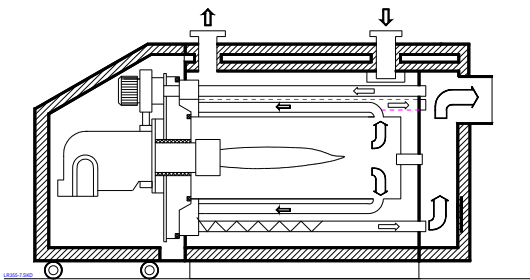
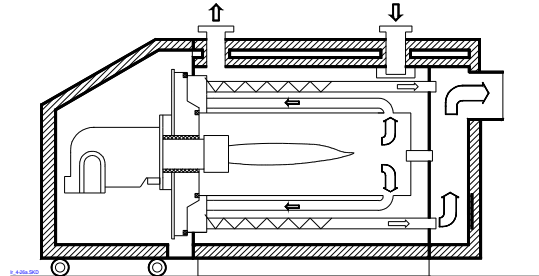
- Maintenance must be performed by qualified personnel regularly or at least once a year.
- Prior to performing any maintenance operations, switch off the power supply by using the main switch and cut off the fuel supply as well.
- Only parts indicated by the manufacturer in the Spare Parts Catalogue may be replaced.
- In order to avoid all types of health hazards, suitable clothing and a protective mask must be worn for work on or with components made of synthetic silicon mineral fibres (ceramic and glass fibres, insulation wool).

## 2. Description

### 2.1. General information

Pyronox LR boilers are high efficiency, power-saving boilers ranging from 530 to 3000 kW and from 450 to 2600 kW for low-NO<sub>x</sub> applications. They can be operated in combination with oil or gas burners.

The Pyronox LR boiler range are three pass, smoke tube boilers with combustion chamber and flue way using the Low-Nox technology. The geometry of the furnace, the furnace's low charge, coupled with the Ygnis patented flame escape system, allow users to obtain low emission values and safe operation in conformity with law provisions.



Upon request, the Pyronox LR and LRK boilers are also available with an integrated and watercooled flue gas recirculating system (ARF).

The third pass is equipped with turbulators. Their turbulent action further increases the heat exchange and allows the system to work at low combustion gas temperatures, guaranteeing optimal fuel use as a result.

The boiler's thermal insulation is made of glass fibre felt that adheres to the boiler shell, guaranteeing minimal loss in stand-by mode. In addition, the front part of the boiler is provided with superior quality ceramic fibre insulation. The outstanding characteristics of the material are the low thermal conductivity and the low specific thermal capacity. This leads to a further reduction of the stand-by losses.

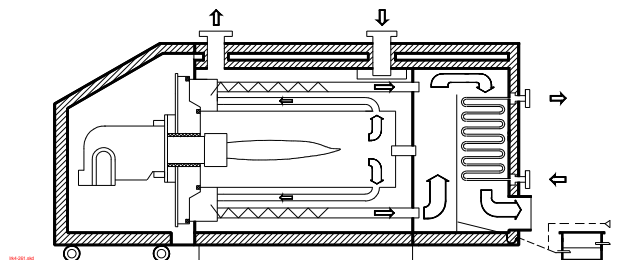
A soundproofing hood can be optionally provided that covers the whole of the front of the boiler, with which burner and ARF-ventilator noise can be kept down to a minimum and thermal radiation can be further reduced.

A revolving door gives easy access to parts of the boiler that are in contact with combustion gases. This allows cleaning of combustion chamber and passage ways to be easily performed from the front. The turbulators are retractable from the front. The combustion gas collector on the rear of the boiler is provided with an opening for easy cleaning.

The boiler's thick casing is easy and quick to install. Casing plates are painted with an environment-friendly paint, so they are permanently protected from corrosion.

In the LR-NT version, the boilers in the back part of the third pass is equipped with jacketed pipes and the water-impacted part of the smoke box is double-walled. This prevents the flue gases from condensing out, even with return temperatures below the usual limits. This version thus allows operation under return conditions that are only possible using low-temperature boilers.

The LRK version is equipped with an integrated flue gas recuperator made of special stainless steel that is also designed for operation with oil and/or gas burners. In this combination, the LRK becomes a condensing unit that uses the condensation heat of the steam present in the flue gases. As a result, the efficiency can increase to over 107% (in relation to the lower calorific value) at a correspondingly low return temperature.



## 2.2. Conformity and certificates

These boilers fulfill the requirements of the low voltage directive 73/23/EEC, of the EMC-directive 89/336/EEC and the efficiency directive 92/42/EEC.

The LRK boiler range as well as the LR range with ECA-rating have efficiencies in conformity with the requirements of the Enhanced Capital Allowance Scheme (ECA).

CE-certificate:	CE 0461
Type marking:	
Boiler	01-226-598 X
Recuperator	01-236-686 X

## 3. Scope of supply

- Boiler body (with recuperator in LRK, LRK-NT version), flue gas collector and flue gas tube
- Internal flue gas recirculating system, if ordered
- Gas-tight boiler door that can be opened to the left or right, with insulation and burnerconnection (and flue gas fan connection, if ordered)
- Furnace sight glass integrated in the boiler door
- Supply and return tubes with flanges, counterflanges, gaskets and screws
- Filling and discharge tubes with ball valves
- Flue gas turbulators
- Boiler insulation
- Tread-proof boiler lid over the entire unit
- All-around casing (packed separately)
- Heat and sound proofing hood (if ordered)
- Boiler control panel (version depending on order)
- Temperature monitor (water-side) for recuperator outlet, supplied loose (LRK, LRK-NT version)
- Condensate outlet with siphon (LRK, LRK-NT version)
- Burner pipe insulation material (supplied loose)
- Cleaning set
- Installation and operating instructions

## 4. Technical data

### 4.1. Main data / operating conditions

Max. operating pressure (standard model)		6,0 bar g
Test pressure (other pressures on request)		9,0 bar g
Boiler supply and return pipe flanges		PN 6
Max. operating temperature (safety cut-out)		110°C
Min. operating temperature	with fuel oil	60 °C
	with natural gas	70 °C
	with propane	70 °C
Min. return temperature:		
Pyronox LR	with fuel oil	50 °C
	with natural gas	60 °C
	with propane	60 °C
Pyronox LR-NT	with fuel oil	35 °C
	with natural gas	45 °C
	with propane	45 °C
Recuperator LRK, LRK-NT		no limits
Min. flue gas temperature		
with fuel oil	S-content 50 ppm	100 °C
	500 ppm	110 °C
	0.1%	115 °C
	0.2%	120 °C
	0.5%	125 °C
with natural gas	S-content 10 mg/nm <sup>3</sup>	95 °C
	150 mg/nm <sup>3</sup>	110 °C
Max. CO <sub>2</sub> -content (dry flue gas)	with fuel oil	15.5%
	with natural gas	11.7%
	with propane	13.7%

### 4.2. Minimum operating pressure

LR, LR-NT	21	22	23	24	25	26	27	28	29	30	31	32
bar g	0.55	0.55	0.65	0.50	0.70	0.75	0.85	1.10	1.25	1.30	1.60	1.70

### 4.3. Required water quality

#### First fill

Total hardness: < 10 °f (100 mg CaCO<sub>3</sub>/l; 84 mg MgCO<sub>3</sub>/l)

#### Make-up water

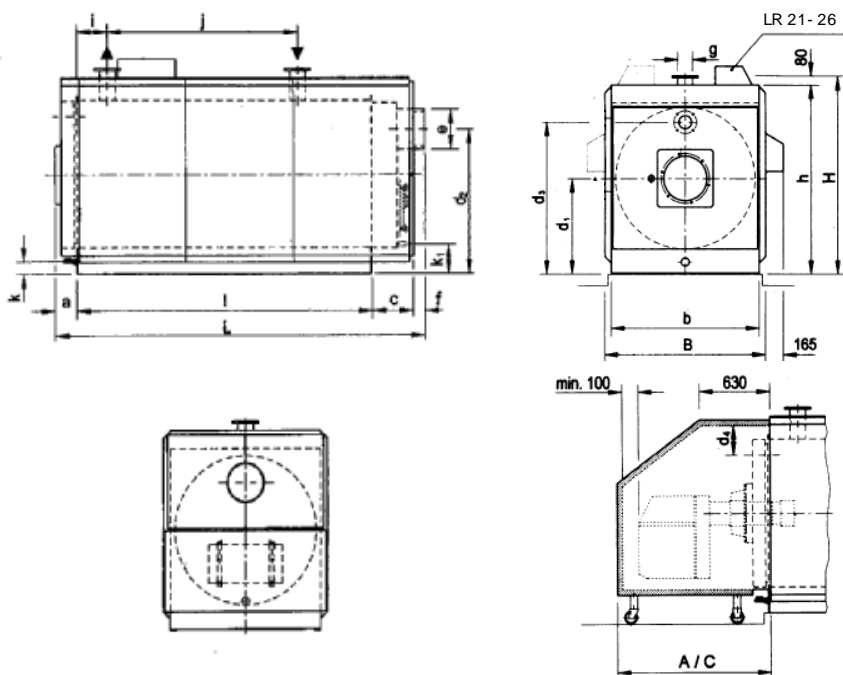
Total hardness: < 1 °f (10 mg CaCO<sub>3</sub>/l; 8.4 mg MgCO<sub>3</sub>/l)

#### Circulating water

Total hardness: lower than 1 °f  
 pH (at 20°C): 8.3 – 9.5  
 Phosphates (PO<sub>4</sub>): lower than 30 mg/l  
 Chlorides (Cl): lower than 50 mg/l  
 Oxygen (O<sub>2</sub>): lower than 0.1 mg/l

4.4. Dimensions

4.4.1. Pyronox LR, LR-NT

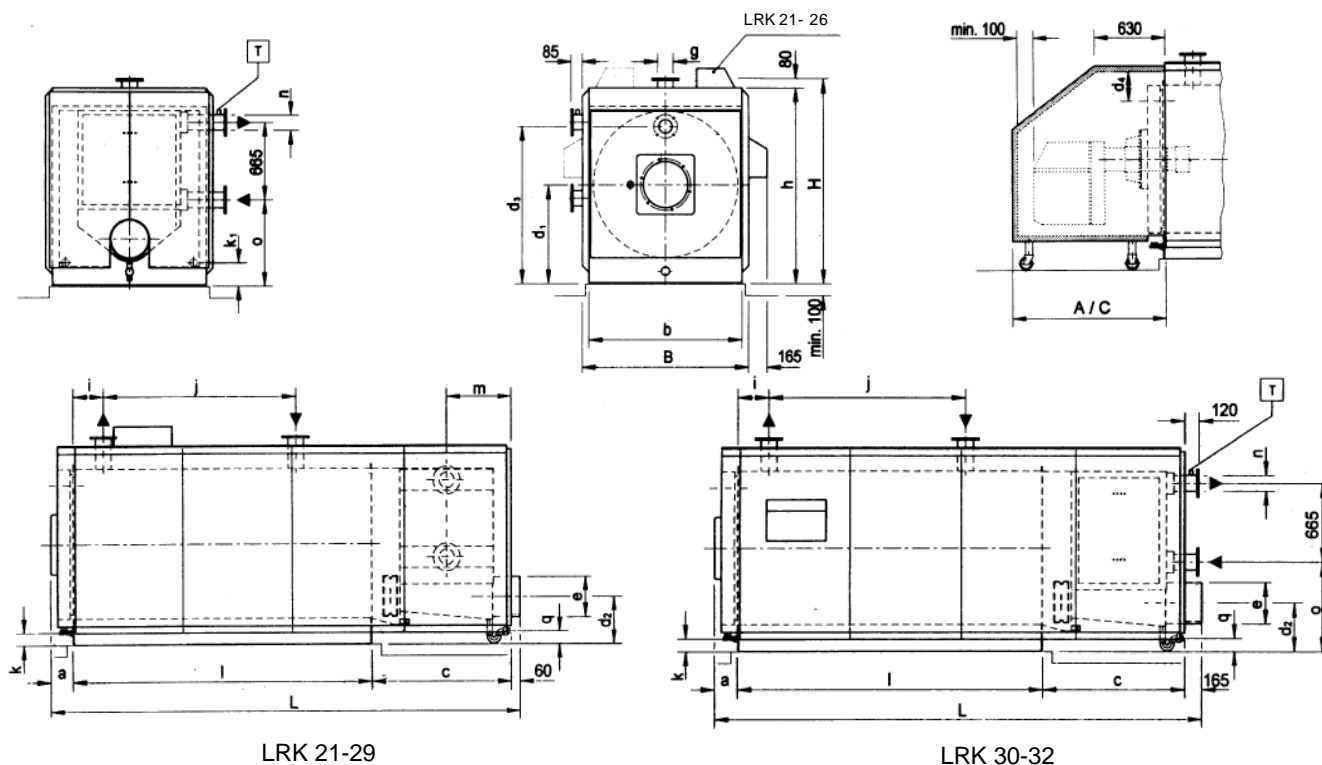


Pyronox LR, LR-NT			21	22	23	24	25	26	27	28	29	30	31	32
Boiler feet length	l	mm	1580	1695	1695	1880	1880	1975	2314	2314	2674	2854	3096	3356
Boiler feet insert width *	b	mm	1000	1060	1060	1130	1130	1210	1300	1300	1375	1445	1570	1645
Boiler height	h	mm	1 290	1 370	1 370	1 455	1 455	1 545	1 650	1 650	1 725	1 790	1 910	2 000
Door thickness	a	mm	145	145	145	145	145	145	145	145	200	200	200	200
Flue gas collector	c	mm	300	300	300	335	335	345	400	400	400	430	470	495
Burner flange centre	d <sub>1</sub>	mm	640	690	690	740	740	790	840	840	875	905	965	1015
Height flue	d <sub>2</sub>	mm	950	1000	1000	1055	1055	1115	1200	1200	1275	1315	1410	1470
EGR (ARF) flange centre	d <sub>3</sub>	mm	1015	1087	1087	1 150	1 150	1233	1320	1320	1385	1465	1585	1630
Distance EGR (ARF) flange centre - sound-proof hood	d <sub>4</sub>	mm	215	223	223	245	245	252	270	270	280	265	265	310
Flue outside diameter	e	mm	200	250	250	250	250	300	350	350	350	400	450	500
Flue length	f	mm	100	100	100	100	100	100	80	80	80	80	80	80
ø supply - return PN6	g	DN	100	100	100	100	100	100	125	125	125	150	150	200
Distance front - supply	i	mm	150	150	150	200	200	200	238	238	274	292	318	344
Distance supply - return	j	mm	950	950	950	1150	1150	1150	1493	1493	1727	1844	2000	2168
Discharge height	k	mm DN	80 1 ¼"	100 1 ¼"	100 1 ¼"	115 1 ¼"	115 1 ¼"	125 1 ¼"	110 1 ¼"	110 1 ¼"	107 1 ¼"	103 1 ¼"	100 1 ¼"	110 1 ¼"
Height flue collector discharge	k <sub>1</sub>	mm DN	206.5 ¾"	206.5 ¾"	206.5 ¾"	206.5 ¾"	206.5 ¾"	271.5 ¾"	251 1 ¼"	251 1 ¼"	246 1 ¼"	241 1 ¼"	241 1 ¼"	253.5 1 ¼"
Overall length	L	mm	2125	2240	2240	2460	2460	2565	2939	2939	3354	3564	3846	4131
Boiler width	B	mm	1120	1180	1180	1250	1250	1330	1420	1420	1495	1565	1690	1765
Height supply - return flange	H	mm	1370	1450	1450	1535	1535	1625	1730	1730	1805	1870	1990	2080
Short sound-proof. hood	A	mm	1080	1180	1180	1180	1180	1280	1380	1380	1380	1430	1430	1430
Long sound-proof. hood	C	mm	1330	1530	1530	1530	1530	1730	1630	1630	1630	1780	1880	1880
Weight empty LR	G	kg	1166	1523	1523	1854	1854	2020	2399	2399	2950	3404	4166	4761
Weight empty LR-NT	G	kg	1259	1645	1645	2002	2002	2182	2591	2591	3186	3676	4499	5142
Boiler water content	V	L	530	650	650	790	790	960	1360	1360	1760	2060	2610	3070
Boiler gas content	VG	L	590	690	690	910	910	1100	1460	1460	1880	2280	3030	3720
Furnace diameter	DF	mm	516	549	549	614	614	640	675	675	712	750	811	870
Furnace length	LF	mm	1517	1623	1623	1794	1794	1889	2225	2225	2559	2745	2985	3265
Furnace volume	VF	m <sup>3</sup>	0.32	0.38	0.38	0.53	0.53	0.61	0.80	0.80	1.02	1.21	1.54	1.90

\* without insulation material

16.10.07/TN

4.4.2. Pyronox LRK, LRK-NT



Pyronox LRK, LRK-NT			21	22	23	24	25	26	27	28	29	30	31	32
Boiler feet length	l	mm	1580	1695	1695	1880	1880	1975	2314	2314	2674	2854	3096	3356
Boiler feet insert width *	b	mm	1000	1060	1060	1 130	1 130	1210	1300	1300	1375	1445	1570	1645
Boiler height	h	mm	1 290	1 370	1 370	1 455	1 455	1 545	1 650	1 650	1 725	1 790	1 910	2000
Door thickness	a	mm	145	145	145	145	145	145	145	145	200	200	200	200
Flue collector/ recuperator	c	mm	800	800	800	875	875	950	1105	1105	1260	1360	1360	1360
Bumer flange centre	d <sub>1</sub>	mm	640	690	690	740	740	790	840	840	875	905	965	1 015
Height flue	d <sub>2</sub>	mm	270	240	240	305	305	355	400	400	448	400	435	490
EGR (ARF) flange centre	d <sub>3</sub>	mm	1 015	1 087	1 087	1 150	1 150	1 233	1 320	1 320	1 385	1 465	1 585	1 630
Distance EGR (ARF) flange centre - sound-proof hood	d <sub>4</sub>	mm	215	223	223	245	245	252	270 •	270	280	265	265	310
Flue outside diameter	e	mm	200	250	250	250	250	300	350	350	350	400	450	500
Flue length	f	mm	60	60	60	60	60	60	60	60	60	165	165	165
ø supply - return PN6	g	DN	1 00	1 00	1 00	1 00	1 00	1 00	1 25	1 25	1 25	1 50	1 50	200
Distance front - supply	i	mm	150	150	150	200	200	200	238	238	274	292	318	344
Distance supply - return	j	mm	950	950	950	1 150	1 150	1 150	1 493	1 493	1 727	1 844	2000	21 68
Discharge height	k	mm DN	80 1 ¼"	1 00 1 ¼"	1 00 1 ¼"	1 15 1 ¼"	1 15 1 ¼"	1 25 1 ½"	1 10 1 ¼"	1 10 1 ¼"	1 07 1 ¼"	1 03 1 ¼"	1 00 1 ¼"	1 10 1 ¼"
Distance recuperator water studs - recup. backside	m	mm	285	285	285	305	305	335	385	385	455	—	—	—
ø flow - return recuperator	n	DN	65	80	80	80	80	100	100	100	125	125	150	150
sanitary version **	n	DN	1 ½"	1 ½"	1 ½"	1 ½"	2"	2"	2"	2"	2 ½"	—	—	—
Height recuperator return flange centre	o	mm	405	475	475	560	560	650	720	720	795	780	860	940
Height of condensate outlet	q	mm DN	1 30 1 ½"	85 1 ½"	85 1 ½"	1 25 1 ½"	1 25 1 ½"	1 65 1 ½"	1 85 1 ½"	1 85 1 ½"	235 1 ½"	1 60 1 ½"	1 70 1 ½"	200 1 ½"
Height flue collector discharge	k <sub>1</sub>	mm DN	1 68 1"	1 83 1"	1 83 1"	207 1"	207 1"	203 1"	205 1 ¼"	205 1 ¼"	208 1 ¼"	1 68 1 ¼"	1 66 1 ¼"	1 89 1 ¼"
Overall length	L	mm	2585	2700	2700	2960	2960	3130	3624	3624	4194	4579	4821	5081
Boiler width	B	mm	1120	1180	1180	1250	1250	1330	1420	1420	1495	1565	1690	1765
Height supply - return flange	H	mm	1370	1450	1450	1535	1535	1625	1730	1730	1805	1 870	1 990	2080
Short sound-proof. hood	A	mm	1 080	1 180	1 180	1 180	1 180	1 280	1 380	1 380	1 380	1 430	1 430	1430
Long sound-proof. hood	C	mm	1 330	1 530	1 530	1 530	1 530	1 730	1 630	1 630	1 630	1 780	1 880	1880
Weight empty LRK	G	kg	1486	1833	1833	2204	2204	2440	2889	2889	3510	4144	5086	5831
Weight empty LRK-NT	G	kg	1579	1955	1955	2352	2352	2602	3081	3081	3746	4416	5419	6212
Boiler water content	V	L	565	690	690	840	840	1020	1430	1430	1855	2170	2755	3240
Boiler gas content	VG	L	940	1180	1180	1510	1510	1880	2460	2460	3180	3980	5230	6320
Furnace diameter	DF	mm	516	549	549	614	614	640	675	675	712	750	811	870
Furnace length	LF	mm	1517	1623	1623	1794	1794	1889	2225	2225	2559	2745	2985	3265

\* without insulation material

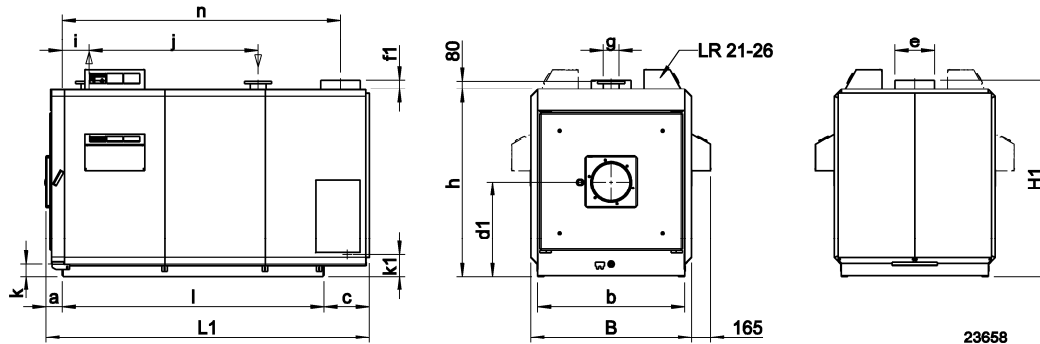
\*\* Option

16.10.07/TN

#### 4.5. Dimensions of custom made models

The following custom made models are available on request. They are however subject to different delivery times!

