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# TECHNICAL MANUAL

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# CALDER & CALDER PLUS

**PRESSURISED STEEL BOILERS**

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## 1 GENERAL WARNINGS

Each generator is provided with a **manufacture plate** that can be found in the envelope with the boiler documents. The plate lists:

- Serial number or identification code;
- Rated thermal output in kW;
- Furnace thermal output in kW;
- Types of fuels that can be used;
- Max operating pressure.

A **manufacture certificate** is also provided which certifies the hydraulic test positive performance.

The installation must be performed in compliance with the regulations in force by **professionally qualified personnel**. The term “professionally qualified personnel” means persons with specific technical skills in the sector of heating system components.

Incorrect installation may cause damage to persons, animals or objects for which the manufacturer cannot be held responsible.

**At the first start up**, all regulation and control devices positioned on the control panel should be checked for efficiency. The **guarantee** shall be valid only upon compliance with the instruction given in this manual.

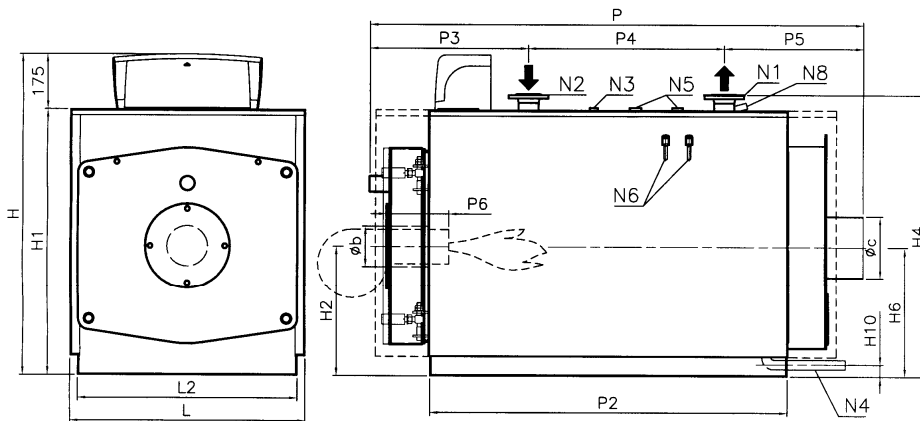
Our boilers have been built and tested in observance of EEC requirements and, as a consequence, CE-marked. EEC directives are as follows:

- **Directive on Gas** 90/396/EEC
- **Directive on Output** 92/42/EEC
- **Directive on Electromagnetic Compatibility** 89/336/EEC
- **Directive on Low Voltage** 73/23/EEC

**IMPORTANT:** This boiler has been designed to heat hot water at a temperature inferior to the boiling temperature at atmospheric pressure and must be connected to a heating plant and/or a domestic hot water plant within the limits of its performance and output.