##### 4.5.1. Vertical flue connection Pyronox LR and LR-NT



Pyronox LR			21	22	23	24	25	26	27	28	29	30	31	32
Flue outside diameter	e	mm	200	250	250	250	250	300	350	350	350	400	450	500
Flue height	f <sub>1</sub>	mm	60	100	100	100	100	100	80	80	80	80	80	80
Flue position	n	mm	1702	1812	1812	2025	2025	2106	2459	2459	2819	3004	3260	3521
Overall length	L <sub>1</sub>	mm	2025	2140	2140	2360	2360	2465	2859	2859	3274	3484	3766	4051
Overall height	H <sub>1</sub>	mm	1370	1470	1470	1555	1555	1645	1730	1730	1805	1870	1990	2080

16/10/07 RR

The other dimensions are identical to those of the standard range.

##### 4.5.2. Different operating pressures

Pyronox LR and LRK boilers can be provided for the operating pressures of 4, 8 and 10 bar-g. Their dimensions and performances are identical to those of the standard range of 6 bar-g, but their weights are different:

###### Empty weights

Pyronox LR			21	22	23	24	25	26	27	28	29	30	31	32
4 bar	G	kg	1127	1439	1439	1802	1802	1959	2302	2302	2753	3194	3937	4440
8 bar	G	kg	1190	1606	1606	1979	1979	2159	2715	2715	3286	3761	4601	5221
10 bar	G	kg	1277	1608	1608	2227	2227	2436	2746	2746	3362	4053	4980	5706

16/10/07 RR

Pyronox LR-NT			21	22	23	24	25	26	27	28	29	30	31	32
4 bar	G	kg	1220	1561	1561	1950	1950	2121	2494	2494	2989	3466	4270	4821
8 bar	G	kg	1283	1728	1728	2127	2127	2321	2907	2907	3522	4033	4934	5602
10 bar	G	kg	1370	1730	1730	2375	2375	2598	2938	2938	3598	4325	5313	6087

16/10/07 RR

###### Empty weights

Pyronox LRK			21	22	23	24	25	26	27	28	29	30	31	32
4 bar	G	kg	1447	1749	1749	2152	2152	2379	2792	2792	3313	3934	4857	5510
8 bar	G	kg	1510	1916	1916	2329	2329	2579	3205	3205	3846	4501	5521	6291
10 bar	G	kg	1597	1918	1918	2577	2577	2856	3236	3236	3922	4793	5900	6776

16/10/07 RR

Pyronox LRK-NT			21	22	23	24	25	26	27	28	29	30	31	32
4 bar	G	kg	1540	1871	1871	2300	2300	2541	2984	2984	3549	4206	5190	5891
8 bar	G	kg	1603	2038	2038	2477	2477	2741	3397	3397	4082	4773	5854	6672
10 bar	G	kg	1690	2040	2040	2725	2725	3018	3428	3428	4158	5065	6233	7157

16/10/07 RR

##### 4.5.3. LRK sanitary version

The recuperators of the Pyronox LRK 21 to 29 can be provided as sanitary version with water collectors and -connections made of stainless steel. Their dimensions and performances are identical to those of the standard range, apart from the dimensions of the water connections (see table in chapter 4.4.2).

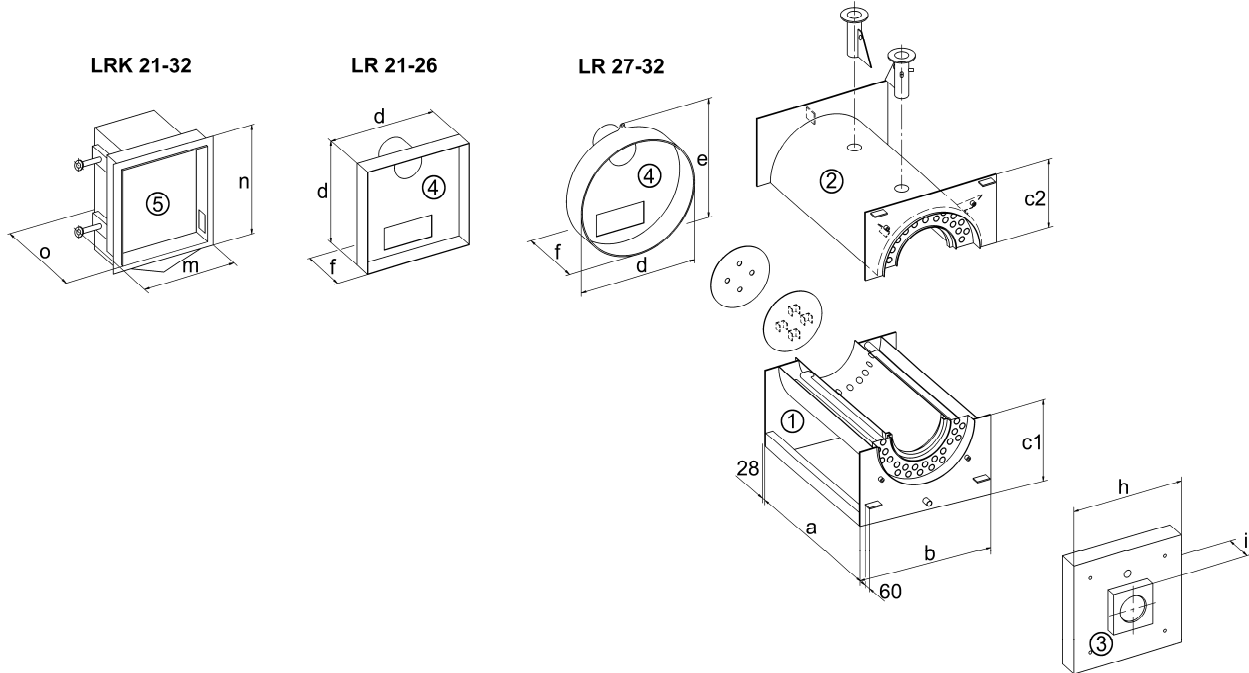
**4.5.4. Version with flue gas recirculation (ARF)**

For connection dimensions see chapter 6.7.

**4.5.5. Divided version**

Also available as a custom made option is a divided version of the boiler. Thanks to the inferior dimensions of the individual parts, this version is most suitable when bringing-in conditions are tight. The individual prefabricated parts must be welded together in the boiler room.

Attention: The welding work may only be performed by a qualified welder licenced to weld pressurized vessels.



**Dimensions**

Pyronox LR/LRK		21	22-23	24-25	26	27-28	29	30	31	32
a	mm	1582	1694	1880	1975	2314	2674	2854	3096	3356
b	mm	1000	1060	1130	1210	1300	1375	1445	1570	1645
c1	mm	661	712	740	790	863	875	905	965	1027
c2	mm	480	552	565	605	650	690	779	840	845
d	mm	900	900	1000	1070	1210	1290	1360	1480	1555
e	mm	---	---	---	---	1265	1345	1415	1535	1610
f	mm	400	400	435	445	480	480	510	550	575
h	mm	950	1000	1085	1150	1260	1347	1415	1540	1610
i	mm	167	167	168	168	168	234	234	234	234
m	mm	1075	1135	1200	1285	1426	1494	1400	1525	1590
n	mm	1154	1276	1323	1368	1410	1438	1455	1565	1625
o	mm	860	859	937	1010	1114	1270	1475	1475	1475

23278 MH / 21.2.07

**Weight for 6 bar**

1	kg	382	476	593	606	886	1151	1345	1638	1944
2	kg	381	474	565	618	845	1106	1301	1590	1772
3	kg	92	103	121	136	185	235	255	305	330
4	kg	44	44	57	62	75	90	100	120	140
5	kg	210	268	303	354	500	640	650	830	915

23278 RR / 16.10.07

Weights for 4, 8 and 10 bar on request.

### 4.6. Technical data

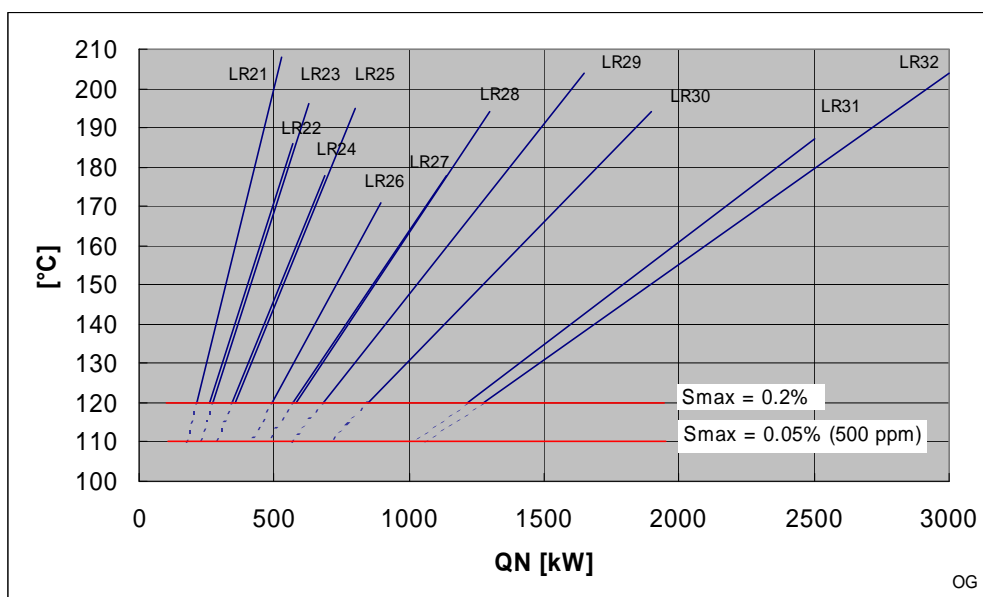
#### 4.6.1. Pyronox LR

##### Technical specifications LR (fuel oil)

LR			21	22	23	24	25	26	27	28	29	30	31	32	
<b>Power</b>															
Boiler nominal power qN (80/60°C)	max.	kW	530	580	630	700	800	895	1150	1300	1650	1900	2500	3000	
	min.		211	272	272	355	355	494	582	582	680	847	1217	1272	
Calorific power qF	max.	kW	584	631	689	758	874	966	1246	1420	1812	2076	2722	3295	
	min.		223	287	287	374	374	520	613	613	716	891	1280	1339	
Modulation rate at 80/60 °C		2	38%	45%	42%	49%	43%	54%	49%	43%	40%	43%	47%	41%	
<b>Efficiencies</b>															
Overall efficiency 60 / 80 °C	100%	%	90.8	91.9	91.4	92.3	91.5	92.6	92.3	91.5	91.0	91.5	91.8	91.0	
Overall efficiency 50 / 70 °C	30%	%	95.3	95.3	95.3	95.3	95.4	95.3	95.3	95.4	95.5	95.4	95.4	95.4	
Overall efficiency 60 / 80 °C	min qF	%	94.8	94.9	94.9	94.9	94.9	95.0	95.0	95.0	95.0	95.0	95.1	95.0	
Efficiency DIN4702-8, 60 / 75 °C	ηN	%	94.4	94.6	94.5	94.8	94.6	94.8	94.8	94.7	94.6	94.7	94.8	94.7	
<b>Mass flows</b>															
Fuel oil flow	max.	1	kg/h	49.3	53.2	58.1	64.0	73.8	81.5	105.1	119.8	152.9	175.2	229.7	278.1
	min.	1		18.8	24.2	24.2	31.6	31.6	43.9	51.7	51.7	60.4	75.2	108	113.0
Exhaust gas mass flow	max. wet		kg/s	0.25	0.27	0.30	0.33	0.38	0.42	0.54	0.61	0.78	0.89	1.18	1.42
	min. wet			0.10	0.12	0.12	0.16	0.16	0.22	0.26	0.26	0.31	0.38	0.55	0.58
<b>Exhaust gas data, losses</b>															
Overpressure combustion chamber	max.	mbar	5.85	4.13	4.95	4.93	6.60	5.23	6.29	8.22	9.47	9.25	10.16	9.32	
Exhaust gas temperature at 80/60 °C	max.	°C	208	186	196	178	195	171	178	194	204	194	187	204	
	min.		2	120											
Exhaust gas losses at 80/60 °C	max.	%	9.0	7.9	8.4	7.5	8.3	7.2	7.6	8.3	8.8	8.4	8.0	8.8	
Stand-by loss qB	70 °C	W	781	883	883	1020	1020	1177	1382	1382	1565	1742	2073	2330	
<b>Hydraulic data</b>															
Water resistance	Δt=10K	mbar	42	50	59	73	96	120	81	103	167	106	184	84	
	Δt=20K		11	13	15	18	24	30	20	26	42	27	46	21	
Water flow	max.	m <sup>3</sup> /h	45.5	54.1	54.1	68.7	68.7	76.9	111.7	111.7	141.8	163.2	214.8	257.8	
Operating temperatures	max.	°C	95												
	SCO		110												

Values acc. EN304 at:  
 - λ=1.2, CO<sub>2</sub>=12.7%  
 - T-air=20°C, rel. humidity=60%, p-baro=100kPa  
 1: LCV = 11.85 kWh/kg  
 2: Sulphur content up to 0.2%

3zugskessel, V-07/06  
 OG



Flue gas temperature diagram LR, fuel oil with clean boiler

**Technical specifications LR (natural gas)**

LR			21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>														
Boiler nominal power qN (80/60°C)	max.		530	580	630	700	800	895	1150	1300	1650	1900	2500	3000
	min.		95	121	121	175	175	269	311	314	367	459	713	714
Calorific power qF	max.		585	632	691	759	876	967	1248	1422	1815	2079	2725	3300
	min.	3	99	127	127	182	182	280	324	327	383	478	743	744
Modulation rate		3	17%	20%	18%	24%	21%	29%	26%	23%	21%	23%	27%	23%
<b>Efficiencies</b>														
Overall efficiency 60 / 80 °C	100%	%	90.7	91.8	91.3	92.2	91.4	92.5	92.2	91.4	90.9	91.4	91.7	90.9
Overall efficiency 60 / 80 °C	30%	%	95.2	95.5	95.4	95.7	95.6	95.9	95.8	95.7	95.5	95.7	96.0	95.6
Overall efficiency 60 / 80 °C	min qF	%	95.6	95.7	95.7	95.8	95.8	95.9	96.0	96.0	96.0	96.0	96.1	96.0
Efficiency DIN4702-8, 60 / 75 °C	ηN	%	94.6	95.0	94.9	95.2	95.0	95.4	95.3	95.1	94.9	95.1	95.4	95.0
<b>Mass flows</b>														
Gas flow, NG type E	max.	1.2	58.7	63.4	69.3	76.2	87.9	97.0	125.2	142.7	182.1	208.6	273.4	331.1
	min.	1.2	10.0	12.9	12.9	18.1	18.1	27.4	33.5	33.5	38.5	47.8	75.9	74.9
Exhaust gas mass flow	max. wet		0.24	0.26	0.29	0.32	0.37	0.40	0.52	0.59	0.76	0.87	1.14	1.38
	min. wet		0.04	0.05	0.05	0.08	0.08	0.11	0.14	0.14	0.16	0.20	0.32	0.31
<b>Exhaust gas data, losses</b>														
Overpressure combustion chamber	max.		5.97	4.22	5.06	5.03	6.74	5.33	6.41	8.39	9.67	9.43	10.35	9.50
Exhaust gas temperature at 80/60 °C	max.		209	187	197	179	196	172	179	194	205	195	188	205
	min.	3	95											
Exhaust gas losses at 80/60 °C	max.		9.1	8.0	8.5	7.6	8.4	7.3	7.7	8.4	9.0	8.5	8.2	9.0
Stand-by loss qB	70 °C		781	883	883	1021	1021	1178	1382	1382	1565	1742	2073	2330
<b>Hydraulic data</b>														
Water resistance	Δt=10K		42	50	59	73	96	120	81	103	167	106	184	84
	Δt=20K		11	13	15	18	24	30	20	26	42	27	46	21
Water flow	max.		45.5	54.1	54.1	68.7	68.7	76.9	111.7	111.7	141.8	163.2	214.8	257.8
Operating temperatures	max.		95											
	SCO		110											

Values acc. EN303-3 at:

- λ=1.15, CO2=10%

- T-air=20°C, rel. humidity=60%, p-baro=100kPa

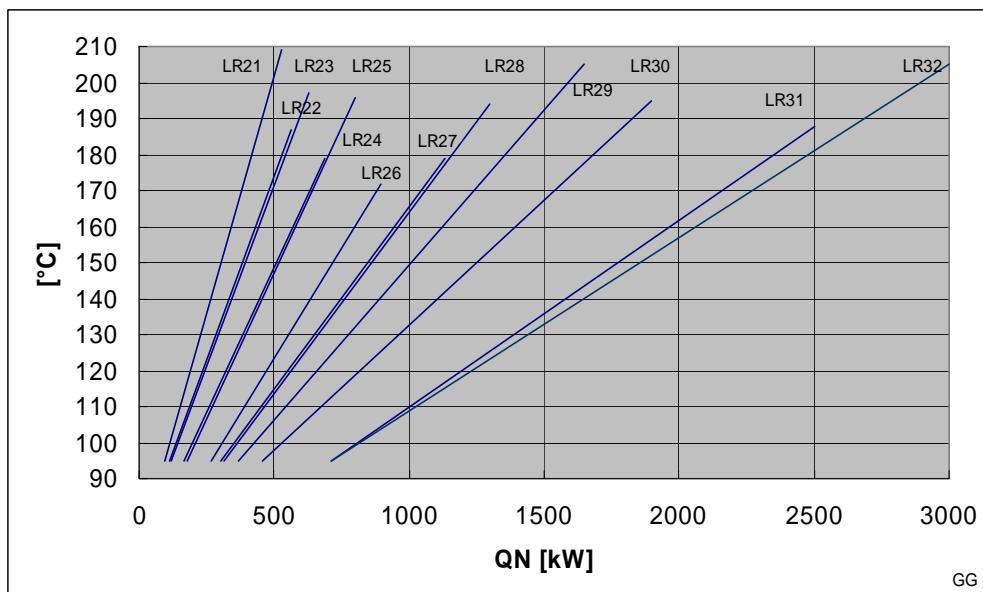
1: LCV = 9.97 kWh/nm3

2: nm3 at 0°C, 1013 mbar

3: S max = 10 mg / nm3

3zugskessel, V-07/06

GG



Flue gas temperature diagram LR, natural gas with clean boiler

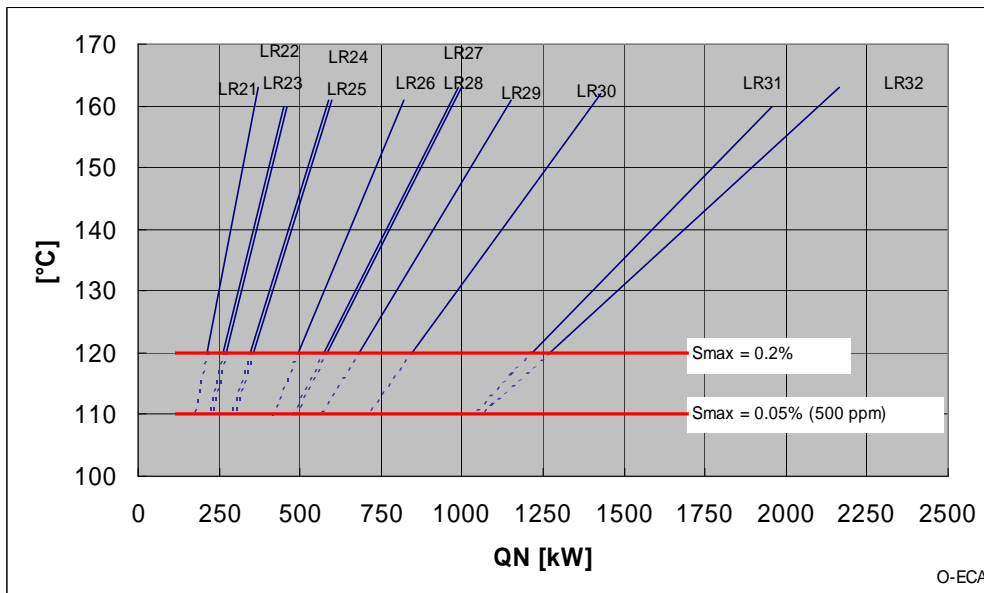
4.6.2. Pyronox LR, ECA-rating

Technical specifications LR (fuel oil, ECA-rating)

LR			21	22	23	24	25	26	27	28	29	30	31	32	
<b>Power</b>															
Boiler nominal power q <sub>N</sub> (80/60°C)	max.	kW	370	460	460	600	600	820	1000	1000	1150	1430	1955	2165	
	min.		211	272	272	355	355	494	582	582	680	847	1217	1272	
Calorific power q <sub>F</sub>	max.	kW	398	494	494	645	645	881	1075	1075	1235	1536	2098	2329	
	min.		223	287	287	374	374	520	613	613	716	891	1280	1339	
Modulation rate at 80 / 60°C			56%	58%	58%	58%	58%	59%	57%	57%	58%	58%	61%	57%	
<b>Efficiencies</b>															
Overall efficiency 60 / 80 °C	100%	%	93.0	93.1	93.1	93.1	93.1	93.1	93.0	93.0	93.1	93.1	93.1	93.0	
Overall efficiency 50 / 70 °C	30%	%	94.7	94.8	94.8	94.8	94.8	94.9	94.9	94.9	94.9	94.9	95.0	94.9	
<b>Mass flows</b>															
Fuel oil flow	max.	1	kg/h	33.6	41.7	41.7	54.4	54.4	74.3	90.7	90.7	104.2	129.6	177.0	196.5
	min.	1		18.8	24.2	24.2	31.6	31.6	43.9	51.7	51.7	60.4	75.2	108	113.0
Exhaust gas mass flow	max. wet		kg/s	0.17	0.21	0.21	0.28	0.28	0.38	0.46	0.46	0.53	0.66	0.90	1.00
	min. wet			0.10	0.12	0.12	0.16	0.16	0.22	0.26	0.26	0.31	0.38	0.55	0.58
<b>Exhaust gas data, losses</b>															
Overpressure combustion chamber	max.		mbar	2.68	2.53	2.53	3.55	3.55	4.35	4.65	4.65	4.32	4.99	5.99	4.64
Exhaust gas temperature at 80/60 °C	max.		°C	163	160	160	161	161	161	163	163	161	162	160	163
	min.	1		120											
Exhaust gas losses at 80/60 °C	max.		%	6.8	6.6	6.6	6.7	6.7	6.7	6.8	6.8	6.7	6.8	6.7	6.8
Stand-by loss q <sub>B</sub>	70 °C		W	781	883	883	1020	1020	1177	1382	1382	1565	1742	2073	2330
<b>Hydraulic data</b>															
Water resistance	Δt=10K		mbar	20	32	32	54	54	101	61	61	81	60	113	44
	Δt=20K			5	8	8	14	14	25	15	15	20	15	28	11
Water flow	max.		m <sup>3</sup> /h	31.8	39.5	39.5	51.6	51.6	70.5	85.9	85.9	98.8	122.9	168.0	186.0
Operating temperatures	max.		°C	95											
	SCO			110											

Values acc. EN304 at:  
 - λ=1.2, CO<sub>2</sub>=12.7%  
 - T<sub>air</sub>=20°C, rel. humidity=60%, p<sub>baro</sub>=100kPa  
 1: LCV = 11.85 kWh/kg  
 %m: C=86.5, H=13.1, O=0.2, S max = 0.2%

3zugskessel, V-07/06  
 O-ECA



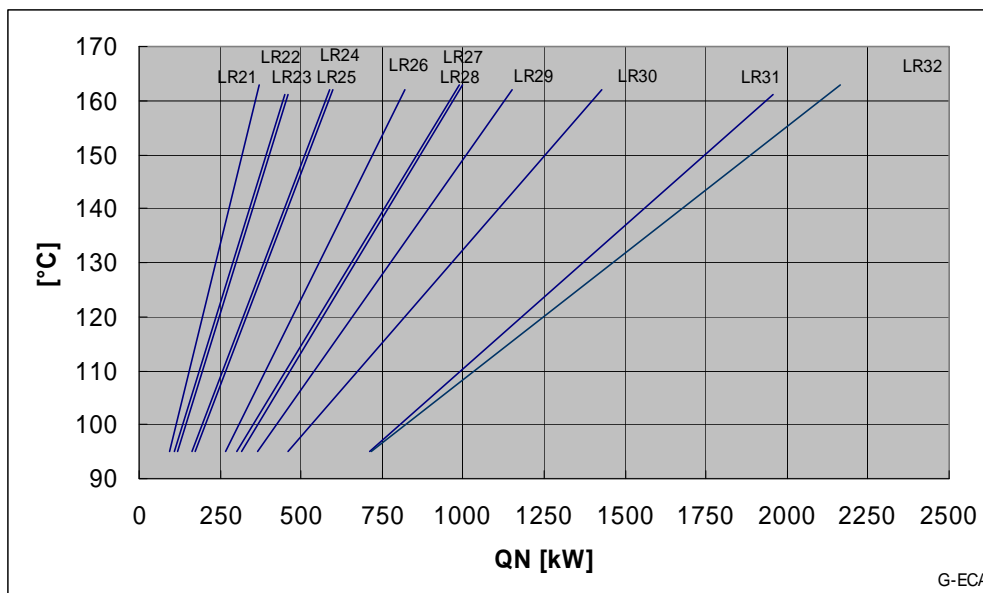
Flue gas temperature diagram LR, ECA-rating, fuel oil with clean boiler

**Technical specifications LR (natural gas, ECA-rating)**

LR			21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>														
Boiler nominal power q <sub>N</sub> (80/60°C)	max.		370	460	460	600	600	820	1000	1000	1150	1430	1955	2165
	min.		95	121	121	175	175	269	311	314	367	459	713	714
Calorific power q <sub>F</sub>	max.		398	495	495	645	645	882	1075	1075	1236	1538	2100	2329
	min.		99	127	127	182	182	280	324	327	383	478	743	744
Modulation rate			25%	26%	26%	28%	28%	32%	30%	30%	31%	31%	35%	32%
<b>Efficiencies</b>														
Overall efficiency 60 / 80 °C	100%	%	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0
Overall efficiency 60 / 80 °C	30%	%	95.4	95.5	95.5	95.8	95.8	95.9	95.9	95.9	96.0	96.0	96.1	96.0
<b>Mass flows</b>														
Gas flow, NG type E	max.	1,2	39.9	49.7	49.7	64.7	64.7	88.5	108.0	108.0	124.0	154.3	210.7	233.8
	min.	1,2	10.0	12.9	12.9	18.1	18.1	27.4	33.5	33.5	38.5	47.8	75.9	74.9
Exhaust gas mass flow	max. wet		0.17	0.21	0.21	0.27	0.27	0.37	0.45	0.45	0.52	0.64	0.88	0.97
	min. wet		0.04	0.05	0.05	0.08	0.08	0.11	0.14	0.14	0.16	0.20	0.32	0.31
<b>Exhaust gas data, losses</b>														
Overpressure combustion chamber	max.		2.74	2.58	2.58	3.62	3.62	4.43	4.74	4.74	4.41	5.09	6.11	4.73
Exhaust gas temperature at 80/60 °C	max.		163	161	161	162	162	162	163	163	162	162	161	163
	min.	3	95											
Exhaust gas losses at 80/60 °C	max.	%	6.8	6.7	6.7	6.8	6.8	6.8	6.8	6.8	6.8	6.9	6.8	6.9
Stand-by loss q <sub>B</sub>	70 °C	W	781	883	883	1020	1020	1177	1382	1382	1565	1742	2073	2330
<b>Hydraulic data</b>														
Water resistance	Δt=10K		21	32	32	54	54	101	61	61	81	60	113	44
	Δt=20K		5	8	8	14	14	25	15	15	20	15	28	11
Water flow	max.	m <sup>3</sup> /h	31.8	39.5	39.5	51.6	51.6	70.5	85.9	85.9	98.8	122.9	168.0	186.0
Operating temperatures	max.		95											
	SCO		110											

Values acc. EN303-3 at:  
 - λ=1.15, CO<sub>2</sub>=10%  
 - T<sub>air</sub>=20°C, rel. humidity=60%, p<sub>baro</sub>=100kPa  
 1: LCV = 9.97 kWh/nm<sup>3</sup>  
 2: nm<sup>3</sup> at 0°C, 1013 mbar  
 3: S max = 10 mg / nm<sup>3</sup>

3zugskessel, V-07/06  
 G-ECA



Flue gas temperature diagram LR, ECA-rating, natural gas with clean boiler

4.6.3. Pyronox LR (low-NOx version)

Technical specifications LR (fuel oil, low NOx)

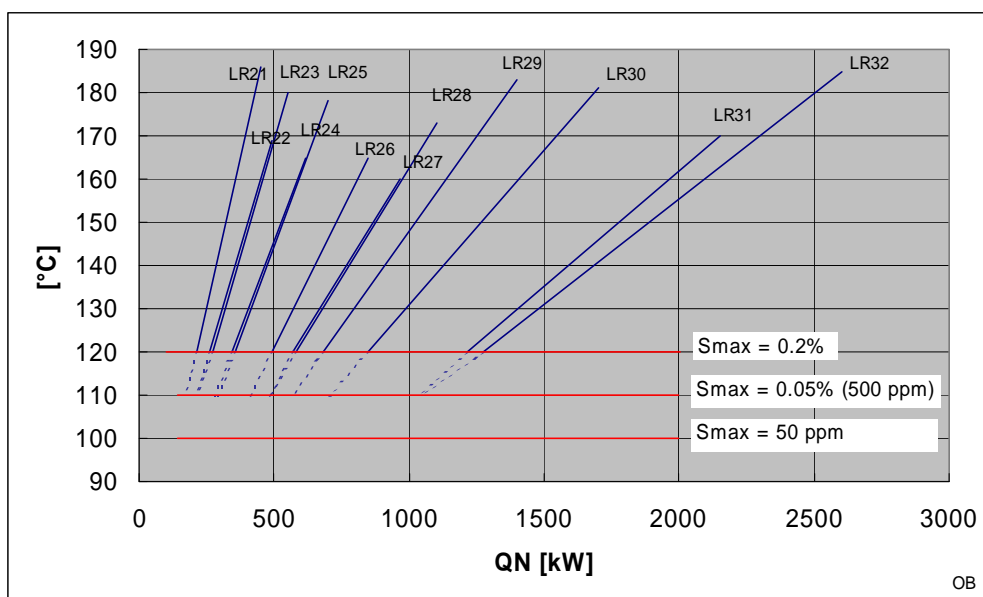
LR			21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>														
Boiler nominal power qN (80/60°C)	max.		450	500	550	625	700	850	975	1100	1400	1700	2150	2600
	min.	2	211	272	272	355	355	494	582	582	680	847	1217	1272
	min.	3	168	216	216	290	290	410	488	488	566	704	1041	1053
Calorific power qF	max.		490	539	597	673	759	915	1047	1189	1521	1844	2320	2827
	min.	2	223	287	287	374	374	520	613	613	716	891	1280	1339
	min.	3	176	227	227	304	304	430	511	511	593	738	1090	1103
Modulation rate at 80/60 °C		2	46%	53%	48%	56%	49%	57%	59%	52%	47%	48%	55%	47%
		3	36%	42%	38%	45%	40%	47%	49%	43%	39%	40%	47%	39%
<b>Efficiencies</b>														
Overall efficiency 60 / 80 °C	100%	%	91.9	92.7	92.2	92.9	92.3	92.9	93.1	92.5	92.1	92.2	92.7	92.0
Overall efficiency 50 / 70 °C	30%	3	95.3	95.3	95.3	95.3	95.4	95.3	95.3	95.4	95.4	95.4	95.4	95.4
Overall efficiency 60 / 80 °C	min qF	3	95.2	95.3	95.3	95.4	95.4	95.4	95.4	95.4	95.4	95.5	95.5	95.5
Efficiency DIN4702-8, 60 / 75 °C	ηN	3	94.8	95.0	95.0	95.1	95.1	95.2	95.2	95.1	95.1	95.1	95.3	95.1
<b>Mass flows</b>														
Fuel oil flow	max.	1	41.4	45.5	50.4	56.8	64.1	77.2	88.4	100.3	128.4	155.6	195.8	238.6
	min.	1,3	14.9	19.1	19.1	25.6	25.6	36.3	43.1	43.1	50.1	62.2	92	93.0
Exhaust gas mass flow	max. wet		0.21	0.23	0.26	0.29	0.33	0.39	0.45	0.51	0.66	0.79	1.00	1.22
	min. wet	3	0.08	0.10	0.10	0.13	0.13	0.19	0.22	0.22	0.26	0.32	0.47	0.47
<b>Exhaust gas data, losses</b>														
Overpressure combustion chamber	max.		4.08	3.01	3.70	3.87	4.94	4.69	4.40	5.71	6.61	7.25	7.36	6.85
Exhaust gas temperature at 80/60 °C	max.		186	169	180	165	178	165	160	173	183	181	170	185
	min.	2	120											
	min.	3	110											
Exhaust gas losses at 80/60 °C	max.		7.9	7.0	7.6	6.9	7.5	6.9	6.7	7.3	7.8	7.7	7.2	7.9
Stand-by loss qB	70 °C	W	781	883	883	1020	1020	1178	1382	1382	1565	1742	2073	2330
<b>Hydraulic data</b>														
Water resistance	Δt=10K		30	37	45	59	73	108	58	74	120	85	136	63
	Δt=20K		8	9	11	15	18	27	15	19	30	21	34	16
Water flow	max.	m3/h	38.7	47.3	47.3	60.1	60.1	73.0	94.5	94.5	120.3	146.1	184.7	223.4
Operating temperatures	max.		95											
	SCO		110											

Values acc. EN304 at:

- lamda=1.2, CO2=12.7%
- T-air=20°C, rel. humidity=60%, p-baro=100kPa
- 1: LCV = 11.85 kWh/kg
- 2: Sulphur content up to 0.2%
- 3: Max. sulphur content 0.05% (500 ppm)

3zugskessel, V-07/06

OB



Flue gas temperature diagram LR, low-NOx and fuel oil with clean boiler

**Technical specifications LR (natural gas. low NOx)**

LR			21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>														
Boiler nominal power qN (80/60°C)	max.		450	500	550	625	700	850	975	1100	1400	1700	2150	2600
	min.		95	121	121	175	175	269	311	314	367	459	713	714
Calorific power qF	max.		491	540	597	674	759	916	1048	1190	1523	1847	2323	2831
	min.	3	99	127	127	182	182	280	324	327	383	478	743	744
Modulation rate		3	20%	24%	21%	27%	24%	31%	31%	27%	25%	26%	32%	26%
<b>Efficiencies</b>														
Overall efficiency 60 / 80 °C	100%	%	91.7	92.6	92.1	92.8	92.2	92.8	93.0	92.4	91.9	92.1	92.6	91.8
Overall efficiency 60 / 80 °C	30%	%	95.4	95.5	95.5	95.8	95.7	95.9	96.0	95.9	95.8	95.9	96.1	95.9
Overall efficiency 60 / 80 °C	min qF	%	95.6	95.7	95.7	95.8	95.8	95.9	96.0	96.0	96.0	96.0	96.1	96.0
Efficiency DIN4702-8, 60 / 75 °C	ηN	%	94.9	95.2	95.1	95.4	95.2	95.5	95.6	95.4	95.3	95.3	95.6	95.3
<b>Mass flows</b>														
Gas flow, NG type E	max.	1,2	49.3	54.2	59.9	67.6	76.2	91.9	105.2	119.4	152.8	185.3	233.1	284.1
	min.	1,2	10.0	12.9	12.9	18.1	18.1	27.4	33.5	33.5	38.5	47.8	75.9	74.9
Exhaust gas mass flow	max. wet		0.20	0.23	0.25	0.28	0.32	0.38	0.44	0.50	0.64	0.77	0.97	1.18
	min. wet		0.04	0.05	0.05	0.08	0.08	0.11	0.14	0.14	0.16	0.20	0.32	0.31
<b>Exhaust gas data, losses</b>														
Overpressure combustion chamber	max.		4.17	3.07	3.76	3.95	5.03	4.78	4.49	5.82	6.74	7.40	7.51	6.98
Exhaust gas temperature at 80/60 °C	max.		187	169	180	166	179	166	161	174	184	181	171	186
	min.	3	95											
Exhaust gas losses at 80/60 °C	max.		8.0	7.2	7.7	7.0	7.6	7.0	6.8	7.4	7.9	7.8	7.3	8.0
Stand-by loss qB	70 °C	W	781	883	883	1021	1021	1178	1382	1382	1565	1742	2073	2330
<b>Hydraulic data</b>														
Water resistance	Δt=10K		30	37	45	59	73	108	58	74	120	85	136	63
	Δt=20K		8	9	11	15	18	27	15	19	30	21	34	16
Water flow	max.		38.7	47.3	47.3	60.1	60.1	73.0	94.5	94.5	120.3	146.1	184.7	223.4
Operating temperatures	max.		95											
	SCO		110											

Values acc. EN303-3 at:

- λ=1.15, CO2=10%

- T-air=20°C, rel. humidity=60%, p-baro=100kPa

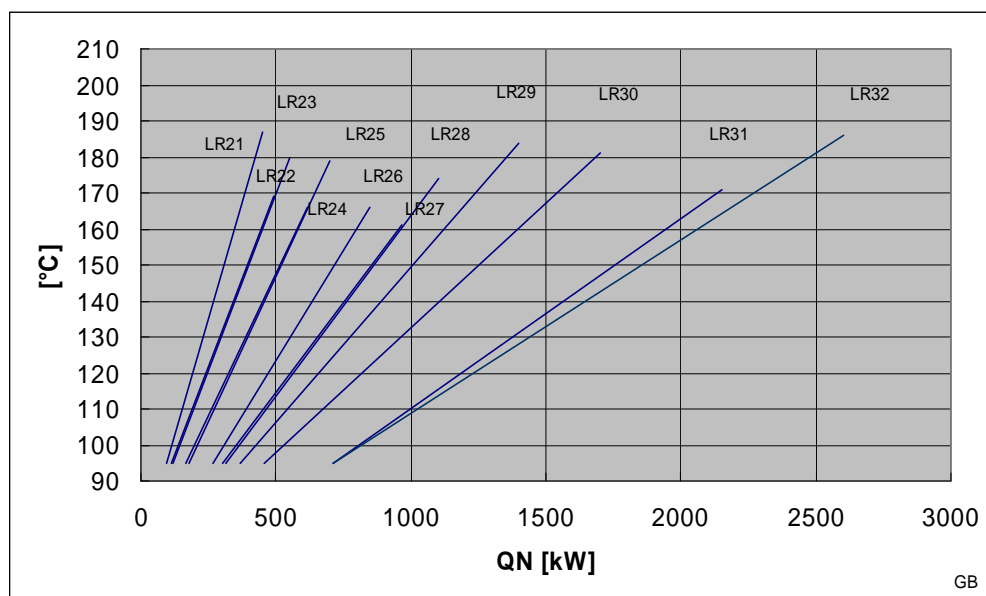
1: LCV = 9.97 kWh/nm3

2: nm3 at 0°C, 1013 mbar

3: S max = 10 mg / nm3

3zugskessel, V-07/06

GB



Flue gas temperature diagram LR, low-NOx and natural gas with clean boiler

4.6.4. Pyronox LR (low-NOx version with internal flue gas recirculation, ARF)

Technical specifications LR (fuel oil, low NOx) with ARF

LR			21	22	23	24	25	26	27	28	29	30	31	32	
<b>Power</b>															
Boiler nominal power q <sub>N</sub> (80/60°C)	max.	4	kW	380	430	470	585	600	755	935	935	1185	1455	1865	2325
	min.	2,4		176	225	225	294	294	412	506	506	584	735	1025	1072
	min.	3,4		142	180	180	237	237	336	409	409	478	598	842	875
Calorific power q <sub>F</sub>	max.		kW	413	462	509	631	649	813	1008	1008	1284	1575	2009	2532
	min.	2		186	237	237	310	310	434	533	533	616	774	1079	1129
	min.	3		149	189	189	249	249	352	429	429	502	627	882	917
Modulation rate at 80/60 °C		2		45%	51%	47%	49%	48%	53%	53%	48%	49%	54%	45%	
		3		36%	41%	37%	39%	38%	43%	43%	43%	39%	40%	44%	36%
<b>Efficiencies</b>															
Overall efficiency 60 / 80 °C	100%		%	92.1	92.9	92.5	92.7	92.5	92.9	92.7	92.7	92.3	92.4	92.8	91.8
Overall efficiency 50 / 70 °C	30%	3	%	95.3	95.2	95.3	95.2	95.3	95.3	95.2	95.3	95.2	95.2	95.3	95.3
<b>Mass flows</b>															
Fuel oil flow	max.	1	kg/h	34.8	39.0	42.9	53.3	54.8	68.6	85.1	85.1	108.3	132.9	169.5	213.2
	min.	1,3		15.6	15.9	15.9	21	21	29.7	36.2	36.2	42.4	52.9	74.5	77.4
Exhaust gas mass flow	max. wet		kg/s	0.18	0.20	0.22	0.27	0.28	0.35	0.43	0.43	0.55	0.68	0.87	1.09
	min. wet	3		0.06	0.08	0.08	0.11	0.11	0.15	0.18	0.18	0.22	0.27	0.38	0.40
<b>Exhaust gas data, losses</b>															
Overpressure combustion chamber	max.		mbar	4.18	3.13	3.79	4.76	5.03	5.33	5.89	5.89	6.75	7.63	7.54	7.57
Exhaust gas temperature at 80/60 °C	max.		°C	183	166	176	172	175	168	171	171	179	178	168	189
	min.	2		121	121	121	121	122	121	123	123	124	124	123	124
	min.	3		111	111	111	112	112	111	113	113	115	115	113	113
Exhaust gas losses at 80/60 °C	max.		%	7.6	6.8	7.3	7.1	7.2	6.9	7.1	7.1	7.5	7.5	7.0	8.0
Stand-by loss q <sub>B</sub>	70 °C		W	781	883	883	1020	1020	1177	1382	1382	1565	1742	2073	2330
<b>Hydraulic data</b>															
Water resistance	Δt=10K		mbar	22	28	33	51	54	85	54	54	86	62	103	50
	Δt=20K			6	7	8	13	14	21	14	14	21	16	26	13
Water flow	max.		m <sup>3</sup> /h	32.6	36.9	40.4	50.3	51.6	64.9	80.3	80.3	101.8	125.0	160.2	199.8
Operating temperatures	max.		°C	95											
	SCO			110											

Values acc. EN304 at:

- λ=1.2, CO<sub>2</sub>=12.7%

- T<sub>air</sub>=20°C, rel. humidity=60%, p<sub>baro</sub>=100kPa

1: LCV = 11.85 kWh/kg

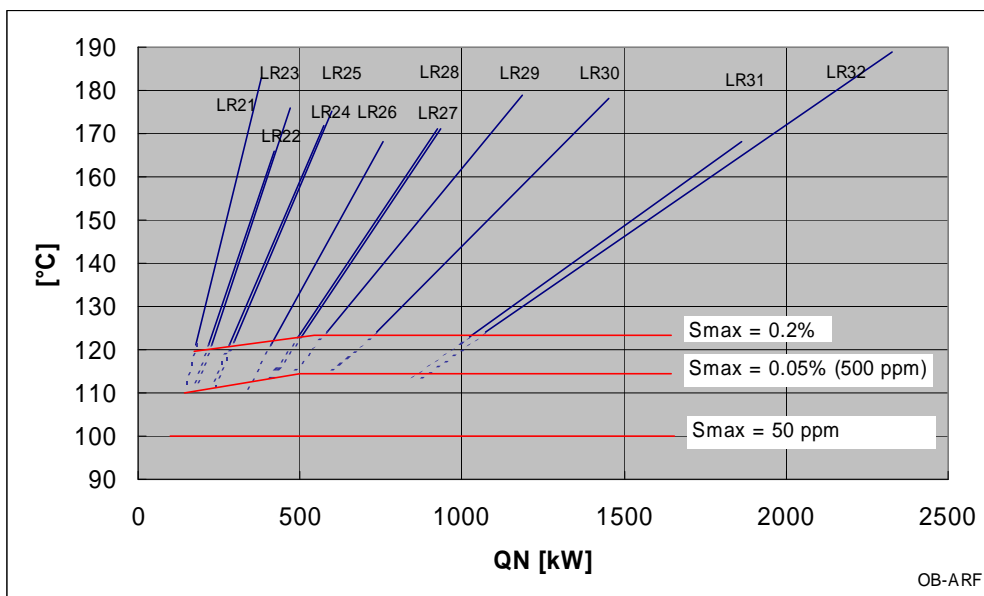
2: Sulphur content up to 0.2%

3: Max. sulphur content 0.05% (500 ppm)

2: with 15% internal exhaust gas recirculation, constant amount at partial load.