## 2 TECHNICAL SPECIFICATIONS

### 2.1 CALDER 70 - 1300 BOILER

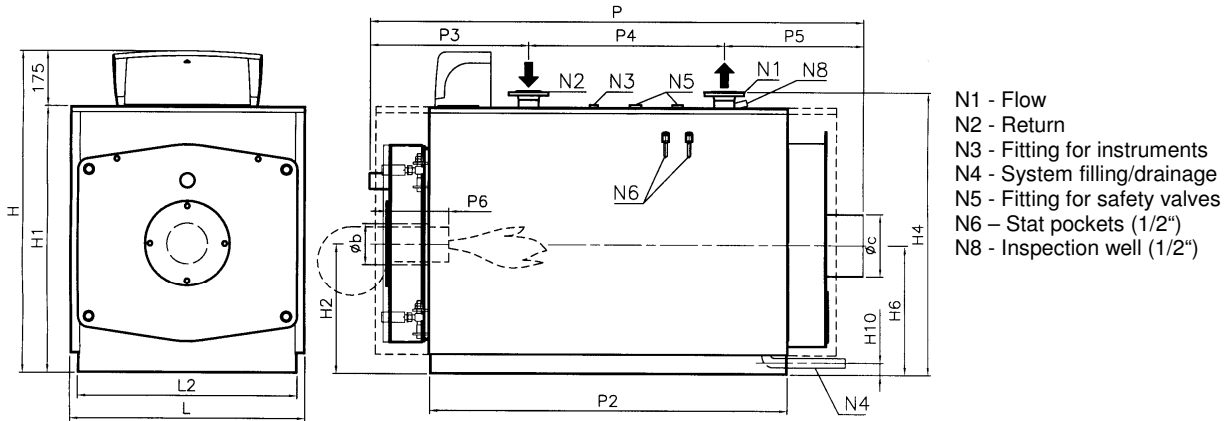


- N1 - Flow
- N2 - Return
- N3 - Fitting for instruments
- N4 - System filling/drainage
- N5 - Fitting for safety valves
- N6 - Bulb wells (1/2")
- N8 - Inspection well (1/2")

CALDER SIZE	70	80	90	100	120	150	200	250	300	350	400	500	620	750	850	950	1000	1200	1300
<b>kW Output</b>	70	80	90	100	120	150	200	250	300	350	400	500	620	750	850	950	1000	1200	1300
Efficiency NCV 100%80-60 F/R	92.1	91.9	91.8	91.7	91.6	92.0	91.7	91.9	92.3	92.1	92.3	92.2	92.2	92.2	92.2	92.2	92.2	92.2	92.2
Efficiency NCV 30%80-60 F/R	90.2	90.2	90.3	90.4	90.4	91.1	91.3	90.4	90.6	90.6	90.8	90.7	90.7	90.6	90.7	90.7	90.6	90.6	90.6
Approx Gas Consump m <sup>3</sup> /hr	8.1	9.2	10.4	11.5	13.9	17.2	23.1	28.8	34.4	40.2	45.8	57.4	71.1	86.0	97.5	109.0	117.1	137.7	149.1
Gas Side Rest mbar	0.8	1.0	0.8	1.0	1.1	1.2	1.9	2.0	2.0	2.9	4.1	4.2	6.4	5.2	7.2	5.2	4.0	5.5	6.5
Hydraulic Rest mbar 12 °C	9	9	10	12	13	14	15	15	16	18	20	22	27	25	27	32	26	30	32
Flue Gas Vol Kg/hr	120	137	155	172	207	257	344	429	513	600	683	855	1060	1282	1452	1624	1744	2051	2222
Approx Flue Gas Temp. °C	188	192	194	197	200	190	197	193	184	188	182	185	185	185	184	185	186	185	185
<b>Dimensions</b>																			
Height H	1030	1030	1030	1030	1030	1080	1080	1080	1180	1180	1190	1380	1380	1510	1510	1510	1660	1660	1660
Height H1	855	855	855	855	855	905	905	905	1005	1005	1015	1205	1205	1335	1335	1335	1485	1485	1485
Height H2	415	415	415	415	415	440	440	440	490	490	500	610	610	675	675	675	750	750	750
Height H4	911	911	911	911	911	961	961	961	1061	1061	1095	1285	1285	1417	1417	1417	1568	1568	1568
Height H6	415	415	415	415	415	440	440	440	490	490	500	610	610	675	675	675	750	750	750
Height H10	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	50	60	60	60	60	60	60	60	60	60	60
Width L	750	750	750	750	750	800	800	800	900	900	940	1160	1160	1290	1290	1290	1440	1440	1440
Width L2	700	700	700	700	700	750	750	750	850	850	890	1110	1110	1110	1240	1240	1390	1390	1390
Length P	994	994	1119	1119	1119	1364	1364	1614	1614	1864	1872	1946	2235	2247	2247	2497	2477	2477	2477
Length P2	630	630	755	755	755	1000	1000	1250	1250	1500	1502	1502	1792	1753	1753	2003	2003	2003	2003
Length P3	413	413	513	513	513	513	513	513	523	523	600	663	663	704	704	704	703	703	703
Length P4	240	240	265	265	265	475	475	725	700	980	850	850	1150	1100	1100	1200	1200	1200	1200
Length P5	341	341	341	341	341	376	376	376	391	361	422	433	422	443	443	593	574	574	574
Length P6 min	200	200	200	200	200	200	200	200	200	200	230	270	270	270	270	270	270	270	270
max	250	250	250	250	250	250	250	250	250	250	280	320	320	320	320	320	320	320	320
Ø N1 & N2	50	50	50	50	50	50	50	50	65	65	80	80	80	100	100	100	125	125	125
Ø N3	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"
Ø N4	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 1/2"	1 1/2"
Ø N5												1 1/4"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"
Water content l	105	105	123	123	123	172	172	220	300	356	360	540	645	855	855	950	1200	1200	1200
Dry weight kg	216	216	258	258	258	346	346	431	475	542	584	853	963	1205	1205	1417	1843	1843	1843