3zugskessel, V-07/06

OB



Flue gas temperature diagram LR, low-NOx, fuel oil and ARF with clean boiler

**Technical specifications LR (natural gas, low NOx) with ARF**

LR			21	22	23	24	25	26	27	28	29	30	31	32	
<b>Power</b>															
Boiler nominal power qN (80/60°C)	max.	4	kW	380	430	470	585	600	755	935	935	1185	1455	1865	2325
	min.	4		84	108	108	148	148	215	263	263	308	389	560	569
Calorific power qF	max.		kW	413	463	509	632	649	814	1009	1009	1285	1577	2011	2535
	min.	3		88	113	113	155	155	224	275	275	321	406	584	594
Modulation rate		3		21%	24%	22%	25%	24%	28%	27%	27%	25%	26%	29%	23%
<b>Efficiencies</b>															
Overall efficiency 60 / 80 °C	100%		%	92.0	92.8	92.4	92.6	92.4	92.7	92.6	92.6	92.2	92.3	92.7	91.7
Overall efficiency 60 / 80 °C	30%		%	95.4	95.5	95.5	95.6	95.6	95.8	95.8	95.8	95.7	95.7	96.0	95.7
<b>Mass flows</b>															
Gas flow, NG type E	max.	1,2	nm <sup>3</sup> /h	41.5	46.5	51.0	63.4	65.1	81.7	101.3	101.3	128.9	158.3	201.7	254.3
	min.	1,2		8.8	11.4	11.4	15.5	15.5	22.5	27.6	27.6	32.2	40.8	58.6	59.6
Exhaust gas mass flow	max. wet		kg/s	0.17	0.19	0.21	0.26	0.27	0.34	0.42	0.42	0.54	0.66	0.84	1.06
	min. wet			0.04	0.05	0.05	0.06	0.06	0.09	0.12	0.12	0.14	0.17	0.24	0.25
<b>Exhaust gas data, losses</b>															
Overpressure combustion chamber	max.		mbar	4.27	3.20	3.85	4.85	5.12	5.44	6.00	6.00	6.89	7.79	7.68	7.71
Exhaust gas temperature at 80/60 °C	max.		°C	184	167	177	173	175	168	171	171	180	179	169	189
	min.	3		97	98	98	97	97	97	98	98	99	100	98	99
Exhaust gas losses at 80/60 °C	max.		%	7.7	6.9	7.4	7.2	7.3	7.0	7.2	7.2	7.6	7.6	7.1	8.0
Stand-by loss qB	70 °C		W	780	883	883	1020	1020	1178	1382	1382	1565	1742	2073	2330
<b>Hydraulic data</b>															
Water resistance	Δt=10K		mbar	22	28	33	51	54	85	54	54	86	63	103	50
	Δt=20K			6	7	8	13	14	21	14	14	21	16	26	13
Water flow	max.		m <sup>3</sup> /h	32.6	36.9	40.4	50.3	51.6	64.9	80.3	80.3	101.8	125.0	160.2	199.8
Operating temperatures	max.		°C	95											
	SCO			110											

Values acc. EN303-3 at:

- lamda=1.15, CO2=10%

- T-air=20°C, rel. humidity=60%, p-baro=100kPa

1: LCV = 9.97 kWh/nm3

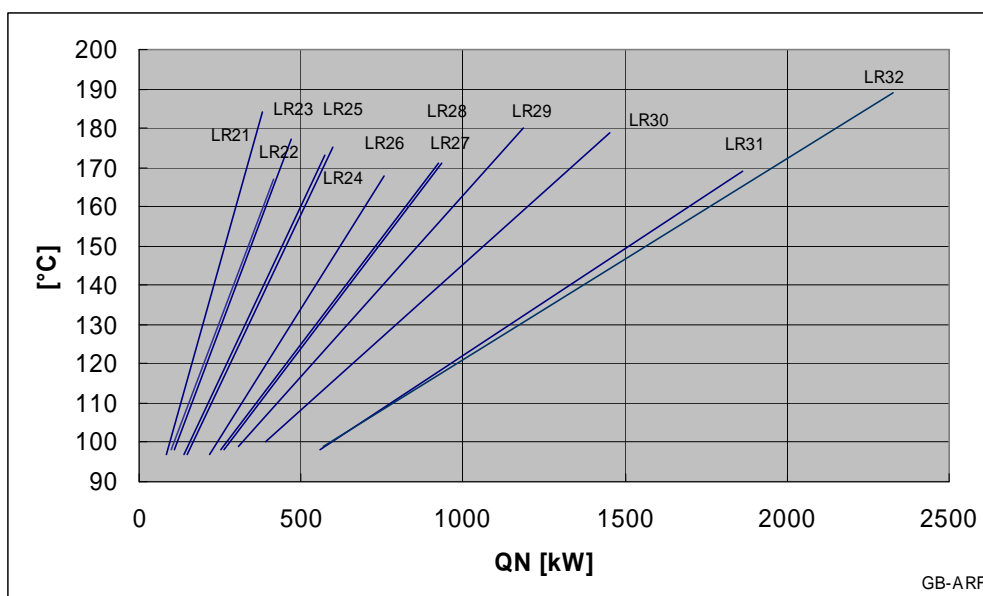
2: nm3 at 0°C, 1013 mbar

3: S max = 10 mg / nm3

4: with 15% internal exhaust gas recirculation, constant amount at partial load.

3zugskessel, V-07/06

GB



Flue gas temperature diagram LR, low-NOx, natural gas and ARF with clean boiler

4.6.5. Pyronox LR-NT

Technical specifications LR-NT (fuel oil)

LR-NT			21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>														
Boiler nominal power qN (80/60°C)	max.		530	580	630	700	800	895	1150	1300	1650	1900	2500	2750
	min.		185	235	235	315	315	422	512	512	602	740	1035	1048
Calorific power qF	max.		592	638	698	766	885	980	1263	1444	1846	2113	2776	3079
	min.	2	196	248	248	332	332	444	540	540	634	779	1089	1104
Modulation rate at 80/60 °C		2	33%	39%	36%	43%	38%	45%	43%	37%	34%	37%	39%	36%
<b>Efficiencies</b>														
Overall efficiency 60 / 80 °C	100%	%	89.5	90.9	90.3	91.4	90.4	91.4	91.0	90.0	89.3	89.9	90.0	89.3
Overall efficiency @ tm = 48 °C	30%	%	95.0	95.0	95.0	95.0	95.0	95.0	95.1	95.0	95.1	95.1	95.1	95.1
Overall efficiency 60 / 80 °C	min qF	%	94.8	94.9	94.9	94.9	94.9	95.0	95.0	95.0	94.9	95.0	95.0	95.0
Efficiency DIN4702-8, 60 / 75 °C	ηN	%	94.0	94.4	94.3	94.6	94.4	94.6	94.6	94.4	94.2	94.4	94.5	94.3
<b>Mass flows</b>														
Fuel oil flow	max.	1	49.9	53.9	58.9	64.7	74.7	82.7	106.6	121.9	155.8	178.3	234.3	259.8
	min.	1	16.5	20.9	20.9	28	28	37.5	45.5	45.5	53.5	65.7	91.9	93.1
Exhaust gas mass flow	max. wet		0.25	0.27	0.30	0.33	0.38	0.42	0.54	0.62	0.80	0.91	1.20	1.33
	min. wet		0.08	0.11	0.11	0.14	0.14	0.19	0.23	0.23	0.27	0.34	0.47	0.48
<b>Exhaust gas data, losses</b>														
Overpressure combustion chamber	max.		6.35	4.45	5.34	5.30	7.14	5.84	6.97	9.19	10.69	10.34	11.27	8.40
Exhaust gas temperature at 80/60 °C	max.		235	207	220	197	218	197	205	225	240	227	225	239
	min.	2	120											
Exhaust gas losses at 80/60 °C	max.		10.3	8.9	9.5	8.4	9.4	8.5	8.8	9.8	10.6	10.0	9.5	10.6
Stand-by loss qB	70 °C		781	883	883	1020	1020	1178	1382	1382	1565	1742	2073	2330
<b>Hydraulic data</b>														
Water resistance	Δt=10K		42	50	59	73	96	120	81	103	167	106	184	70
	Δt=20K		11	13	15	18	24	30	20	26	42	27	46	18
Water flow	max.		45.5	54.1	54.1	68.7	68.7	76.9	111.7	111.7	141.8	163.2	214.8	257.8
Operating temperatures	max.		95											
	SCO		110											

Values acc. EN304 at:

- lamda=1.2, CO2=12.7%

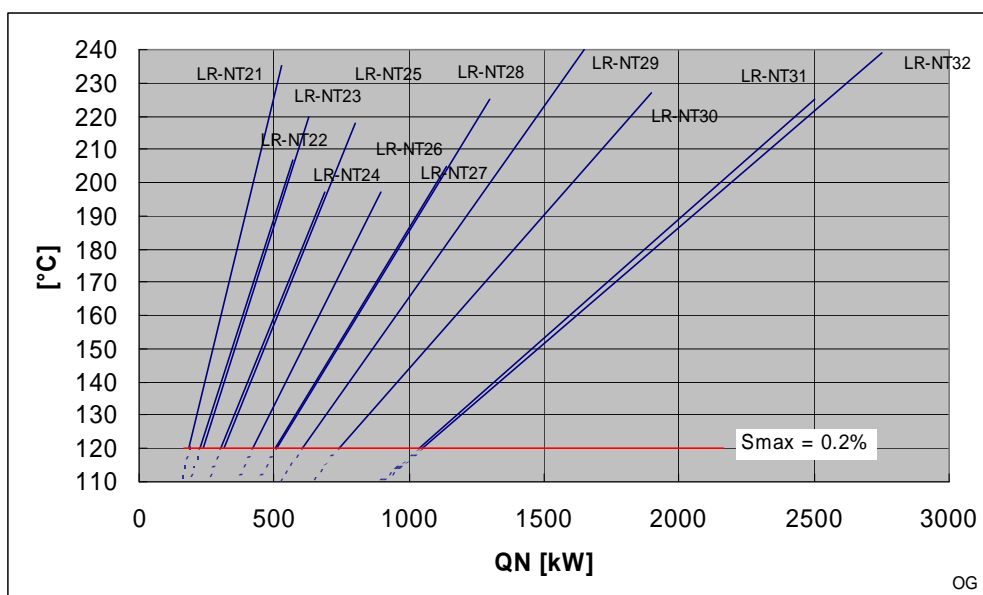
- T-air=20°C, rel. humidity=60%, p-baro=100kPa

1: LCV = 11.85 kWh/kg

2: Sulphur content up to 0.2%

3zugskessel, V-09/07

NT-OG



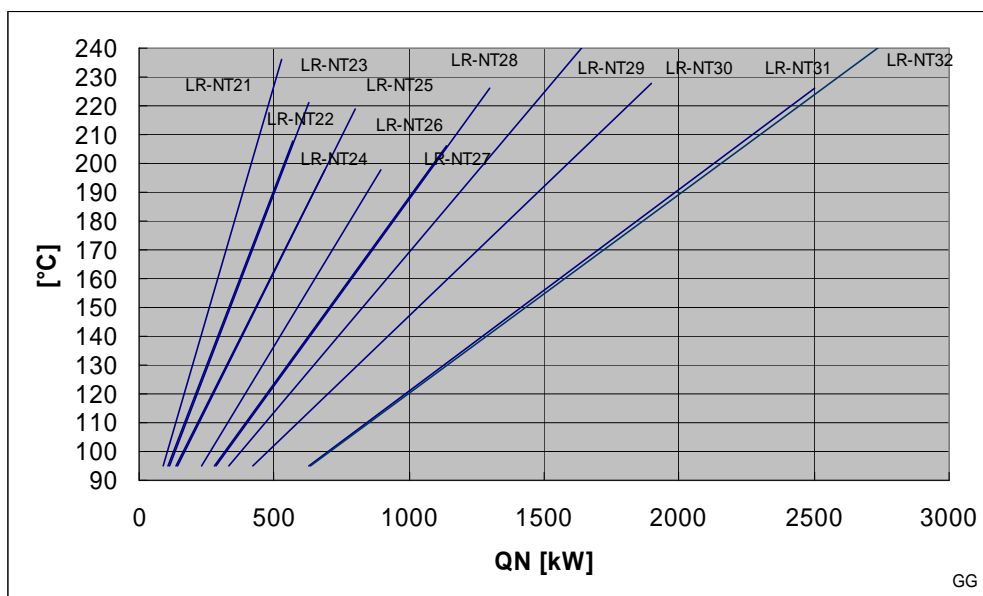
Flue gas temperature diagram LR-NT, fuel oil with clean boiler

**Technical specifications LR-NT (natural gas)**

LR-NT			21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>														
Boiler nominal power qN (80/60°C)	max.		530	580	630	700	800	895	1150	1300	1650	1900	2500	2750
	min.		89	115	115	145	145	232	287	287	331	419	629	633
Calorific power qF	max.		593	639	700	767	887	981	1266	1446	1851	2116	2781	3085
	min.	3	94	120	120	152	152	242	299	299	345	437	654	660
Modulation rate		3	16%	19%	17%	20%	17%	25%	24%	21%	19%	21%	24%	21%
<b>Efficiencies</b>														
Overall efficiency 60 / 80 °C	100%	%	89.4	90.8	90.1	91.3	90.3	91.2	90.9	89.9	89.1	89.9	89.9	89.2
Overall efficiency @ tm = 58 °C	30%	%	95.6	95.9	95.8	96.1	96.0	96.1	96.1	96.0	95.8	96.1	96.2	96.0
Overall efficiency 60 / 80 °C	min qF	%	95.5	95.6	95.6	95.7	95.7	95.9	95.9	95.9	95.9	96.0	96.1	96.0
Efficiency DIN4702-8, 60 / 75 °C	ηN	%	94.2	94.7	94.5	95.0	94.7	95.1	95.0	94.7	94.4	94.7	94.8	94.5
<b>Mass flows</b>														
Gas flow, NG type E	max.	1.2	59.5	64.2	70.2	77.0	89.0	98.4	127.1	145.1	185.8	212.4	279.0	309.5
	min.	1.2	9.4	12.0	12.0	15.2	15.2	24.3	30.0	30.0	34.6	43.8	65.6	66.2
Exhaust gas mass flow	max. wet		0.25	0.27	0.29	0.32	0.37	0.41	0.53	0.60	0.77	0.88	1.16	1.29
	min. wet		0.04	0.05	0.05	0.06	0.06	0.10	0.12	0.12	0.14	0.18	0.27	0.28
<b>Exhaust gas data, losses</b>														
Overpressure combustion chamber	max.		6.48	4.54	5.46	5.41	7.29	5.96	7.12	9.38	10.94	10.56	11.50	8.57
Exhaust gas temperature at 80/60 °C	max.		236	208	221	198	219	198	206	226	241	228	226	241
	min.	3	95											
Exhaust gas losses at 80/60 °C	max.		10.4	9.0	9.7	8.6	9.6	8.6	9.0	10.0	10.7	10.1	10.0	10.7
Stand-by loss qB	70 °C		781	883	883	1020	1020	1178	1382	1382	1565	1742	2073	2330
<b>Hydraulic data</b>														
Water resistance	Δt=10K		42	50	59	73	96	120	81	103	167	106	184	70
	Δt=20K		11	13	15	18	24	30	20	26	42	27	46	18
Water flow	max.		45.5	54.1	54.1	68.7	68.7	76.9	111.7	111.7	141.8	163.2	214.8	236.3
Operating temperatures	max.		95											
	SCO		110											

Values acc. EN303-3 at:  
 - lamda=1.15, CO2=10%  
 - T-air=20°C, rel. humidity=60%, p-baro=100kPa  
 1: LCV = 9.97 kWh/nm3  
 2: nm3 at 0°C, 1013 mbar  
 3: S max = 10 mg / nm3

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 NT-GG



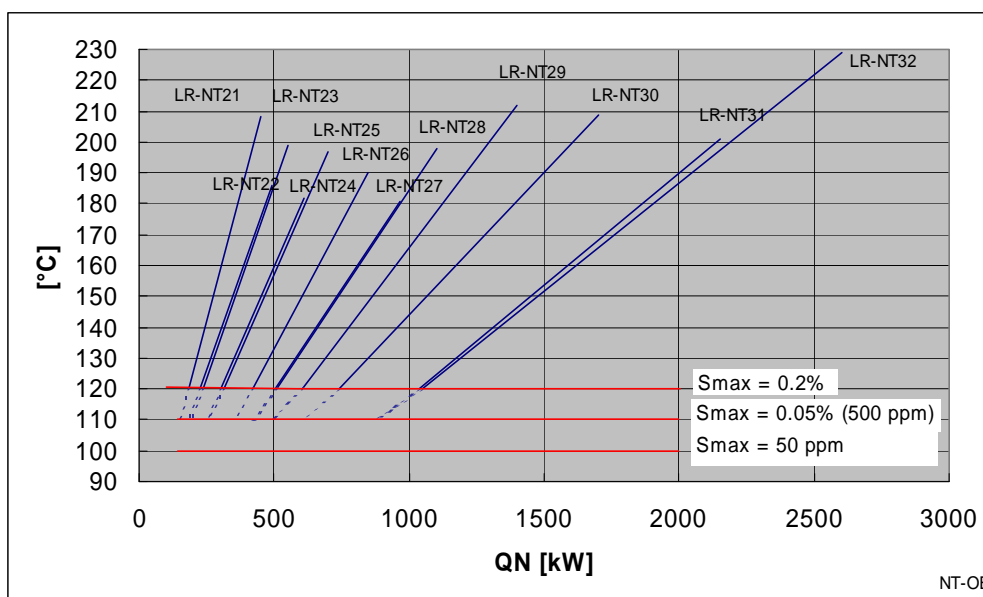
Flue gas temperature diagram LR-NT, natural gas with clean boiler

**4.6.6. Pyronox LR-NT (lox NOx version)**  
**Technical specifications LR-NT (fuel oil, low NOx)**

LR-NT				21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>															
Boiler nominal power qN (80/60°C)	max.		kW	450	500	550	625	700	850	975	1100	1400	1700	2150	2600
	min.	2		185	235	235	315	315	422	512	512	602	740	1035	1048
	min.	3		147	188	188	257	257	358	429	429	494	616	886	890
Calorific power qF	max.		kW	496	544	603	678	766	927	1059	1204	1544	1872	2358	2895
	min.	2		196	248	248	332	332	444	554	540	634	779	1089	1104
	min.	3		154	197	197	269	269	375	450	450	517	645	928	933
Modulation rate at 80/60 °C		2		40%	46%	41%	49%	43%	48%	52%	45%	41%	42%	46%	38%
		3		31%	36%	33%	40%	35%	40%	42%	37%	33%	34%	39%	32%
<b>Efficiencies</b>															
Overall efficiency 60 / 80 °C	100%		%	90.8	91.9	91.3	92.1	91.4	91.7	92.1	91.3	90.7	90.8	91.2	89.8
Overall efficiency @ tm = 48 °C	30%	3	%	95.4	95.4	95.4	95.5	95.5	95.5	95.5	95.5	95.5	95.5	95.5	95.5
Overall efficiency 60 / 80 °C	min qF	3	%	95.2	95.3	95.3	95.4	95.4	95.4	95.4	95.4	95.5	95.5	95.5	95.4
Efficiency DIN4702-8, 60 / 75 °C	ηN	3	%	94.5	94.9	94.7	95.0	94.8	95.0	95.1	94.9	94.8	94.8	95.0	94.6
<b>Mass flows</b>															
Fuel oil flow	max.	1	kg/h	41.8	45.9	50.9	57.2	64.6	78.2	89.3	101.6	130.3	157.9	199.0	244.3
	min.	1,3		13	16.6	16.6	22.7	22.7	31.7	38.0	38.0	43.6	54.5	78.3	78.7
Exhaust gas mass flow	max. wet		kg/s	0.21	0.23	0.26	0.29	0.33	0.40	0.46	0.52	0.66	0.81	1.02	1.25
	min. wet	3		0.07	0.08	0.08	0.12	0.12	0.16	0.19	0.19	0.22	0.28	0.40	0.40
<b>Exhaust gas data, losses</b>															
Overpressure combustion chamber	max.		mbar	4.41	3.22	3.96	4.13	5.29	5.22	4.84	6.31	7.37	8.04	8.09	7.40
Exhaust gas temperature at 80/60 °C	max.		°C	208	186	199	182	197	190	181	198	212	209	201	229
	min.	2		120											
	min.	3		110											
Exhaust gas losses at 80/60 °C	max.		%	8.9	7.9	8.5	7.7	8.4	8.1	7.7	8.5	9.2	9.0	8.7	10.1
Stand-by loss qB	70 °C		W	781	883	883	1020	1020	1178	1382	1382	1565	1742	2073	2330
<b>Hydraulic data</b>															
Water resistance	Δt=10K		mbar	30	37	45	58	73	108	58	74	120	85	136	63
	Δt=20K			8	9	11	15	18	27	15	19	30	21	34	16
Water flow	max.		m <sup>3</sup> /h	38.7	47.3	47.3	60.1	60.1	73.0	94.5	94.5	120.3	146.1	184.7	223.4
Operating temperatures	max.		°C	95											
	SCO			110											

Values acc. EN304 at:  
 - lamda=1.2, CO2=12.7%  
 - T-air=20°C, rel. humidity=60%, p-baro=100kPa  
 1: LCV = 11.85 kWh/kg  
 2: Sulphur content up to 0.2%  
 3: Max. sulphur content 0.05% (500 ppm)

3zugskessel, V-09/07  
 NT-OB



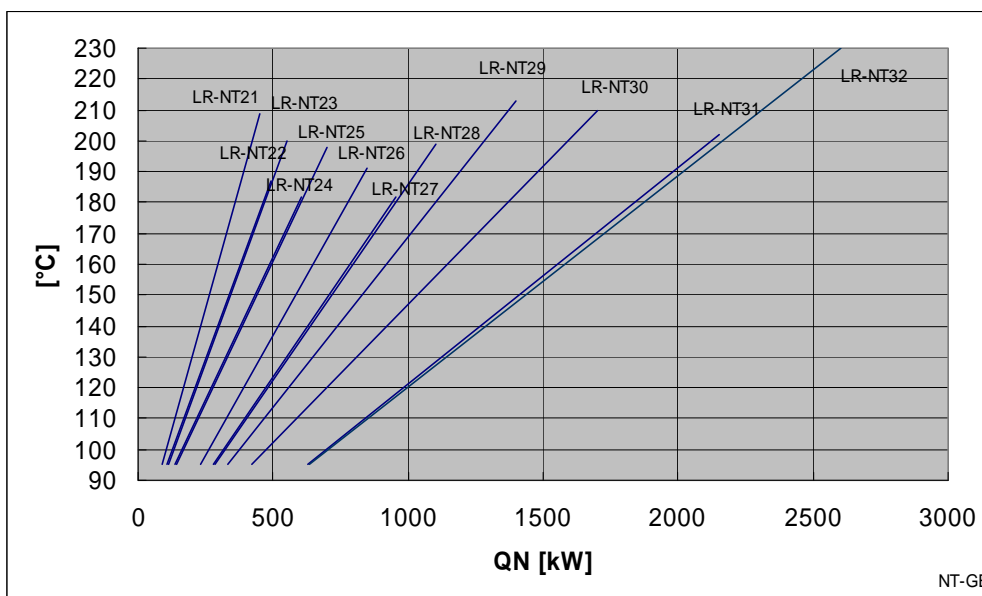
Flue gas temperature diagram LR-NT, low NOx, fuel oil with clean boiler

**Technical specifications LR-NT (natural gas, low NOx)**

LR-NT			21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>														
Boiler nominal power qN (80/60°C)	max.		450	500	550	625	700	850	975	1100	1400	1700	2150	2600
	min.		89	115	115	145	145	232	287	287	331	419	629	633
Calorific power qF	max.		496	545	603	679	767	928	1060	1207	1546	1875	2361	2900
	min.	3	94	120	120	152	152	242	299	299	345	437	654	660
Modulation rate		3	19%	22%	20%	22%	20%	26%	28%	25%	22%	23%	28%	23%
<b>Efficiencies</b>														
Overall efficiency 60 / 80 °C	100%	%	90.7	91.8	91.1	92.0	91.3	91.6	92.0	91.2	90.5	90.7	91.0	89.7
Overall efficiency @ tm = 58 °C	30%	3	95.9	96.0	96.0	96.0	96.1	96.1	96.1	96.1	96.2	96.2	96.2	96.1
Overall efficiency 60 / 80 °C	min qF	%	95.5	95.6	95.6	95.7	95.7	95.9	95.9	95.9	95.9	96.0	96.1	96.0
Efficiency DIN4702-8, 60 / 75 °C	ηN	%	94.6	95.0	94.8	95.2	95.0	95.2	95.3	95.1	94.9	95.0	95.3	94.7
<b>Mass flows</b>														
Gas flow, NG type E	max.	1,2	49.8	54.7	60.5	68.1	76.9	93.1	106.3	121.1	155.1	188.1	236.9	290.9
	min.	1,2	10.0	12.0	12.0	14.9	14.9	23.8	28.8	30.0	34.6	44.9	69.5	69.9
Exhaust gas mass flow	max. wet		0.21	0.23	0.25	0.28	0.32	0.39	0.44	0.50	0.65	0.78	0.99	1.21
	min. wet		0.04	0.05	0.05	0.06	0.06	0.10	0.12	0.12	0.14	0.19	0.29	0.29
<b>Exhaust gas data, losses</b>														
Overpressure combustion chamber	max.		4.49	3.28	4.03	4.21	5.40	5.33	4.93	6.45	7.52	8.21	8.26	7.55
Exhaust gas temperature at 80/60 °C	max.		209	187	200	182	198	191	182	199	213	210	202	230
	min.	3	95											
Exhaust gas losses at 80/60 °C	max.		9.1	8.0	8.6	7.8	8.5	8.2	7.8	8.6	9.3	9.2	8.8	10.2
Stand-by loss qB	70 °C	W	781	883	883	1020	1020	1178	1382	1382	1565	1742	2073	2330
<b>Hydraulic data</b>														
Water resistance	Δt=10K		30	37	45	58	73	108	58	74	120	85	136	63
	Δt=20K		8	9	11	15	18	27	14	18	30	21	34	16
Water flow	max.		38.7	47.3	47.3	60.1	60.1	73.0	94.5	94.5	120.3	146.1	184.7	223.4
Operating temperatures	max.		95											
	SCO		110											

Values acc. EN303-3 at:  
 - lamda=1.15, CO2=10%  
 - T-air=20°C, rel. humidity=60%, p-baro=100kPa  
 1: LCV = 9.97 kWh/nm3  
 2: nm3 at 0°C, 1013 mbar  
 3: S max = 10 mg / nm3

3zugskessel, V-09/07  
 NT-GB



Flue gas temperature diagram LR-NT, low NOx, natural gas with clean boiler

## 4.7. Additional data for Pyronox LRK and LRK-NT

## 4.7.1. Pyronox LRK

## Technical specifications recuperator (fuel oil)

LRK				21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>															
Nominal power qN (30 / 35°C)	max.	1	kW	42	42	47	50	59	64	82	96	130	141	179	237
	min.	1		18	22	22	29	29	39	48	48	55	69	96	106
<b>Efficiencies</b>															
Overall efficiency 30 / 35 °C	100%	1	%	98.2	98.5	98.3	98.9	98.3	99.2	98.9	98.3	98.2	98.3	98.4	98.2
Overall efficiency 30 / 35 °C	30%	2	%	102.9	102.8	102.9	102.7	103.0	102.6	102.7	102.9	103.1	103.0	102.9	103.2
Efficiency DIN4702-8, 60 / 75 °C	$\eta_N$		%	102.4	102.4	102.4	102.5	102.5	102.4	102.4	102.4	102.8	102.7	102.6	102.7
<b>Exhaust gas data, losses</b>															
Additional exhaust gas pressure drop	max		mbar	2.75	1.29	1.56	1.85	2.51	1.41	1.26	1.68	2.77	2.08	2.20	2.15
Total combustion space overpressure	max		mbar	8.60	5.42	6.51	6.78	9.11	6.64	7.55	9.90	12.24	11.33	12.36	11.48
Exhaust gas temperature at 30 / 35 °C	max.	1	°C	51	48	49	47	49	47	47	49	50	49	48	50
	min.	1		35	35	35	36	36	37	36	36	36	36	36	36
Exhaust gas losses at 30 / 35 °C	max.	1	%	1.6	1.5	1.6	1.4	1.5	1.4	1.5	1.6	1.7	1.6	1.7	1.6
Stand-by loss qB	70 °C		W	824	926	926	1073	1073	1239	1447	1447	1645	1831	2166	2427
<b>Hydraulic data</b>															
Water resistance	$\Delta t=5K$		mbar	22	29	38	29	41	33	40	54	64	52	53	66
	$\Delta t=10K$			6	7	10	7	10	8	10	14	16	13	13	17
Water flow	max.		m <sup>3</sup> /h	7.2	7.2	8.1	8.6	10.1	11.0	14.1	16.5	22.3	24.2	30.7	40.6
	min.			1.8	2.0	2.0	2.5	2.5	2.7	4.1	4.1	5.6	6.0	7.7	10.2
<b>Condensate</b>															
Amount of condensate	max.		L / h	13.5	16.0	17.5	21.5	22.5	29.5	34.5	37.0	45.0	55.0	73.0	84.0

Values at:

3zugskessel, V-01/07

- lamda=1.2, CO<sub>2</sub>=12.7%

OG

- T-air=20°C, rel. humidity=60%, p-baro=100kPa

1: Boiler at 60 / 80 °C

2: Boiler at 50 / 70 °C

## Technical specifications recuperator (natural gas)

LRK				21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>															
Nominal power qN (30 / 35°C)	max.	1	kW	67	72	79	87	101	110	143	163	208	239	313	378
	min.	1		12	15	15	22	22	33	38	39	45	57	90	109
<b>Efficiencies</b>															
Overall efficiency 30 / 35 °C	100%	1	%	102.1	103.3	102.7	103.6	102.9	103.9	103.6	102.9	102.4	102.9	103.2	102.4
Overall efficiency 30 / 35 °C	30%	1	%	107.5	107.5	107.6	107.6	107.6	107.7	107.7	107.7	107.7	107.8	107.8	107.8
Efficiency DIN4702-8, 60 / 75 °C	$\eta_N$		%	107.0	107.1	107.1	107.2	107.2	107.3	107.3	107.2	107.2	107.3	107.3	107.2
<b>Exhaust gas data, losses</b>															
Additional exhaust gas pressure drop	max		mbar	2.81	1.32	1.60	1.89	2.57	1.44	1.29	1.71	2.83	2.13	2.25	2.20
Total combustion space overpressure	max		mbar	8.78	5.54	6.66	6.92	9.31	6.77	7.70	10.10	12.50	11.57	12.60	11.70
Exhaust gas temperature at 30 / 35 °C	max.	1	°C	50	48	49	47	49	46	47	49	50	49	48	50
	min.	1		32	32	32	32	32	33	32	33	32	32	33	33
Exhaust gas losses at 30 / 35 °C	max.	1	%	1.6	1.5	1.5	1.4	1.6	1.4	1.5	1.6	1.6	1.6	1.6	1.6
Stand-by loss qB	70 °C		W	824	926	926	1073	1073	1239	1447	1447	1645	1831	2166	2427
<b>Hydraulic data</b>															
Water resistance	$\Delta t=5K$		mbar	53	89	107	88	117	100	120	157	163	149	161	168
	$\Delta t=10K$			13	22	27	22	29	25	30	39	41	37	40	42
Water flow	max.		m <sup>3</sup> /h	11.5	12.3	13.5	14.9	17.3	18.9	24.5	27.9	35.7	41.0	53.7	64.8
	min.			1.8	2.0	2.0	2.5	2.5	2.7	4.1	4.1	5.6	6.0	7.7	10.2
<b>Condensate</b>															
Amount of condensate	max.		L / h	38.0	48.0	49.0	61.0	64.0	81.0	98.0	102.0	123.5	151.0	199.0	242.0

Values at:

3zugskessel, V-01/07

- lamda=1.15, CO<sub>2</sub>=10%

GG

- T-air=20°C, rel. humidity=60%, p-baro=100kPa

1: Boiler at 60 / 80 °C

4.7.2. Pyronox LRK (low-NOx version)

Technical specifications recuperator (fuel oil, low NOx)

LRK				21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>															
Nominal power qN (30 / 35°C)	max.	1	kW	32	36	39	44	50	60	69	79	100	122	153	186
	min.	1,3		14	17	17	23	23	32	38	38	45	56	81	84
<b>Efficiencies</b>															
Overall efficiency 30 / 35 °C	100%	1	%	98.4	99.3	98.8	99.5	98.9	99.5	99.8	99.1	98.6	98.8	99.3	98.5
Overall efficiency 30 / 35 °C	30%	2	%	102.7	102.5	102.7	102.5	102.7	102.5	102.5	102.7	102.8	102.8	102.6	102.8
Efficiency DIN4702-8, 60 / 75 °C	ηN	3	%	102.4	102.5	102.5	102.5	102.6	102.5	102.5	102.6	102.6	102.7	102.7	102.7
<b>Exhaust gas data, losses</b>															
Additional exhaust gas pressure drop	max		mbar	1.87	0.92	1.15	1.43	1.85	1.25	0.85	1.14	1.89	1.61	1.56	1.54
Total combustion space overpressure	max		mbar	5.95	3.93	4.85	5.30	6.79	5.94	5.25	6.85	8.50	8.86	8.92	8.39
Exhaust gas temperature at 30 / 35 °C	max.	1	°C	48	46	48	46	47	46	45	47	48	48	46	48
	min.	1,3		34	35	35	35	35	35	36	36	35	35	35	35
Exhaust gas losses at 30 / 35 °C	max.		%	1.5	1.4	1.4	1.3	1.4	1.4	1.3	1.4	1.5	1.5	1.4	1.5
Stand-by loss qB	70 °C		W	824	926	926	1073	1073	1239	1447	1447	1645	1831	2166	2427
<b>Hydraulic data</b>															
Water resistance	Δt=5K		mbar	12	21	26	23	29	30	28	36	38	39	39	41
	Δt=10K			3	5	7	6	7	8	7	9	10	10	10	10
Water flow	max.		m3/h	5.5	6.2	6.7	7.5	8.6	10.3	11.8	13.5	17.1	20.9	26.2	31.9
	min.			5.5	7.3	9.5	7.3	10.3	8.3	10.0	13.5	16.0	13.0	13.3	16.5
<b>Condensate</b>															
Amount of condensate	max.		L / h	14.4	16.7	17.6	21.2	22.6	29.3	34.1	36.6	44.5	54.5	72.3	83.0

Values at:

- lamda=1.2, CO2=12.7%
- T-air=20°C, rel. humidity=60%, p-baro=100kPa
- 1: Boiler at 60 / 80 °C
- 2: Boiler at 50 / 70 °C
- 3: Max. sulphur content 0.05% (500 ppm)

3zugskessel, V-01/07

OB

Technical specifications recuperator (natural gas, low NOx)

LRK				21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>															
Nominal power qN (30 / 35°C)	max.	1	kW	56	62	68	77	87	104	119	136	174	212	265	325
	min.	1		12	15	15	21	21	32	38	39	45	57	87	87
<b>Efficiencies</b>															
Overall efficiency 30 / 35 °C	100%	1	%	103.2	104.0	103.5	104.2	103.6	104.2	104.4	103.8	103.4	103.5	104.0	103.3
Overall efficiency 30 / 35 °C	30%	1	%	107.5	107.5	107.5	107.6	107.7	107.7	107.7	107.7	107.7	107.8	107.8	107.8
Efficiency DIN4702-8, 60 / 75 °C	ηN		%	107.0	107.1	107.1	107.2	107.2	107.3	107.3	107.3	107.3	107.3	107.4	107.3
<b>Exhaust gas data, losses</b>															
Additional exhaust gas pressure drop	max		mbar	1.92	0.94	1.17	1.46	1.89	1.28	0.89	1.17	1.94	1.65	1.59	1.58
Total combustion space overpressure	max		mbar	6.09	4.01	4.93	5.41	6.92	6.06	5.38	6.99	8.68	9.05	9.10	8.56
Exhaust gas temperature at 30 / 35 °C	max.	1	°C	48	46	47	46	47	46	45	46	47	47	46	48
	min.	1		32	32	32	33	33	33	33	33	32	32	33	32
Exhaust gas losses at 30 / 35 °C	max.		%	1.5	1.4	1.4	1.3	1.4	1.4	1.3	1.4	1.5	1.5	1.4	1.5
Stand-by loss qB	70 °C		W	824	926	926	1073	1073	1239	1447	1447	1645	1831	2166	2427
<b>Hydraulic data</b>															
Water resistance	Δt=5K		mbar	37	64	79	68	88	89	83	109	115	117	116	124
	Δt=10K			9	16	20	17	22	22	21	27	29	29	29	31
Water flow	max.		m3/h	9.6	10.6	11.7	13.2	14.9	17.8	20.4	23.3	29.8	36.3	45.4	55.7
	min.			5.5	7.3	9.5	7.3	10.3	8.3	10.0	13.5	16.0	13.0	13.3	16.5
<b>Condensate</b>															
Amount of condensate	max.		L / h	38.0	47.0	49.0	60.0	63.0	81.0	96.0	101.0	123.5	151.0	198.0	230.0

Values at:

- lamda=1.15, CO2=10%
- T-air=20°C, rel. humidity=60%, p-baro=100kPa
- 1: Boiler at 60 / 80 °C

3zugskessel, V-01/07

GB

4.7.3. Pyronox LRK (low-NOx version with ARF)

Technical specifications recuperator (fuel oil, low NOx) with ARF

LRK				21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>															
Nominal power qN (30 / 35°C)	max.	1	kW	31	33	37	43	47	58	68	68	95	115	144	181
	min.	1,3		12	15	15	19	19	27	33	33	40	50	68	73
<b>Efficiencies</b>															
Overall efficiency 30 / 35 °C	100%	1	%	99.5	100.1	99.8	99.6	99.8	99.9	99.5	99.5	99.7	99.7	100.0	99.0
Overall efficiency 30 / 35 °C	30%	2,3	%	103.1	102.9	103.1	102.9	103.1	103.0	102.8	103.0	103.1	103.1	103.0	103.2
<b>Exhaust gas data, losses</b>															
Additional exhaust gas pressure drop	max		mbar	1.32	0.67	0.83	1.27	1.34	0.99	0.82	0.82	1.34	1.17	1.16	1.24
Total combustion space overpressure	max		mbar	5.50	3.80	4.62	6.03	6.37	6.32	6.71	6.71	8.09	8.80	8.70	8.81
Exhaust gas temperature at 30 / 35 °C	max.	1	°C	46	45	45	46	45	45	46	46	46	46	45	47
	min.	1		34	34	34	34	34	35	35	35	34	34	35	34
Exhaust gas losses at 30 / 35 °C	max.		%	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3
Stand-by loss qB	70 °C		W	824	926	926	1073	1073	1239	1447	1447	1645	1831	2166	2427
<b>Hydraulic data</b>															
Water resistance	Δt=5K		mbar	11	19	23	22	26	27	27	27	34	35	34	39
	Δt=10K			3	5	6	6	7	7	7	7	9	9	9	10
Water flow	max.		m3/h	5.3	5.7	6.3	7.4	8.1	9.9	11.7	11.7	16.3	19.7	24.7	31.0
	min.			5.5	7.3	9.5	7.3	10.3	8.3	10.0	13.5	16.0	13.0	13.3	16.5
<b>Condensate</b>															
Amount of condensate	max.		L / h	14.0	16.0	17.0	20.0	21.0	27.0	32.0	32.0	41.0	50.0	66.0	79.0

Values at:

- lamda=1.2, CO2=12.7%
- T-air=20°C, rel. humidity=60%, p-baro=100kPa
- 1: Boiler at 60 / 80 °C
- 2: Boiler at 50 / 70 °C
- 3: Max. sulphur content 0.05% (500 ppm)

3zugskessel, V-01/07

ARF OB

Technical specifications recuperator (natural gas, low NOx) with ARF

LRK				21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>															
Nominal power qN (30 / 35°C)	max.	1	kW	51	55	61	74	78	96	117	117	156	191	240	304
	min.	1		11	14	14	19	19	27	33	33	39	49	70	72
<b>Efficiencies</b>															
Overall efficiency 30 / 35 °C	100%	1	%	104.2	104.8	104.4	104.2	104.5	104.6	104.2	104.2	104.4	104.4	104.7	103.7
Overall efficiency 30 / 35 °C	30%	1	%	107.7	107.7	107.8	107.7	107.8	107.8	107.8	107.9	107.9	108.0	108.0	108.0
<b>Exhaust gas data, losses</b>															
Additional exhaust gas pressure drop	max		mbar	1.35	0.69	0.84	1.30	1.37	1.01	0.84	0.84	1.37	1.20	1.19	1.27
Total combustion space overpressure	max		mbar	5.62	3.89	4.69	6.15	6.49	6.45	6.84	6.84	8.26	8.99	8.87	8.98
Exhaust gas temperature at 30 / 35 °C	max.	1	°C	46	44	45	46	45	45	46	46	45	45	44	47
	min.	1		32	32	32	32	32	32	33	33	32	32	32	32
Exhaust gas losses at 30 / 35 °C	max.		%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3
Stand-by loss qB	70 °C		W	824	926	926	1073	1073	1239	1447	1447	1645	1831	2166	2427
<b>Hydraulic data</b>															
Water resistance	Δt=5K		mbar	30	52	64	63	71	76	80	80	92	96	95	109
	Δt=10K			7	13	16	16	18	19	20	20	23	24	24	27
Water flow	max.		m3/h	8.7	9.4	10.5	12.7	13.4	16.5	20.1	20.1	26.7	32.7	41.1	52.1
	min.			5.5	7.3	9.5	7.3	10.3	8.3	10.0	13.5	16.0	13.0	13.3	16.5
<b>Condensate</b>															
Amount of condensate	max.		L / h	35.0	42.0	46.0	56.0	59.0	76.0	95.0	95.0	115.0	141.0	186.0	223.0

Values at:

- lamda=1.15, CO2=10%
- T-air=20°C, rel. humidity=60%, p-baro=100kPa
- 1: Boiler at 60 / 80 °C

3zugskessel, V-01/07

ARF GB

### 4.7.4. Pyronox LRK-NT

#### Technical specifications recuperator (fuel oil)

LRK-NT				21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>															
Nominal power qN (30 / 35°C)	max.	1	kW	50	46	55	53	68	67	91	116	160	172	223	269
	min.	1		16	20	20	26	26	34	43	43	51	62	86	90
<b>Efficiencies</b>															
Overall efficiency 30 / 35 °C	100%	1	%	98.0	98.2	98.1	98.2	98.1	98.2	98.2	98.1	98.0	98.1	98.1	98.0
Overall efficiency 30 / 35 °C	30%	2	%	102.8	102.5	102.6	102.4	102.6	102.3	102.5	102.7	102.8	102.7	102.7	102.9
Efficiency DIN4702-8, 60 / 75 °C	$\eta_N$		%	102.2	102.3	102.3	102.3	102.4	102.3	102.4	102.4	102.4	102.4	102.5	102.6
<b>Exhaust gas data, losses</b>															
Additional exhaust gas pressure drop	max		mbar	2.92	1.36	1.66	1.94	2.66	1.50	1.35	1.81	3.02	2.26	2.41	1.97
Total combustion space overpressure	max		mbar	9.27	5.81	7.00	7.24	9.80	7.34	8.31	11.00	13.71	12.61	13.69	10.37
Exhaust gas temperature at 30 / 35 °C	max.	1	°C	54	51	53	50	52	50	51	53	55	53	53	54
	min.	1		34	35	35	35	35	36	35	35	35	35	35	35
Exhaust gas losses at 30 / 35 °C	max.		%	1.8	1.6	1.7	1.6	1.7	1.6	1.6	1.8	1.9	1.8	1.8	1.8
Stand-by loss qB	70 °C		W	824	926	926	1073	1073	1239	1447	1447	1645	1831	2166	2427
<b>Hydraulic data</b>															
Water resistance	$\Delta t=5K$		mbar	30	37	51	33	55	38	49	80	98	78	83	86
	$\Delta t=10K$			7	9	13	8	14	9	12	20	24	20	21	21
Water flow	max.		m3/h	8.6	7.9	9.4	9.1	11.7	11.5	15.6	19.9	27.4	29.5	38.2	46.1
	min.			7.2	7.2	8.1	8.6	10.1	11.0	14.1	16.5	22.3	24.2	30.7	40.6
<b>Condensate</b>															
Amount of condensate	max.		L / h	15	17	18	22	23	28	35	38	47	56	75	80