- Flue gas temperature based on 20 ° C room temperature
- 1 safety valve/pressure gauge connection N3 on Boilers up to 350kW
- 1 safety valve connection N5 on 400kW Boiler. Above 400kW 2 connections
- Heat losses through casing 0.8%
- Heat losses with burner off 0.1%
- Electric supply to panel 230v 1ph 50Hz
- Maximum working pressure 5 bar
- Insulation class IP X0D
- Boiler can be fired using Natural Gas, Gas oil and heavy oil.

## 2.2 CALDER PLUS 70 - 1300 BOILER



CALDER PLUS SIZE	70	80	90	100	120	150	200	250	300	350	400	500	620	750	850	950	1000	1200	1300
<b>kW Output</b>	70	80	90	100	120	150	200	250	300	350	400	500	620	750	850	950	1000	1200	1300
Efficiency NCV 100%80-60 F/R	94.3	94.4	94.5	94.7	94.8	95.0	95.2	94.8	95.1	95.3	95.2	95.4	95.5	95.4	95.4	95.3	95.4	95.3	95.3
Efficiency NCV 30%80-60 F/R	94.8	94.7	95.0	94.8	95.1	95.7	95.3	95.4	95.6	95.6	95.4	95.7	95.9	95.9	95.8	95.7	95.8	95.8	95.7
Approx Gas Consump m <sup>3</sup> /hr	7.85	8.96	10.1	11.1	13.4	16.7	22.2	27.9	33.4	38.8	44.4	55.4	68.7	83.2	94.3	105.5	113.1	133.2	144.3
Gas Side Rest mbar	0.9	1.1	0.9	1.1	1.3	1.3	2.2	2.4	2.4	3.4	4.7	4.8	73	5.8	8.0	5.9	4.5	6.2	7.3
Hydraulic Rest mbar 12 °C	9	9	10	12	13	14	15	15	16	18	20	22	27	25	27	32	26	30	32
Flue Gas Vol Kg/hr	117	133	150	167	200	249	331	416	498	579	662	826	1023	1239	1404	1572	1686	1985	2151
Approx Flue Gas Temp. °C	148	148	143	140	136	131	127	135	130	124	127	122	120	122	123	126	122	125	125
<b>Dimensions</b>																			
Height H	1030	1030	1030	1030	1030	1080	1080	1080	1180	1180	1190	1380	1380	1510	1510	1510	1660	1660	1660
Height H1	855	855	855	855	855	905	905	905	1005	1005	1015	1205	1205	1335	1335	1335	1485	1485	1485
Height H2	415	415	415	415	415	440	440	440	490	490	500	610	610	675	675	675	750	750	750
Height H4	911	911	911	911	911	961	961	961	1061	1061	1095	1285	1285	1417	1417	1417	1568	1568	1568
Height H6	415	415	415	415	415	440	440	440	490	490	500	610	610	675	675	675	750	750	750
Height H10	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	50	60	60	60	60	60	60	60	60	60	60
Width L	750	750	750	750	750	800	800	800	900	900	940	1160	1160	1290	1290	1290	1440	1440	1440
Width L2	700	700	700	700	700	750	750	750	850	850	890	1110	1110	1240	1240	1240	1390	1390	1390
Length P	994	994	1119	1119	1119	1364	1364	1614	1614	1864	1872	1946	2235	2247	2247	2497	2477	2477	2477
Length P2	630	630	755	755	755	1000	1000	1250	1250	1500	1502	1792	1792	1753	1753	2003	2003	2003	2003
Length P3	413	413	513	513	513	513	513	513	523	523	600	663	663	704	704	704	703	703	703
Length P4	240	240	265	265	265	475	475	725	700	980	850	1150	1100	1100	1200	1200	1200	1200	1200
Length P5	341	341	341	341	341	376	376	376	391	361	422	433	422	443	443	593	574	574	574
Length P6 min	200	200	200	200	200	200	200	200	200	200	230	270	270	270	270	270	270	270	270
max	250	250	250	250	250	250	250	250	250	250	280	320	320	320	320	320	320	320	320
Ø N1 & N2	50	50	50	50	50	50	50	50	65	65	80	80	80	100	100	100	125	125	125
Ø N3	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"
Ø N4	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1.1/4"	1.1/4"	1.1/4"	1.1/4"	1.1/4"	1.1/4"	1.1/4"	1.1/4"
Ø N5											1.1/4"	1.1/4"	1.1/4"	1.1/2"	1.1/2"	1.1/2"	1.1/2"	1.1/2"	1.1/2"
Water content l	105	105	123	123	123	172	172	220	300	356	360	540	645	855	855	950	1200	1200	1200
Dry weight kg	216	216	258	258	258	346	346	431	475	542	584	853	963	1205	1205	1417	1843	1843	1843

Flue gas temperature based on 20 ° C room temperature  
 1 safety valve/pressure gauge connection N3 on Boilers up to 350kW  
 1 safety valve connection N5 on 400kW Boiler. Above 400kW 2 connections  
 Heat losses through casing 0.5%  
 Heat losses with burner off 0.1%  
 Electric supply to panel 230v 1ph 50Hz  
 Maximum working pressure 5 bar  
 Insulation class IP X0D  
 Boiler can be fired using Natural Gas..

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## 3 INSTALLATION

Before **connecting** the boiler, perform the following operations:

- Thoroughly clean all the **system pipes** in order to remove any foreign matter that could affect correct operation of the boiler;
- Check that the **flue** has an **adequate draught**, that there is no narrowing of passages and that it is free from debris; also check that other appliances do not discharge into the flue (unless designed to serve several utilities). See the regulations in force.

### 3.1 THERMAL PLANT

#### 3.1.1 BOILER ROOM

As a rule, regulations in force should be always observed. Premises in which boilers will be installed should be sufficiently ventilated and guarantee access for ordinary and extraordinary maintenance operations.

#### 3.1.2 FLUE

The pressurised boiler that now equips your heating system is so-called because it uses a burner provided with fan which introduces into the combustion chamber the exact amount of air necessary in relation to the fuel and maintains an overpressure in the furnace equivalent to all the internal resistances of the flue gas path as far as the boiler exhaust. At this point the fan pressure should have dropped to zero to prevent the flue connection pipe and the lower area of the flue itself from being under pressure and combustion gas leaks occurring in the boiler room.

The **connection pipe** from the boiler to the base of the flue must slope upwards in the direction of the flue gas flow with recommended gradient of no less than 10%. Its path must be as short and straight as possible with the bends and fittings rationally designed in accordance with air duct criteria

The paragraph Technical Specifications specifies the flue connection diameters of the boilers for lengths of up to 1 metre. For more winding paths, the diameter must be suitably enlarged.