Values at:

- lamda=1.2, CO2=12.7%
- T-air=20°C, rel. humidity=60%, p-baro=100kPa
- 1: Boiler at 60 / 80 °C
- 2: Boiler at 35 / 60 °C

3zugskessel, V-09/07

NT-OG

#### Technical specifications recuperator (natural gas)

LRK-NT				21	22	23	24	25	26	27	28	29	30	31	32
<b>Power</b>															
Nominal power qN (30 / 35°C)	max.	1	kW	64	72	78	87	99	111	143	159	198	232	306	355
	min.	1		11	14	14	18	18	29	36	36	41	52	78	79
<b>Efficiencies</b>															
Overall efficiency 30 / 35 °C	100%	1	%	100.2	102.0	101.2	102.6	101.4	102.5	102.1	100.9	99.9	100.8	100.9	100.7
Overall efficiency 30 / 35 °C	30%	2	%	107.7	107.7	107.7	107.7	107.8	107.7	107.8	107.9	107.8	107.9	107.9	107.9
Efficiency DIN4702-8, 60 / 75 °C	$\eta_N$		%	106.8	107.0	107.0	107.1	107.0	107.2	107.2	107.1	107.0	107.1	107.2	107.1
<b>Exhaust gas data, losses</b>															
Additional exhaust gas pressure drop	max		mbar	2.99	1.40	1.70	1.98	2.73	1.54	1.38	1.85	3.10	2.31	2.47	2.02
Total combustion space overpressure	max		mbar	9.47	5.94	7.16	7.39	10.02	7.50	8.50	11.23	14.04	12.87	13.97	10.59
Exhaust gas temperature at 30 / 35 °C	max.	1	°C	54	50	52	49	52	49	50	53	55	53	53	53
	min.	1		31	32	32	32	32	32	32	32	32	32	32	32
Exhaust gas losses at 30 / 35 °C	max.		%	1.8	1.6	1.7	1.6	1.7	1.6	1.6	1.7	1.9	1.8	1.8	1.8
Stand-by loss qB	70 °C		W	824	926	926	1073	1073	1239	1447	1447	1645	1831	2166	2427
<b>Hydraulic data</b>															
Water resistance	$\Delta t=5K$		mbar	49	89	105	89	115	102	121	151	149	143	156	150
	$\Delta t=10K$			12	22	26	22	29	26	30	38	37	36	39	38
Water flow	max.		m3/h	11.0	12.3	13.4	14.9	17.0	19.0	24.5	27.3	33.9	39.8	52.5	60.9
	min.			7.2	7.2	8.1	8.6	10.1	11.0	14.1	16.5	22.3	24.2	30.7	40.6
<b>Condensate</b>															
Amount of condensate	max.		L / h	40	45	48	55	62	72	92	100	122	143	190	210

Values at:

- lamda=1.15, CO2=10%
- T-air=20°C, rel. humidity=60%, p-baro=100kPa
- 1: Boiler at 60 / 80 °C
- 2: Boiler at 45 / 70 °C

3zugskessel, V-09/07

NT-GG

4.7.5. Pyronox LRK-NT (low-NOx version)

Technical specifications recuperator (fuel oil, low NOx)

LRK-NT			21	22	23	24	25	26	27	28	29	30	31	32	
<b>Power</b>															
Nominal power qN (30 / 35°C)	max.	1	kW	36	35	42	44	53	61	69	83	115	138	166	238
	min.	1,3		12	15	15	20	20	28	34	34	40	50	70	72
<b>Efficiencies</b>															
Overall efficiency 30 / 35 °C	100%	1	%	98.1	98.4	98.2	98.6	98.2	98.3	98.6	98.2	98.2	98.2	98.0	
Overall efficiency 30 / 35 °C	30%	2,3	%	102.8	102.6	102.8	102.6	102.8	102.6	102.6	102.8	102.9	102.9	103.0	
Efficiency DIN4702-8, 60 / 75 °C	ηN		%	102.4	102.5	102.5	102.5	102.5	102.5	102.5	102.6	102.6	102.7	102.5	
<b>Exhaust gas data, losses</b>															
Additional exhaust gas pressure drop	max		mbar	1.98	0.96	1.20	1.49	1.94	1.33	0.92	1.21	2.03	1.73	1.68	1.72
Total combustion space overpressure	max		mbar	6.39	4.18	5.16	5.62	7.23	6.55	5.76	7.52	9.40	9.77	9.77	9.12
Exhaust gas temperature at 30 / 35 °C	max.	1	°C	51	48	50	48	50	49	48	50	52	51	50	54
	min.	1,3		34	34	34	35	35	35	35	35	34	34	35	34
Exhaust gas losses at 30 / 35 °C	max.	1	%	1.6	1.5	1.6	1.4	1.6	1.5	1.5	1.6	1.7	1.7	1.6	1.8
Stand-by loss qB	70 °C		W	824	926	926	1073	1073	1239	1447	1447	1645	1831	2166	2427
<b>Hydraulic data</b>															
Water resistance	Δt=5K		mbar	16	21	30	23	32	31	28	41	51	50	46	67
	Δt=10K			4	5	8	6	8	8	7	10	13	13	12	17
Water flow	max.		m3/h	6.2	6.0	7.2	7.5	9.1	10.5	11.8	14.2	19.7	23.7	28.5	40.8
	min.			5.5	7.3	9.5	7.3	10.3	8.3	10.0	13.5	16.0	13.0	13.3	16.5
<b>Condensate</b>															
Amount of condensate	max.		L / h	14	16	18	21	23	27	33	35	41	50	66	75

Values at:

- lamda=1.2, CO2=12.7%
- T-air=20°C, rel. humidity=60%, p-baro=100kPa
- 1: Boiler at 60 / 80 °C
- 2: Boiler at 35 / 60 °C
- 3: Max. sulphur content 0.05% (500 ppm)

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NT-OB

Technical specifications recuperator (natural gas, low NOx)

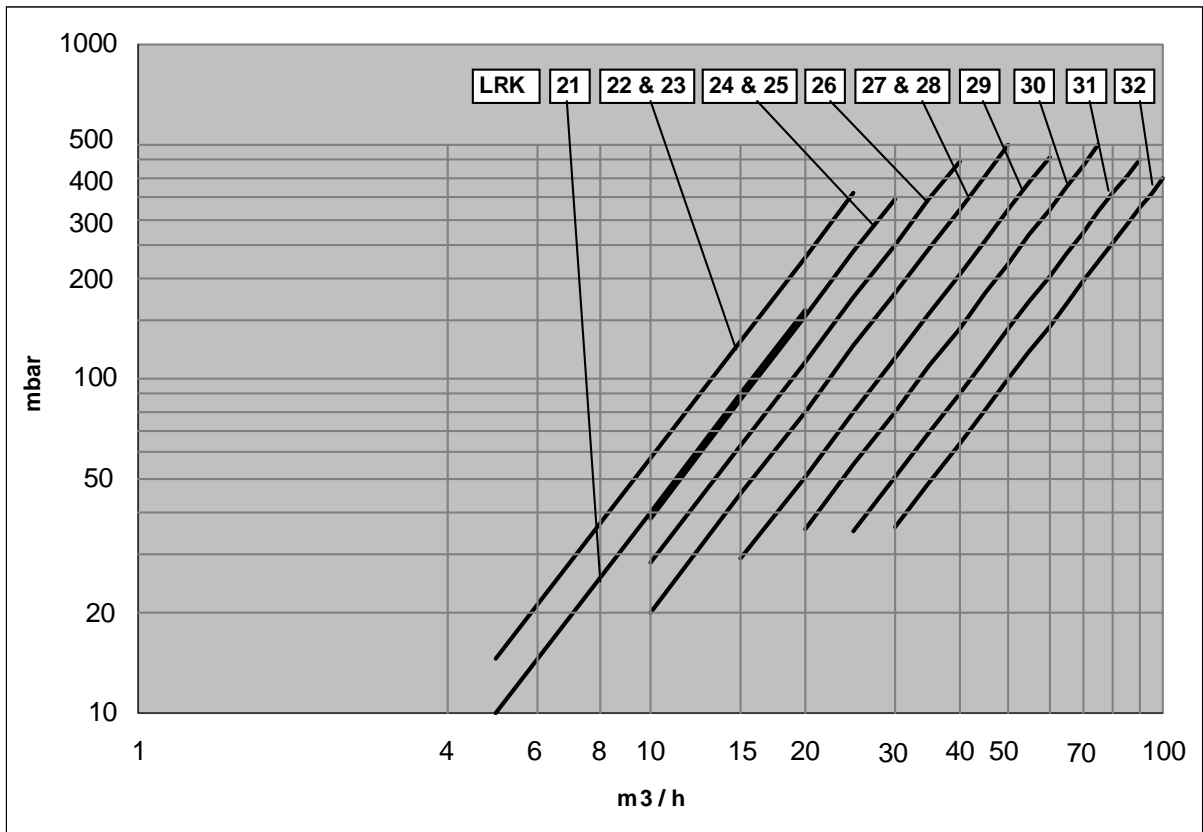
LRK-NT			21	22	23	24	25	26	27	28	29	30	31	32	
<b>Power</b>															
Nominal power qN (30 / 35°C)	max.	1	kW	56	62	68	77	87	105	121	137	173	211	267	316
	min.	1		11	14	14	18	18	29	36	36	41	52	78	79
<b>Efficiencies</b>															
Overall efficiency 30 / 35 °C	100%	1	%	101.9	103.2	102.5	103.4	102.6	102.9	103.4	102.5	101.8	101.9	102.3	100.6
Overall efficiency 30 / 35 °C	30%	2	%	107.7	107.7	107.7	107.6	107.7	107.7	107.6	107.8	107.9	107.9	107.8	107.9
Efficiency DIN4702-8, 60 / 75 °C	ηN		%	106.9	107.1	107.0	107.2	107.1	107.2	107.2	107.2	107.1	107.2	107.3	107.1
<b>Exhaust gas data, losses</b>															
Additional exhaust gas pressure drop	max		mbar	2.02	0.98	1.23	1.52	1.98	1.36	0.94	1.24	2.08	1.77	1.72	1.76
Total combustion space overpressure	max		mbar	6.51	4.26	5.26	5.73	7.38	6.69	5.87	7.69	9.60	9.98	9.98	9.31
Exhaust gas temperature at 30 / 35 °C	max.	1	°C	51	48	49	47	49	48	47	49	51	51	50	53
	min.	1		31	32	32	32	32	32	32	32	32	32	32	32
Exhaust gas losses at 30 / 35 °C	max.	1	%	1.6	1.5	1.6	1.4	1.6	1.5	1.5	1.6	1.7	1.7	1.6	1.8
Stand-by loss qB	70 °C		W	824	926	926	1073	1073	1239	1447	1447	1645	1831	2166	2427
<b>Hydraulic data</b>															
Water resistance	Δt=5K		mbar	37	66	80	70	89	92	86	111	114	117	119	119
	Δt=10K			9	17	20	18	22	23	22	28	29	29	30	30
Water flow	max.		m3/h	9.6	10.6	11.7	13.2	14.9	18.0	20.7	23.5	29.7	36.2	45.8	54.2
	min.			5.5	7.3	9.5	7.3	10.3	8.3	10.0	13.5	16.0	13.0	13.3	16.5
<b>Condensate</b>															
Amount of condensate	max.		L / h	36	41	45	54	58	70	85	92	115	135	170	200

Values at:

- lamda=1.15, CO2=10%
- T-air=20°C, rel. humidity=60%, p-baro=100kPa
- 1: Boiler at 60 / 80 °C
- 2: Boiler at 45 / 70 °C

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NT-GB

4.7.6. Water resistance of recuperators for LRK and LRK-NT



Pressure resistance in relation to water flow of the recuperators LRK et LRK-NT

#### 4.8. Correction values for different operating conditions

##### 4.8.1. Flue gas temperature correction values LR, LR-NT

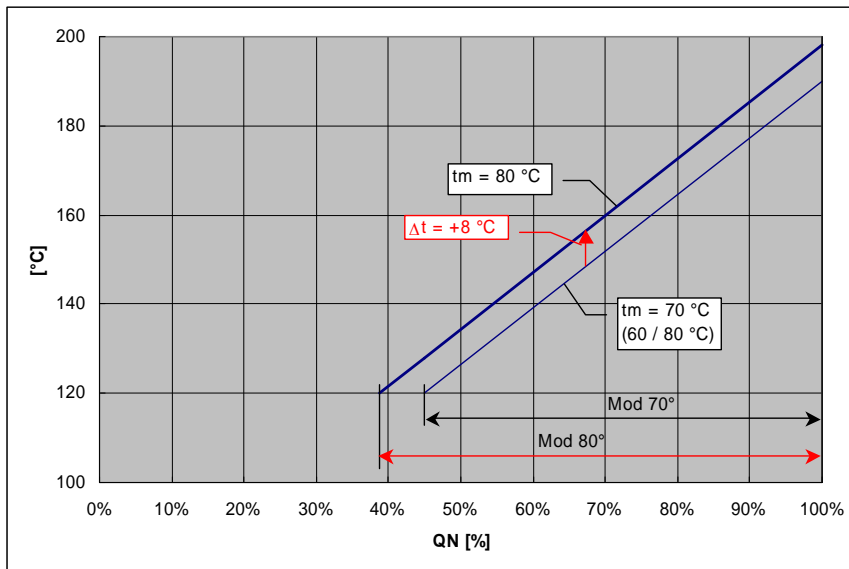
Average boiler water temperature	$t_m$ °C	50	60	70	80	90	100
Flue gas temperature difference	$\Delta t$ K	- 16	- 8	$\pm 0$	+ 8	+ 16	+ 24

Excess air	$\lambda$	1.10	1.15	1.20	1.25	1.30	1.35
Flue gas temperature difference	$\Delta t$ K	-6	-3	$\pm 0$	+3	+6	+8

##### 4.8.2. Modulation range

In chapter 4.5 modulation ranges are indicated for an average boiler water temperature of  $t_m = 70^\circ\text{C}$ .

Since the minimum power of the boiler is limited by the minimum allowable flue gas temperature, the modulation range increases when the average boiler temperature increases. This is exemplarily illustrated in the figure below (example for oil operation with a minimum flue temperature of  $120^\circ\text{C}$ ).



Flue gas temperature – Boiler power diagram, example for two average boiler water temperatures

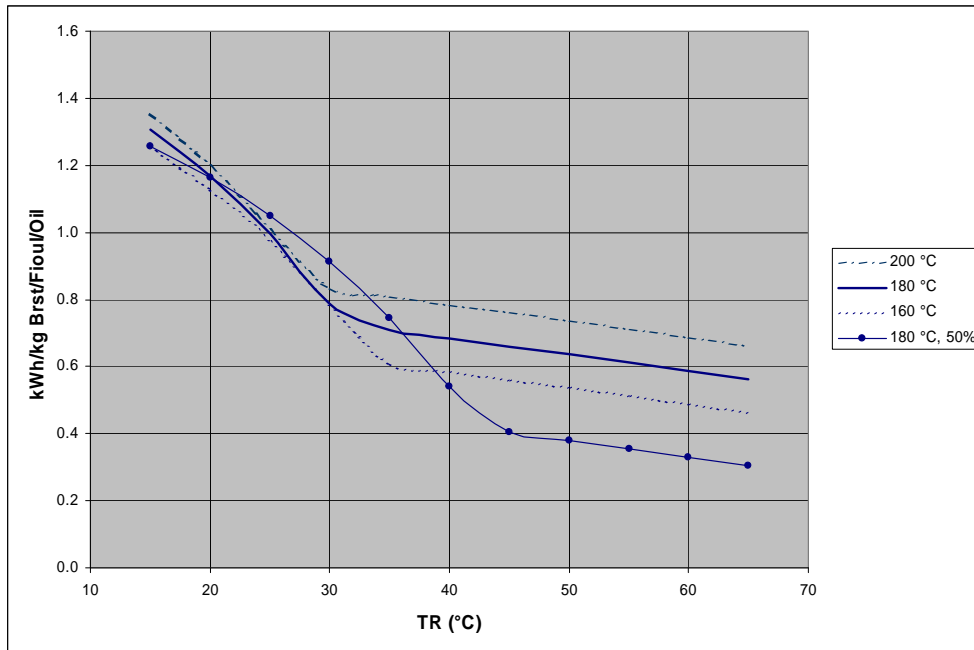
##### 4.8.3. Stand-by loss correction values

Average temperature difference *	$\Delta t_m$	°C	30	40	50	60	70
Stand-by loss correction	$\Delta q_B$	%	-40	-20	$\pm 0$	20	40

\* Average temperature difference = Average boiler water temperature minus ambient air temperature  
 Average boiler water temperature = Average of supply and return temperature

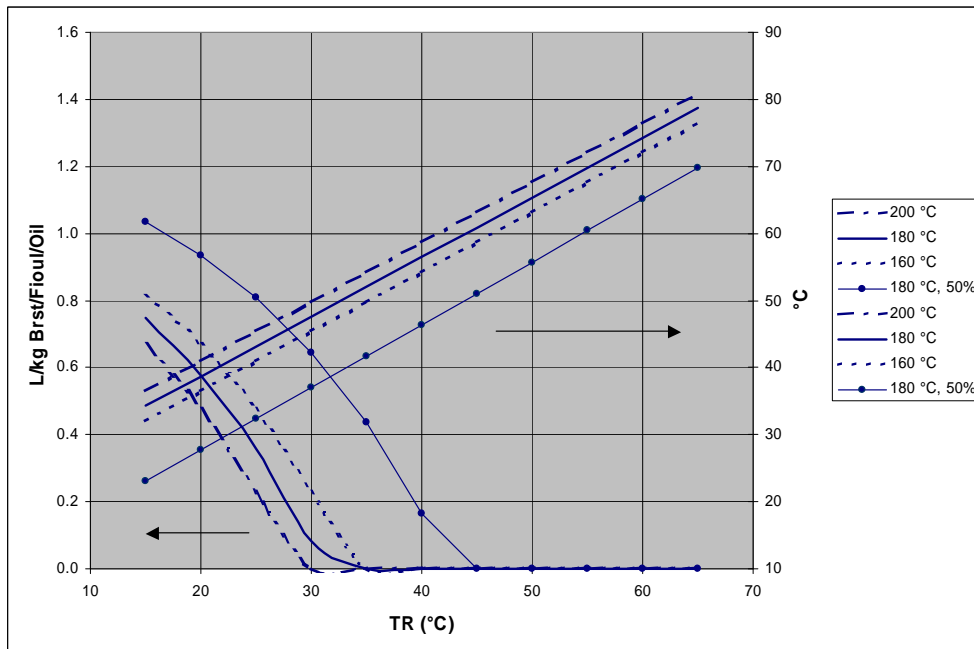
4.8.4. Recuperator data for different operating conditions

Operation on fuel oil:



Recuperator power output per kg of fuel oil for different flue gas inlet temperatures and recuperator return temperatures TR at boiler nominal loads as well as 50% load (for 180°C nominal inlet temperature)

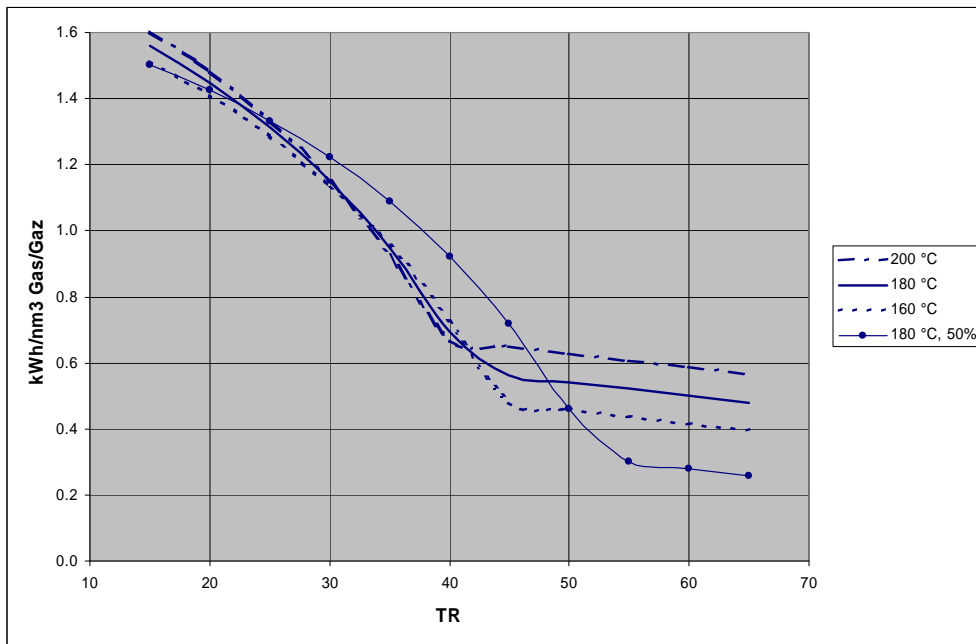
- Values at:
- CO<sub>2</sub> = 12.7%
  - Δt water = 5 K
  - Rel. humidity = 60%, p-baro = 100 kPa



Condensate amount per kg of fuel oil and flue gas temperatures for different flue gas inlet temperatures and recuperator return temperatures TR at boiler nominal loads as well as 50% load (for 180°C nominal inlet temperature)

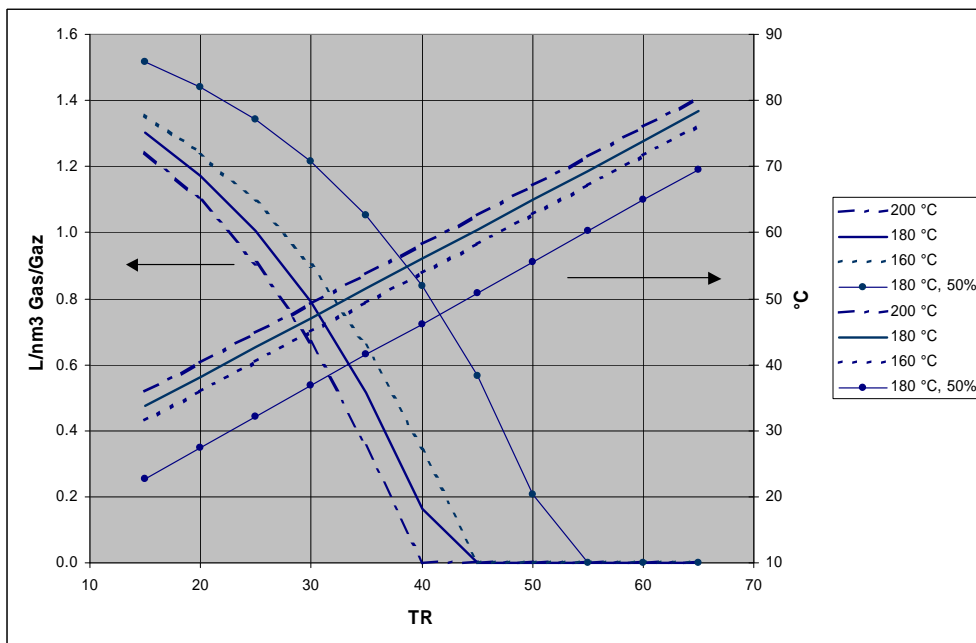
- Values at:
- CO<sub>2</sub> = 12.7%
  - Δt water = 5 K
  - Rel. humidity = 60%, p-baro = 100 kPa

Operation on natural gas:



Recuperator power output per nm3 of gas for different flue gas inlet temperatures and recuperator return temperatures TR at boiler nominal loads as well as 50% load (for 180°C nominal inlet temperature)

- Values at:
- CO<sub>2</sub> = 10%
  - Δt water = 5 K
  - Rel. humidity = 60%, p-baro = 100 kPa



Condensate amount per nm3 of gas and flue gas temperatures for different flue gas inlet temperatures and recuperator return temperatures TR at boiler nominal loads as well as 50% load (for 180°C nominal inlet temperature)

- Values at:
- CO<sub>2</sub> = 10%
  - Δt water = 5 K
  - Rel. humidity = 60%, p-baro = 100 kPa

## 5. Boiler control panel

### 5.1. Description

A wide range of system controls has been designated for Pyronox LR boilers. In the basic version, the panel allows for operation with a two-stage burner. The enlarged modular version of the control system allows users to freely choose the best accessories for their system among a range of modern digital microprocessor governors for boiler, burner, heating line and consumable water control. The panels are ready to be connected. All operating condition and failure data go through the terminals. The steel plate frame is ready for installation on the boiler lid (LR 21-26), respectively either on the left or right side of the boiler (LR27-32).

The wiring diagram including all the options as ordered is joined with the control panel.

### 5.2. Basic equipment

- Burner ON/OFF switch with indicator lamp
- Burner / boiler 6,3 amp delayed-action fuse
- Safety temperature limiting device
- Two-stage thermostat burner stage 1 and 2
- TÜV overheat test switch
- LED for boiler overheat
- LED for burner failure
- LED for external failure
- Thermometer

### 5.3. Optional features

- Counter hours 1st and 2d stage
- Counter impulses 1st and 2d stage
- Relays for external indication of boiler overheat, burner failure, burner stage 1 and 2, external failure
- Module burner reset
- Module summer/winter mode
- Connections for three-phase current burners and pumps

### 5.4. Governor types

#### RDO 243 governor

Heating governor providing burner regulation for single- or two-stage burners or modulating burners for 1 mixing circuit and 1 automatic water loading device.

#### RDO 353 governor

Heating and master cascade governor providing regulation for single-, two-stage or modulating burners, for 1 mixing circuit, 1 automatic water loading device and DHW circulation pump. 6 other mixing circuits can be added for use by means of additional modules RZM 510, three other automatic water loading devices by means of additional modules RZM 515 and the cascade control with three other boilers by means of additional modules RZM 530.

#### RDO 383 governor

Heating and master cascade governor providing regulation for single-, two-stage or modulating burners, for 2 mixing circuits, 1 automatic water loading device and DHW circulation pump. 6 other mixing circuits can be added for use by means of additional modules RZM 510, three other automatic water loading devices by means of additional modules RZM 515 and the cascade control with three other boilers by means of additional modules RZM 530.

### 5.5. Cable sets

Depending on the order, burner cables with 7 and 4-position normed connectors (DIN4791) and a connection cable for acknowledging faults of the burner are supplied with the panel.

## 6. Installation guide

### 6.1. Boiler room and boiler room ventilation

The boiler room must be arranged in compliance with local regulations and installation specifications. Particular attention should be paid to the ventilation of the boiler room.

Supply of combustion air must be guaranteed (non-shut opening).

Minimum air requirement is  $1.6 \text{ m}^3/\text{h}$  for each kW of boiler power.

Minimum free section of combustion air opening is  $6 \text{ cm}^2$  for each kW of boiler power.

Important: The combustion air must not have high dust concentrations.

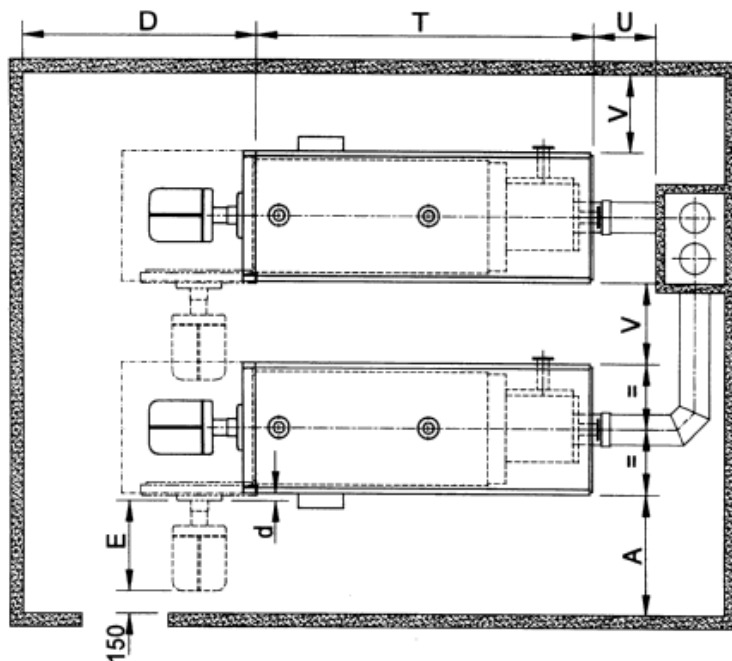
Furthermore, it must be free of halogens (chlorine and fluorine compounds). An excessive presence of halogen in the combustion air leads to great corrosion damage. The maximum permitted amount of halogen in the combustion air is 5 ppm.

Halogen compounds are found in spray cans, thinners, cleaning agents, degreasing agents and solvents, among others. In addition, halogen emissions are strongly suspected in the vicinity of dry cleaners', hair dressing salons, swimming pools, printing offices and washing machines installed in the same room.

In the case of doubt, the perfect quality of the combustion air must be ensured with an external air intake. Make sure that there is a minimum loss of pressure, since this could impair the performance of the burner.

### 6.2. Planning dimensions

#### 6.2.1. Space required



It must be possible to open the furnace door, including burner, by  $90^\circ$  (door opening can be either to the left or to the right; right opening can be changed to left opening at the time of installing the boiler).

$E$  = Burner length

$A = E + d + 150 \text{ mm}$

When a sound proofing hood is used, dimension  $D$  must be checked against the dimensions of the hood (see chap. 4.4).

#### 6.2.2. Boiler base

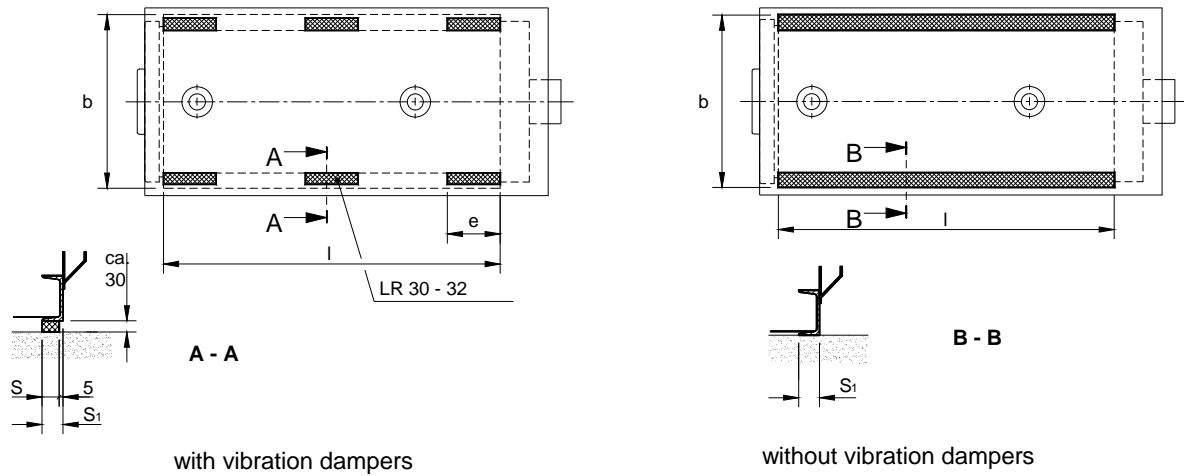
If the floor of the boiler room is moist or loose, a sufficiently high boiler base must be provided. Moisture does not go well with electrical equipment!

A base is also a good idea if the height is not sufficient for installing the burner.

Otherwise, no base is needed for the Pyronox LR series; the Pyronox LRK series requires a base that is at least 100 mm high.

**6.2.3. Boiler support**

It is possible to mount the boiler on vibration dampers (available as option) to reduce noise transmission caused by vibrations.



Pyronox LR, LR-NT			21	22	23	24	25	26	27	28	29	30	31	32
Distance wall - boiler body front	D mm	1600	1700	1700	1900	1900	2000	2300	2300	2700	2800	3100	3300	
Boiler length	T mm	1880	1995	1995	2215	2215	2320	2714	2714	3074	3284	3566	3851	
Distance wall - boiler back	U mm	1000	1000	1000	1000	1000	1000	1000	1000	1000	1150	1150	1150	
Distance wall - boiler flank *	V mm	600	600	600	600	600	600	600	600	600	1000	1000	1000	
Boiler feet length	l mm	1580	1695	1695	1880	1880	1975	2314	2314	2674	2854	3096	3356	
Boiler feet width	b mm	1000	1060	1060	1130	1130	1210	1300	1300	1375	1445	1570	1645	
Measure	d mm	5	0	0	5	5	0	0	0	30	30	30	30	
Silent block length	e mm	274	346	346	346	346	418	562	562	562	562	562	706	
Silent block width	S mm	45	45	45	50	50	50	50	50	50	50	50	50	
Number of silent blocks		4	4	4	4	4	4	4	4	4	6	6	6	
U-girder width	S1 mm	50	50	50	55	55	55	55	55	55	55	55	55	

Pyronox LRK, LRK-NT			21	22	23	24	25	26	27	28	29	30	31	32
Distance wall - boiler body front	D mm	1600	1700	1700	1900	1900	2000	2300	2300	2700	2800	3100	3300	
Boiler length	T mm	2380	2495	2495	2755	2755	2925	3419	3419	3934	4214	4456	4716	
Distance wall - boiler back	U mm	1000	1000	1000	1000	1000	1000	1000	1000	1000	1150	1150	1150	
Distance wall - boiler flank *	V mm	600	600	600	600	600	600	600	600	600	1000	1000	1000	
Boiler feet length	l mm	1580	1695	1695	1880	1880	1975	2314	2314	2674	2854	3096	3356	
Boiler feet width	b mm	1000	1060	1060	1 130	1 130	1210	1300	1300	1375	1445	1570	1645	
Measure	d mm	5	0	0	5	5	0	0	0	30	30	30	30	
Silent block length	e mm	274	346	346	346	346	418	562	562	562	562	562	706	
Silent block width	S mm	45	45	45	50	50	50	50	50	50	50	50	50	
Number of silent blocks		4	4	4	4	4	4	4	4	4	6	6	6	
U-girder width	S1 mm	50	50	50	55	55	55	55	55	55	55	55	55	

\* The dimension can be reduced to 200 mm, as long as this does not impair the operation of the control panel and the ability to open a nearby furnace door.

The mounting instructions for the silent blocks can be found in the separate assembly guide.

Afterwards, you can start installing the connection tubes on the water and flue gas side.

**Attention!** Once the boiler is filled up, it will come down by further 3-5 mm.

## 6.3. Hydraulic connection

### 6.3.1. General notice

For the hydraulic connection of the heating system and water heaters– in particular with regards to technical safety devices such as safety valves, expansion tanks, etc. – refer to generally accepted engineering rules as well as locally applicable standards, specifications and regulations.

If boilers are installed in **garret-based heating plants** or at the highest point of the heating system, then boilers will have to be provided with additional safety devices (such as protections against water shortage). Observe the minimum operating pressure as specified in chapter 4.2. Act in compliance with local safety regulations in force at all times.

Before connecting the boiler to an **old installation**, it is necessary to flush the whole heating system. It is also recommended to provide for a sludge separator.

To protect the boiler from return temperatures below the limits as specified in chapter 4.1, the boiler should be provided with an **automatic return temperature regulation**.

If the Pyronox LR/LRK boilers are combined with a **water heater**, make sure that their size and capacity correspond to the installed boiler capacity.

A component-tested membrane safety valve must be used to reliably prevent the permitted operating overpressure in the water heater from being exceeded; it must not be possible to shut the valve off from the water heater.

When water heaters with an electrical auxiliary heater are used, a reliable check valve must be installed in the charging tube between the boiler and the water heater.

Boiler's maximum operating pressure and the maximum operating temperature are indicated in chapter 4.1.

No minimum level of the amount of circulating water is required.

Damage can occur from **corrosion** when oxygen continuously enters the heating water through open installations, expansion tanks that are too small, floor heaters with pipe material that is not oxygen-tight, etc.

If this cannot be prevented, additional measures are necessary in the form of correctly used oxygen binding agents or chemicals. If it is not possible to realize an installation without oxygen entrance, a **system separation** must be set up using heat exchangers.

### 6.3.2. Special notes for Pyronox LRK, LRK-NT:

#### 6.3.2.1. Water flow rate

It is recommended to select the water flow rate of the recuperator as high as possible (see chapter 4.7).

##### **Important:**

The boiler may not be put into operation before the recuperator has been connected and is flushed with water. Furthermore, if no condensation is desired, such as in the case of oil operation, the customer must ensure that the inlet water in the recuperator is kept at an adequate temperature (min. 50°C) at all times.

#### 6.3.2.2. Draining the condensate

The condensates that result during condensation contain combustion products that are more or less acidic, depending on the fuel type. Any necessary approval for draining the condensate into the sewer system must be obtained from local authorities.

A condensate neutralisation set is available as an option, if desired.

If the condensate is drained directly into the sewer system, then this must take place via an open funnel/hopper. The line to the funnel/hopper must have a slight gradient and should not show any slack.

##### **Important:**

The recuperator is delivered with a siphon arranged in the casing. It must be ensured that no additional siphon is installed since this would prevent the condensate from draining away.

## 6.4. Electrical installation

### 6.4.1. General notice

The electrical installation must be carried out by an authorised electrician from beginning to end. In carrying out the electrical installation, local regulations as well as any standards and specifications in force must be complied with.

The wiring diagram is joined with the control panel.

Note: Electrical connections, especially the connection to the mains, should only be made after all other assembly and installation work has been completed.

Locally made installations (raceways, etc.) must not be clamped to the boiler's panel work!

### 6.4.2. Connecting to the supply mains

External supply is one-phase, alternate current type 230VAC, 50Hz or three-phase alternate current 400VAC, 50Hz, both max. 16A. The apparatus is internally protected by a 6,3A delayed-action fuse (burner/boiler) and by an additional 6,3A delayed-action fuse for each additional governor or module.

The quality of the supply must respect norm EN50160 (voltage  $\pm 10\%$  max, frequency  $\pm 1\%$ ).

All external connection cables to the boiler must be suitably laid on site.

A DIN VDE 0116-compliant disconnecting device must be provided on site.

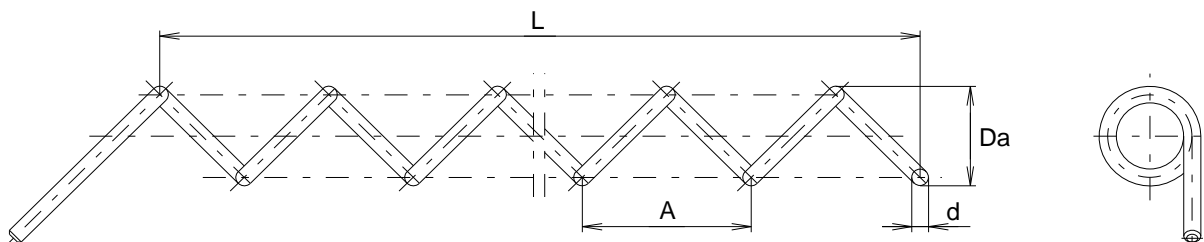
### 6.4.3. Connecting the burner

The electrical connections of the burner (power supply and control) are made by the customer in accordance with the requirements of the burner.

## 6.5. Turbulators

Thanks to the turbulators, which are to be inserted in the smoke tubes, the combustion gas temperature can be controlled.

All smoke tubes in the third pass must equally be provided with turbulators. These smoke tubes are those that are open on the rear part, in the direction of the combustion gas collector. Also, read and follow the instructions in the assembly guide.



Pyronox LR/LRK		21	22	23	24	25	26	27	28	29	30	31	32	
Number of turbulators (without ARF)		24	30	30	33	33	31	36	36	41	48	43	48	
Number of turbulators (with ARF)		21	27	27	30	30	28	32	32	37	43	40	44	
Outer diameter	Da	36					44					60	72	
Edge diameter	d	6					6					8	10	
Pitch	A	55					55					70	80	
Length	L	800					1600	1200					2200	3000

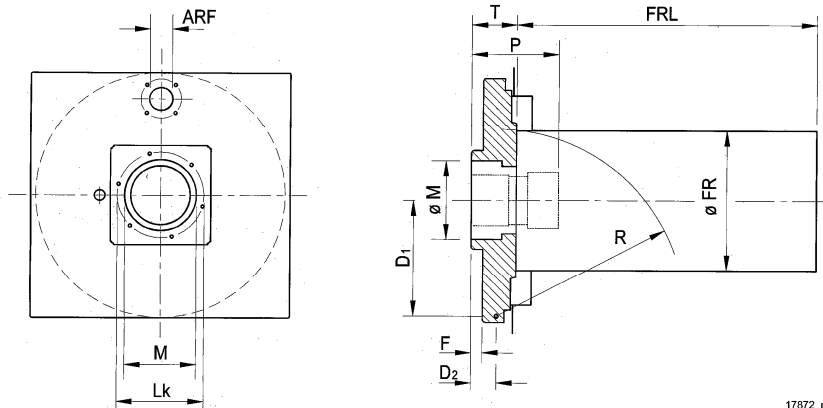
### 6.6. Boiler control panel and casing assembly

Please refer to the separate assembly guide enclosed with the supply.

The boiler casing should only be assembled after the boiler has been hydraulically connected otherwise, there is a risk of damage of the casing. However, the casing must be mounted prior to connecting the unit to the flue!

### 6.7. Connecting the burner and ARF-blower

#### 6.7.1. Burner mating dimensions / orientation possibilities



17872\_m-a

Model		21	22-23	24-25	26	27-28	29	30	31	32
<b>Furnace</b>										
Lenght	FRL mm	1517	1623	1794	1889	2225	2559	2745	2985	3265
Diameter	FR mm	516	549	614	640	675	712	750	811	870
<b>Burner connection</b>										
Burner admittance diameter	M mm	230		300		330	380			
Burner tube lenght min max (qN max) max (qN low NOx)	P mm	195					265		280	
		330					365			
		400					490		540	
Screw hole centre diameter	Lk mm	330		400			450			
		4xM12, 15° vers.		6xM12, 15° vers.			6xM16, 15° vers.			
Maximum door load from burner weight **	kg x m	140	160	180	200	220	250	280	320	360
<b>Exhaust gas fan connection (ARF)</b>										
Bore diameter (ARF)	mm	80			100	120	140	160		
Screw hole diameter	mm	210								
		4xM16, 45° vers.								
<b>Burner orientation</b>										
Max. swivel radius	R mm	720	760	835	880	940	1000	1050	1145	1210
Distance boiler axle - pivot	D <sub>1</sub> mm	460	485	527	560	600	640	675	737	772
Distance door flange - pivot	D <sub>2</sub> mm	103	103	104	104	97	139	139	139	139
Door thickness	T mm	167	167	168	168	168	234	234	234	234
Door flange thickness	F mm	35					60			

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\* Burner tube lengths without consideration of an eventual intermediate flange

\*\* Load as burner weight x distance burner centre of gravity - door. When necessary use a burner support.

### 6.7.2. Burner assembly

The front door is provided with a norm-conform flange for fitting the burner. An additional, intermediate flange may be necessary to fit the burner. The intermediate flange and relative screws must be supplied by the burner manufacturer.

Attention: The intermediate space between the burner tube and door hole must be filled with the supplied insulating material before the burner is commissioned (see separate assembly guide).

### 6.7.3. Connection to the fuel supply

The whole installation may only be carried out by a licensed installation company. The installation must be performed in accordance with local regulations. Particular care is to be taken that measures are foreseen to prevent any burner start when the boiler door is open. Good practice is to connect the fuel supply to the burner in such a way that the supply line has to be disconnected in order to be able to open the boiler door. Another possibility is to attach the burner cables with glands in such a way that the connectors on the burner have to be pulled to open the door.

Customer installations (oil tubes, etc.) must not be attached to the boiler casing!

#### 6.7.3.1. Gas burner

Observe the separate instructions of the burner.

The gas installation must be dimensioned in accordance with the gas flow rate and the available gas pressure.

A shut-off valve must be installed in the gas supply line to the burner.

**Important:** Before the gas burner is connected to the gas line, it must be ensured that the line has been blown through and is free from particles and chips.

The gas line must be checked for leakage during commissioning and after each disconnection (leak detector spray).