## 3.2 HYDRAULIC CONNECTION

### 3.2.1 HOT WATER HEATING SYSTEM WITH CLOSED EXPANSION VESSEL – Furnace output $\leq 350$ kW/h - pressure 5 bar (Fig. 1)

The generator must be provided with:

- a - Safety valve
- b - Expansion vessel (connected with a hose  $\geq 18$  mm diameter)
- c - Regulation thermostats
- d - Safety thermostat
- e - Cut-off pressure switch
- f - Well for control thermometer
- g - Pressure gauge with flange for control pressure gauge
- h - Heat discharge valve or fuel on-off valve.
- N1 - Flow
- N2 - Return
- N3 – Instrument fitting
- N4 – Lower fitting:
  - N4b expansion vessel fitting
  - N4c filling/drain
- N6 - Bulb wells (thermometer, pump consent thermostat, regulation thermostat, safety thermostat).

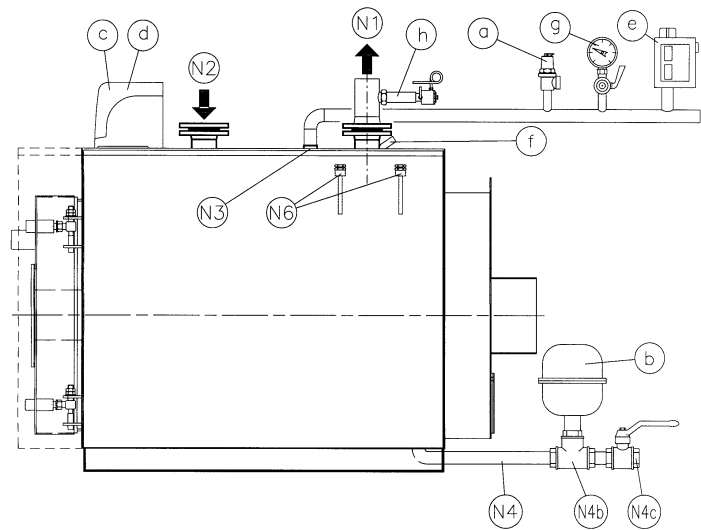


Fig. 1

### 3.2.2 HOT WATER HEATING SYSTEM WITH CLOSED EXPANSION VESSEL – Furnace output $> 350$ kW/h - pressure 5 bar (Fig. 2)

The generator must be provided with:

- a - 1 safety valve
- b - Expansion vessel
- c - Regulation thermostats
- d - 1st safety thermostat
- f - Cut-off pressure switch
- g - Well for control thermometer
- h - Pressure gauge with flange for control pressure gauge
- i - Heat discharge valve or fuel on-off valve
- N1 - Flow
- N2 - Return
- N3 - Instrument fitting
- N4 - Lower fitting:
  - N4b expansion vessel fitting
  - N4c Filling/drain
- N5 - Safety valves fitting
- N6 - Bulb wells (thermometer, pump consent thermostat, regulation thermostat, safety thermostat)

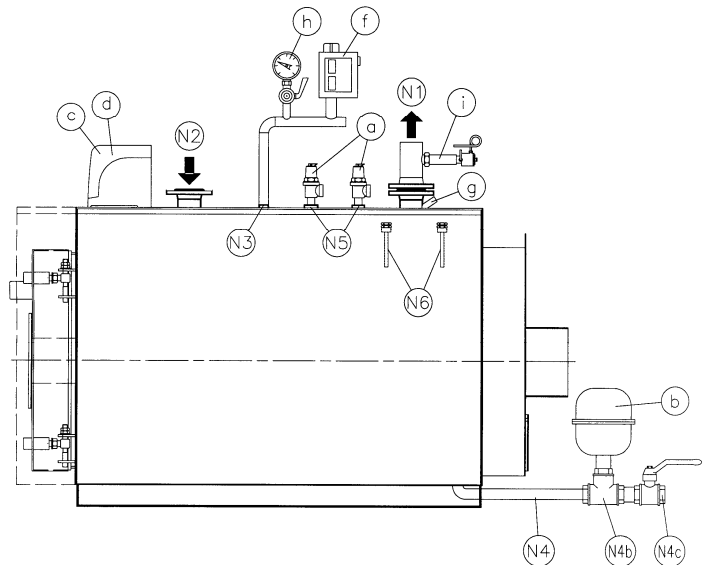


Fig. 2

Ensure that the hydraulic pressure measured after the reduction valve on the supply pipe does not exceed the operating **pressure specified on the rating plate of the component** (boiler, heater etc.).

- As the water contained in the heating system increases in pressure during operation, ensure that its maximum value does not exceed the maximum hydraulic pressure specified on the component rating plate (5 bar).
- Ensure that the safety valve outlets of the boiler and hot water tank, if any, have been connected to an exhaust funnel in order to prevent the valves from **flooding the room** if they open.
- Ensure that the pipes of the water and heating system **are not used as an earth connection** for the electrical system as this can seriously and very rapidly damage the pipes, boiler, heater and radiators.
- Once the heating system has been filled, you are advised to close the supply cock and keep it closed so that **any leaks from the system** will be identified by a drop in hydraulic pressure indicated on the system pressure gauge.

### 3.3 ELECTRICAL CONNECTION

Electrical systems of thermal plants designed only for heating purposes **must comply with numerous legal regulations which apply to in general as well as specifically to each application or fuel type.**

### 3.4 CALDER & CALDER F CONTROL PANEL (Fig. 3)

The control panel supplied with the boilers is made of self-extinguishing plastic and houses the regulation and safety instruments:

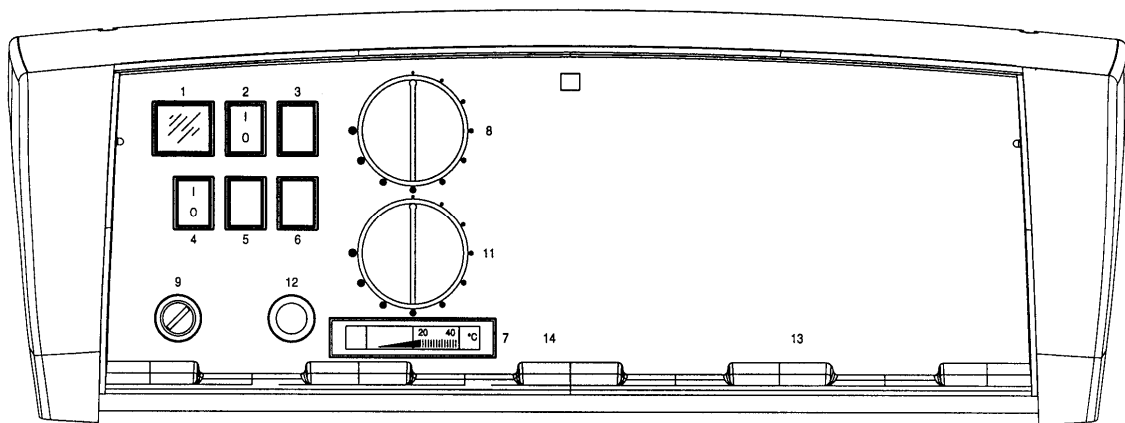


Fig. 3

#### KEY

- 1 PANEL LIVE
- 2 BURNER SWITCH N. 1
- 4 HEATING PUMP SWITCH
- 7 BOILER THERMOMETER
- 8 CONTROL THERMOSTAT N. 1
- 9 SAFETY LIMIT THERMOSTAT N. 1
- 11 CONTROL THERMOSTAT N. 2

The upper part of the control panel can be rotated to gain access to the terminal board and uncoil the thermostat and thermometer capillaries. A copy of the wiring diagram is contained inside the control panel cover. The **regulation thermostats (TR1-TR2)** have an operating range from 60° to 90° and can be set by the user by means of the front knob.