The installation may only be operated using gas of the intended quality – observe burner type plate!

#### 6.7.3.2. Oil burner

Observe the separate instructions of the burner.

### 6.7.4. Part load operation

Stick to the minimum power of the supply heat according the technical data, chapter 4.

## **6.8. Flue gas system**

The pertinent rules of technology and good practice as well as the country-specific regulations and valid standards must be observed.

The Pyronox LR boilers have been developed using the latest technologies. The perfect balance existing between boiler and chimney ensures optimal fuel use and economical system operation as a result.

### **6.8.1. Section determination**

Sections must be calculated for boilers without draught.

Fuel type, power output, combustion gas temperature and quantity, chimney construction and height are all important elements in determining sizes.

### **6.8.2. Flue gas tubes Pyronox LR, LR-NT**

We recommend the use of flue gas tubes made from acid-resistant, non-corrosive materials. The tube must be laid and introduced in the chimney to an inclination of 30-45° to minimize pressure loss. The tube will have to be inserted in such a way as to prevent any condensation reversal from the chimney down into the boiler. To avoid vibration transmission, combustion gas tubes must be fitted with adequate sleeve tubes or clamps. Connections exceeding 1 m in length should be insulated.

At the same time, ensure that the measuring pipes extend beyond the insulation and that flanges and cleaning covers remain accessible.

The chimney must be designed so that it is gas and pressure-tight as well as moisture-insensitive and acid-resistant.

### **6.8.3. Flue gas tubes Pyronox LRK, LRK-NT**

Depending on the return temperature, the flue gases are cooled below the dew point in the recuperator and leave the boiler with 100% moisture. As a result of the flue gas cooling in the flue gas tube, more condensate is eliminated. The flue gas unit must therefore be absolutely acid-resistant and condensate-tight, in addition to being gas and pressure-tight.

The tube must be laid and introduced in the chimney to an inclination of 30-45° to minimize pressure loss. To avoid vibration transmission, combustion gas tubes must be fitted with adequate sleeve tubes or clamps. Connections exceeding 1 m in length should be insulated. At the same time, ensure that the measuring pipes extend beyond the insulation and that flanges and cleaning covers remain accessible.

## **7. Operating conditions**

### **7.1. Fuels**

The Pyronox LR boiler is designed for operation with fuel oil EL and natural gas.

Attention: The use of other fuels such as for example biogas is only permitted with the express approval of the manufacturer.

### **7.2. Combustion air**

The combustion air must not have high dust concentrations.

Important: Furthermore, it must be free of halogens (chlorine and fluorine compounds). An excessive presence of halogen in the combustion air leads to great corrosion damage. Make sure that no paints, thinners, cleaning agents, degreasing agents, solvents, chlorine containers, etc. are stored in the boiler room!

### **7.3. Filling the installation and water quality**

The installation must be thoroughly rinsed before it is finally filled.

When filling for the first time and refilling, check the quality of the water in accordance with the values recommended in chapter 4.3. Poor water quality leads to damage in heating installations from calcification and corrosion. On the other hand, the service life, functional reliability and efficiency can be increased using appropriately treated water.

During the filling process, the circulation pumps should be switched off and all ventilating valves opened, so that the air in the system can completely escape. The filling process is finished when the operating pressure has been reached.

### **7.4. Protection against corrosion**

Normally, no corrosion problems arise if systems are properly designed and installed and are run according to these instructions; consequently there is no need to use chemical additives. However, if water is of poor quality or if oxygen seeps from the air into the heating system (expansion chambers open, expansion/supply chambers too small, plastic tubes without diffusion blocking in floor heating) damages are something which cannot be completely excluded. If you happen to use chemical additives in your system, make sure that they are effective, harmless and above all appropriate for the materials your system is made of. Enquire with your chemical additive supplier.

In this case, you will need to arrange for a specialist water company to carry out annual quality checks on the water used in the heating system in order to avoid any damage to the system.

### **7.5. Requirements for operation**

The maximum operating pressure and the maximum temperature to be observed are listed on the type plate. The minimum temperatures to be observed are given in chapter 4.1.

It is strictly recommended to maintain the boiler in operation during several hours after a cold start-up in order to evaporate condensates that are inevitably formed in any boiler during cold start-up.

## 8. Operation

Read this section of the manual with great care and get an installer to explain the heat producing system in all its different aspects: regulation and control.

If you suspect that the boiler or other part of the system is frozen, do not start the system.

Please also note the operating conditions described in chapter 7.

### 8.1. Commission

Before commissioning the system, please check:

- Whether the burner and the fuel system have been checked and the settings of the burner correspond to the required performance of the unit. Observe the instructions for putting the burner into operation.
- Whether any foreign matter has been removed from the boiler furnace
- Whether the turbulators have been properly installed (see sticker on boiler door)
- Whether the clearance space around the burner tube has been filled with insulation material
- Whether the boiler door is closed properly
- Whether the heating system has been filled up with water and completely vented
- Whether the thermostats are properly regulated and whether the heating system governor has been set according to the necessary parameters by the support service or by the installer
- Whether the regulation and safety devices work properly
- Whether all shut-off valves (of both water and burner) have been opened
- Whether the circulation pumps work
- Whether the air supply is ensured and the flue outlet is free.

The unit is put in operation by actuating the ON/OFF switch on the control panel (position I).

### 8.2. Decommission

The unit is put out of operation by actuating the ON/OFF switch on the control panel (position O).

Should the heat producing system remain off for several weeks, we recommend that the following measures be taken:

- Close the fuel supply,
- Clean and protect the heating surface of the boiler. Your installation contractor will be pleased to give you some advice.
- In case of frost warnings, drain the system or add an anti-freeze product and follow the instructions given at 7.4.

### 8.3. First steps to take in case of failure

In the event of system operational failure, perform the checks in the table below. Also check the governor set-up. If the failure cannot be eliminated, call a reliable engineer or your support service.

<b>Problem</b>	<b>Possible cause</b>	<b>Solution</b>
Burner not functioning	No power	Check fuse, switch on main or safety switch. Connect supply and burner plug
	Burner LED is on	Press burner reset button
	No oil	Add oil
	Gas pressure insufficient	Call the gas board
	Overheat temperature LED is on. Safety thermostat has come into operation	Fix the cause, wait until temperature has dropped below overheat setpoint then reset the safety thermostat by pushing the pin
	External default LED is on.	Fix the cause
Heating elements fail to heat up	Incorrect operation type setting on governor	Set up type of operation and heating programme
	Circulation pump blocked	Remove locking screw, turn shaft until no more resistance is left
	Water level or system pressure	Top up and ventilate
	Shut-off elements on supply and return lines closed	Open them

## 9. Maintenance

To maintain the high degree of efficiency of the unit, it is necessary to service it regularly. Depending on the type of operation, annual or semi-annual servicing is recommended.

The boiler and firing must be inspected by a qualified specialist in accordance with the official regulations.

Before performing any work on the unit, it must be disconnected from the mains and the fuel supply must be shut off.

The device contains components made of synthetic silicon mineral fibres (ceramic and glass fibres, insulation wool). In order to avoid all types of health hazards, suitable clothing and a protective mask must be worn for work on or with these components.

### 9.1. Periodical checks and maintenance operations

- Check manometer with circulation pump off. Low water or pressure level indicates that the system must be filled up with water.
- Check that the expansion chambers function properly
- Check safety valves as well as heating and hot water system blowers
- Carry out burner maintenance according to the recommendations given in the burner manual.
- Check fuel oil level
- Clean boiler and chimney

### 9.2. Boiler cleaning

Boiler should be cleaned by your chimney sweeper and engineer.

The cylindrical type construction of Pyronox LR boilers makes cleaning much easier to perform. However, we recommend that heating surfaces in fuel oil boilers be cleaned with appropriate chemical products. Your installation contractor, as an engineer, will know how to best advise you.

- Turn off burner
- Disconnect burner plug from socket
- Loosen boiler door screws and rotate door together with burner till it stops.
- Remove the turbulators
- Clean the combustion chamber and smoke tubes
- Disassemble the lid on the back of the boiler and clean the flue gas collector
- Re-install the cleaned turbulators following the instructions given in chapter 6.5 of these instructions.
- Re-install lid and close furnace door
- Start up burner again.

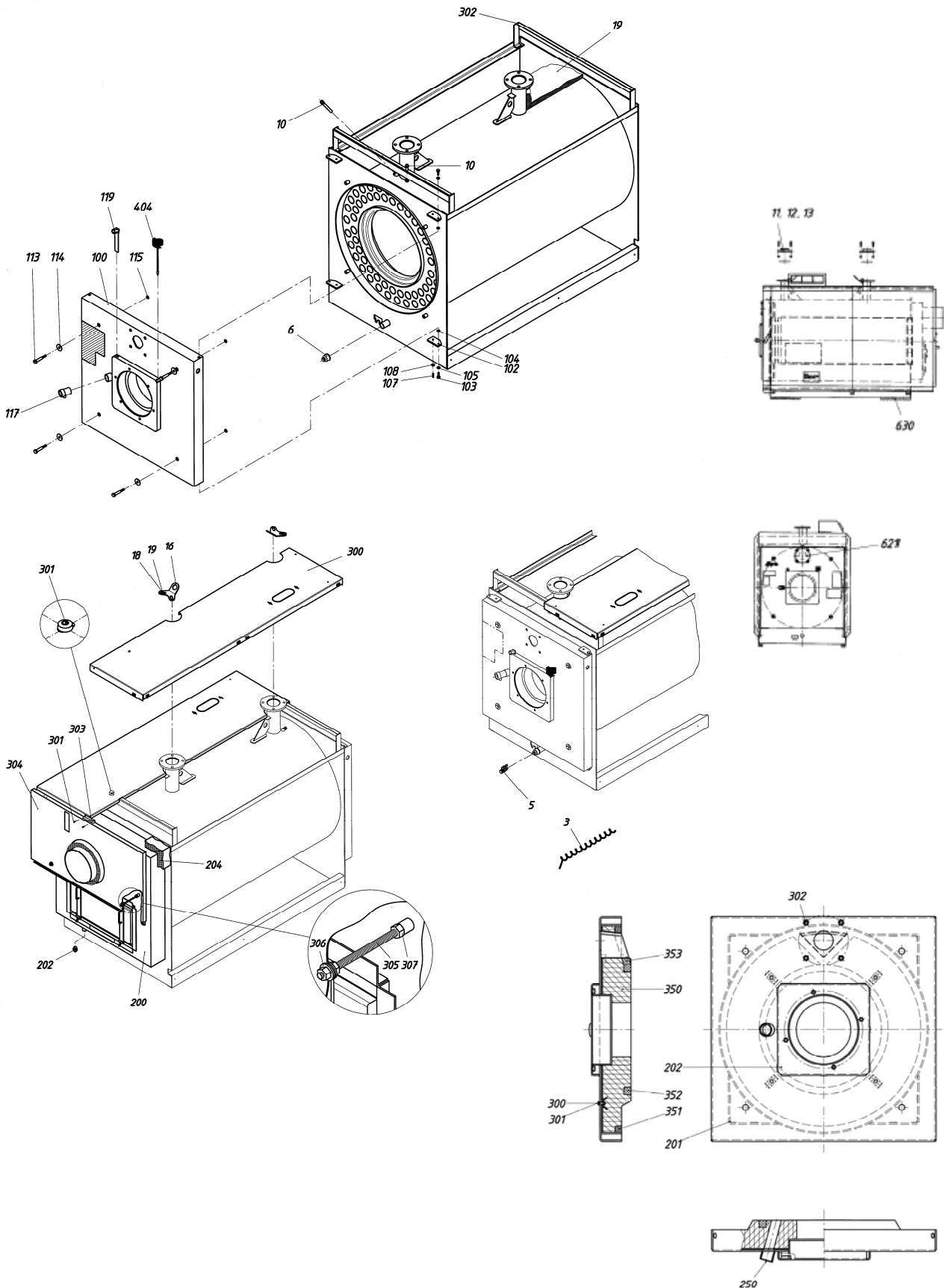
### 9.3. Burner maintenance

The regular maintenance of the burner (body, jet, burner head, igniter, pump filters) must be carried out by a qualified specialist in accordance with the instructions of the burner.

After the work has been completed, the settings of the burner must be checked to ensure that they meet the performance requirements of the boiler.

## 10. Spare parts

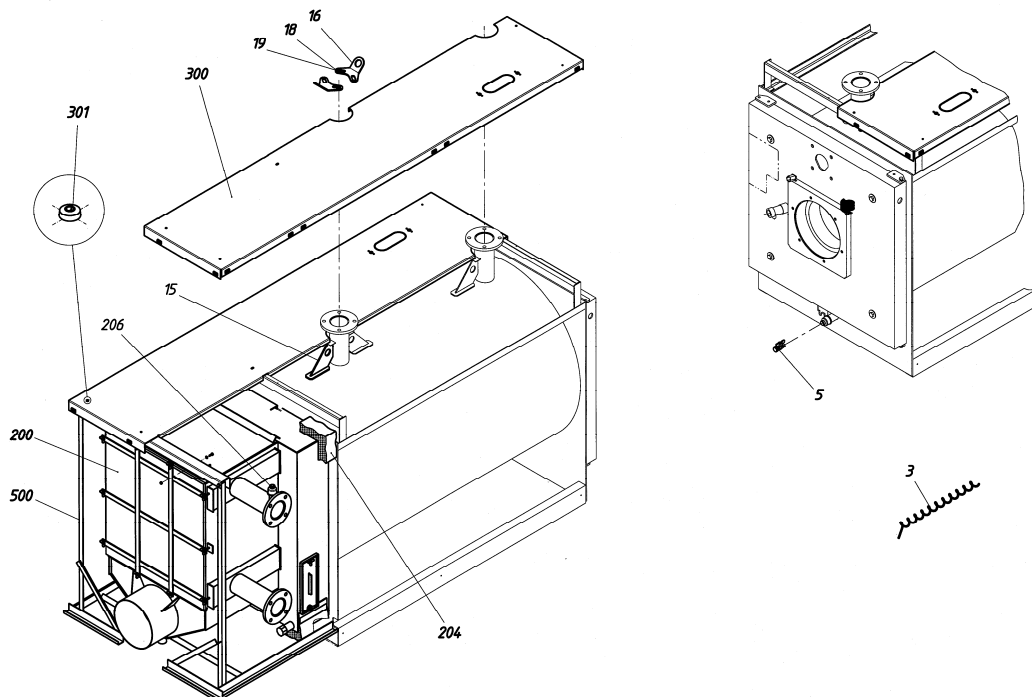
### 10.1. Pyronox LR 21-26



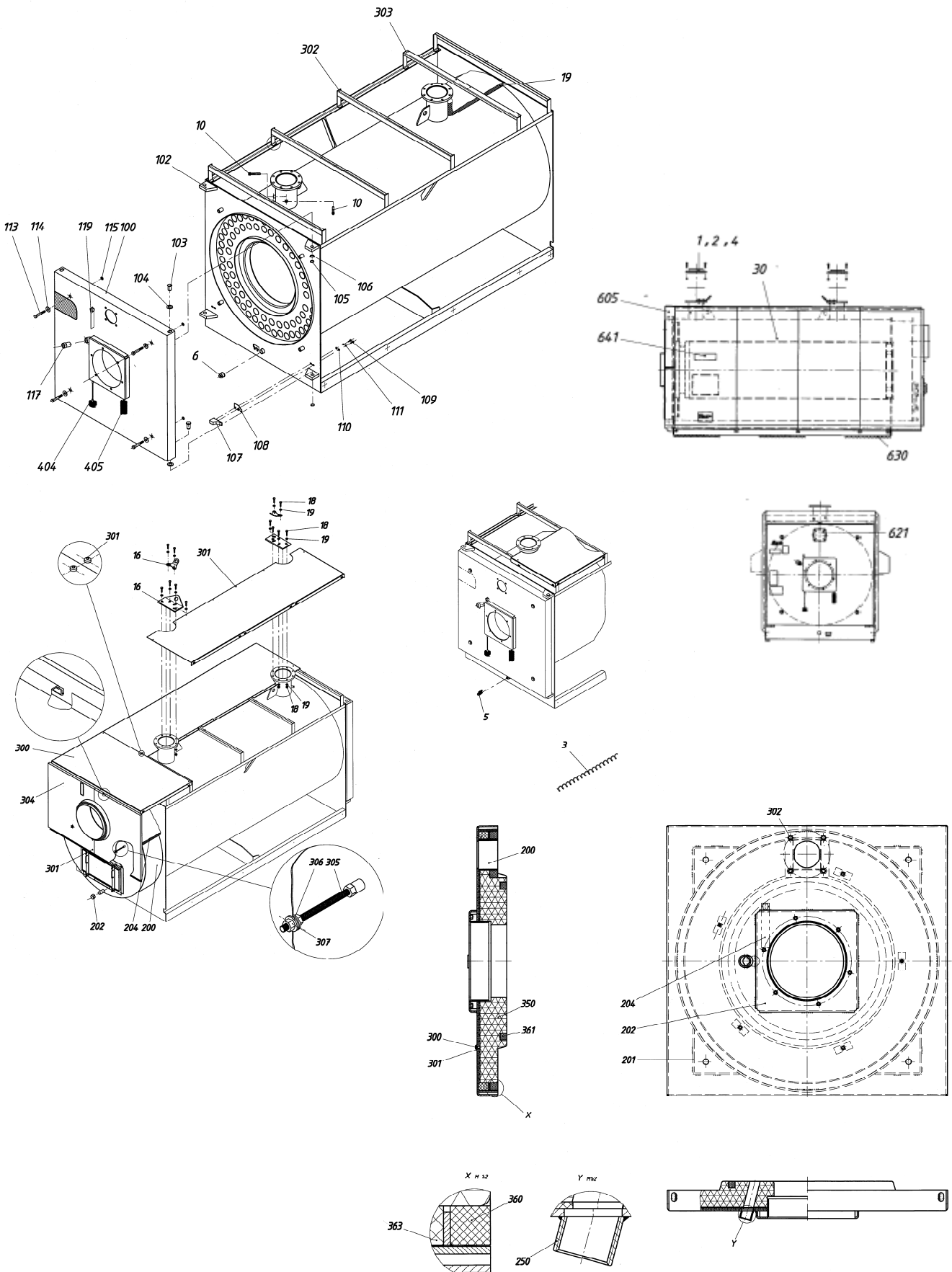
Pyronox LR, LR-NT		21	22	23	24	25	26
Designation	Pos.	N° Art.					
Vibration absorber	630	166003	166007	166007	166008	166008	166009
ARF blind cover	621	166030	166030	166030	166030	166030	166030
Gasket PN6 DN100	12	113081	113081	113081	113081	113081	113081
Hexagon screw	307	112143	112143	112143	112143	112143	112143
Rear wall	304	163955	163956	163956	163957	163957	163958
Connecting strap	303	160185	160185	160185	160185	160185	160185
Saglan mat	204	113221	113221	113221	113221	113221	113221
Stopper	202	111184	111184	111184	111184	111184	111184
Suspension strap	16	160116	160116	160116	160116	160116	160116
Drain cock	5	140058	140058	140058	140058	140058	140058
Turbulators	3	120284	120284	120284	120284	120284	120285
Smoke tube brush	404	120236	120236	120236	120236	120236	120237
Key	119	160235	160235	160235	160235	160235	160235
Sight glass	117	171523	171523	171523	171523	171523	171523
Door bolt	103	120306	120306	120306	120306	120306	120306
Door support	102	160114	160114	160114	160114	160114	160114
Saglan mat	18	113221	113221	113221	113221	113221	113221
Immersion sleeve	10	152385	152385	152385	152385	152385	152385
Reduction socket	6	111101	111101	111101	111101	111101	111101
ARF gasket	353	113156	113156	113156	113156	113156	113156
Gasket, inside	352	113156	113156	113156	113156	113156	113156
Gasket, outside	351	113158	113158	113158	113157	113157	113157
Door insert	350	128070	128071	128071	128072	128072	128073
Socket for sight glass	250	122346	122346	122346	122346	122346	122346
Burner fastening	202	400659	400659	400659	400439	400439	400439

## 10.2. Pyronox LRK 21-26

Spare parts for recuperator on request.



10.3. Pyronox LR 27-32



Pyronox LR, LR-NT		27	28	29	30	31	32
Designation	Pos.	N° Art.					
Panel cover	641	155102	155102	155102	155102	155102	155102
Vibration absorber	630	166017	166017	166017	166018	166018	166019
ARF blind cover	621	160030	160030	166030	166030	166030	166030
Front cover	605	162794	162794	162795	162796	162797	162798
Gasket	4	113082	113082	113082	113083	113083	113085
Rear wall	304	163959	163959	163960	163961	163962	163963
Tapping screw	301	112264	112264	112264	112264	112264	112264
Boiler lid	300	163934	163934	163935	163936	163937	163938
Saglan mat	204	113221	113221	113221	113221	113221	113221
Cap, angular	202	111217	111217	111217	111217	111217	111217
Suspension strap	16	160117	160117	160117	160142	160142	160142
Drain cock	5	140058	140058	140058	140058	140058	140058
Turbulators	3	122520	122520	122520	122520	122521	122522
Smoke tube brush	404	120237	120237	120238	120238	120238	120239
Key	119	160235	160235	160234	160234	160234	160234
Sight glass	117	171523	171523	171523	171523	171523	171523
Flat spring	108	122503	122503	122504	122504	122504	122504
Stop	107	122501	122501	122502	122502	122502	122502
Support washer	106	112369	112369	402695	402695	402695	402695
Retaining ring	105	112034	112034	112021	112021	112021	112021
Door bolt	103	120115	120115	120116	120116	120116	120116
Door support	102	120117	120117	120118	120118	120118	120118
Saglan mat	18	113221	113221	113221	113221	113221	113221
Immersion sleeve	10	152385	152385	152385	152385	152385	152385
Reduction socket	6	111101	111101	111101	111101	111101	111101
Insulation	363	113219	113219	113219	113219	113219	113219
Gasket, inside	361	113156	113156	113156	113156	113156	113156
Gasket, outside	360	113157	113157	113157	113157	113157	113157
Door insert	350	128084	128084	401713	402356	400929	402345
Sight glass socket	250	122346	122346	122346	122346	122346	122346
Key	204	160235	160235	160234	160234	160234	160234
Burner fastening	202	160163	160163	160164	160164	160164	160164

### 10.4. Pyronox LRK 27-32

Spare parts for recuperator on request.