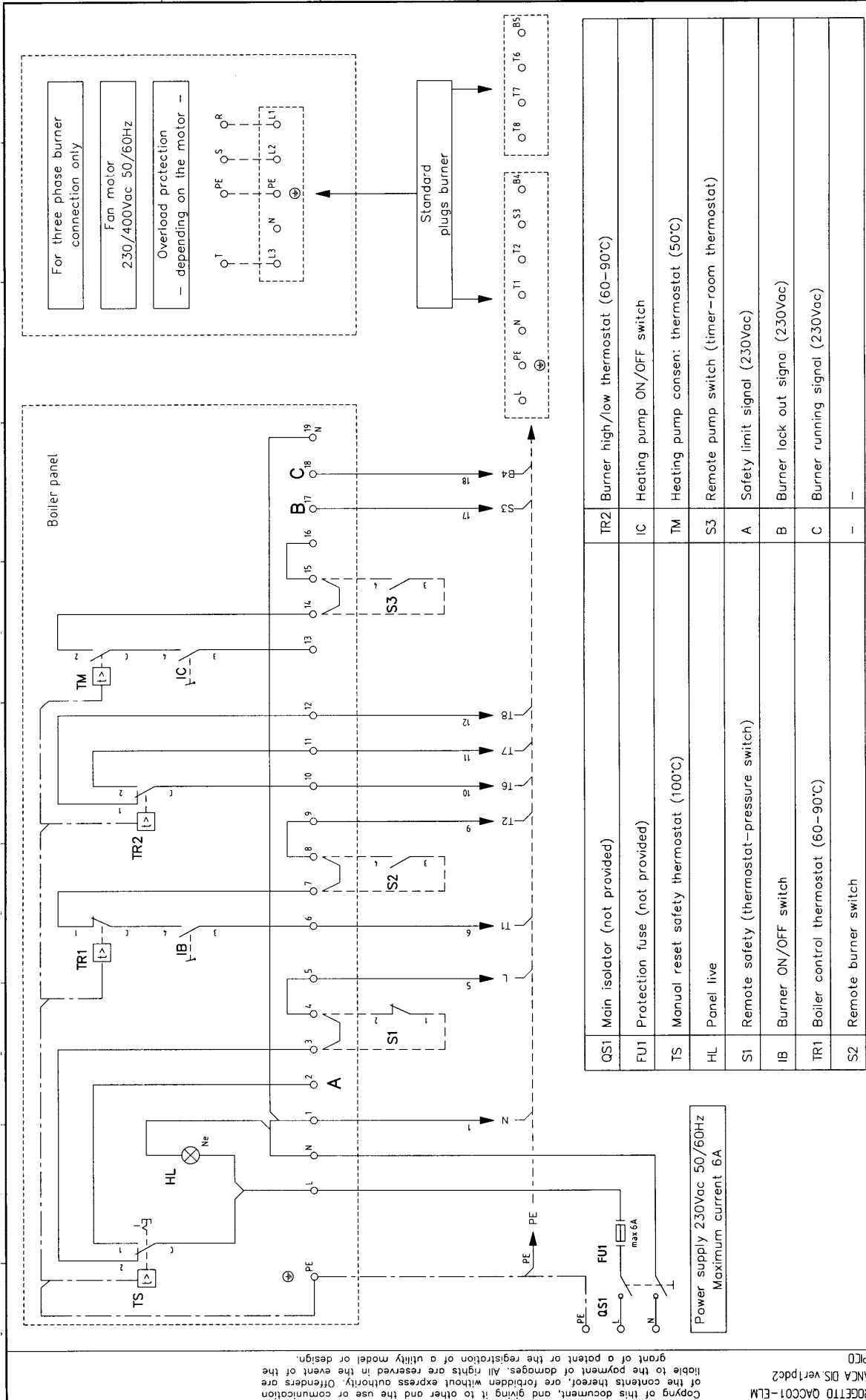
**Safety thermostats (TS)** has a fixed setting of 100 (+0/-6)°C and can be manually reset in accordance with Ministerial Decree 1/12/75 «R».

**Circulator consent thermostat (TM)** has a fixed setting of 50°C with a working range of 6°C: at start-up, with the heating system cold, this permits higher boiler temperatures to be maintained thus reducing the risk of flue gas condensation.

For correct installation, refer to the boiler casing assembly instructions.



### 3.4.1 CALDER & CALDER PLUS WIRING DIAGRAM



Q1	QS1	Main isolator (not provided)	TR2	Burner high/low thermostat (60-90°C)
F1	FU1	Protection fuse (not provided)	IC	Heating pump ON/OFF switch
T1	TS	Manual reset safety thermostat (100°C)	TM	Heating pump consent thermostat (50°C)
H1	HL	Panel live	S3	Remote pump switch (timer-room thermostat)
S1	S1	Remote safety (thermostat-pressure switch)	A	Safety limit signal (230Vac)
IB	IB	Burner ON/OFF switch	B	Burner lock out signal (230Vac)
TR1	TR1	Boiler control thermostat (60-90°C)	C	Burner running signal (230Vac)
S2	S2	Remote burner switch	-	-

REV.	MODIFICA	DATA	FIRMA	APPR.	GP	SDST_IL	SDST_DA	FLE	QACCO1-ELM	Steel boiler control panel		QACCO1-ELM	= UK
										electromechanical			+
													FG
													FS

PROGETTO QACCO1-ELM  
 BANCA DIS ver1.pdc2  
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### 3.5 INVERTING THE DOOR APERTURE

If the door is to be opened to the opposite side, act as follows:

1. Switch the outside nut (or bush) of one hinge with the diametrically opposite closure bush; then at the hinge side, fasten the cone to the door with the inside nut.
2. Repeat the operation for the other hinge.
3. For any adjustment needed, act on the specific hinge nuts.

### 3.6 BURNER CONNECTION

Before installation you are advised to thoroughly clean the inside of all the fuel supply system pipes in order to remove any foreign matter that could affect correct operation of the boiler. See technical specification tables and check the max pressure value inside the furnace. The value found on the table may also increase by 20% if heavy oil is used instead of gas or light oil; furthermore the following checks should also be carried out:

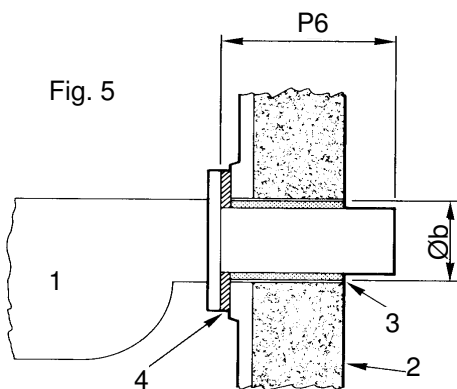
- a) Check the internal and external seal of the fuel supply system;
- b) Regulate the fuel flow according to the power required by the boiler;
- c) Check that the boiler is fired by the correct type of fuel;
- d) Check that the fuel supply pressure is within the values specified on the burner rating plate;
- e) Check that the fuel supply system is sized for the maximum flow rate necessary for the boiler and that it is provided with all control and safety devices provided for by the regulations referred to above;
- f) Check that the boiler room vents are sized in order to guarantee the air flow established by the regulations referred to above and that they are in any case sufficient to obtain perfect combustion.

In particular, when using gas:

- g) Check that the feeding line and the gas ramp comply with the regulations in force;
- h) Check that all the gas connections are sealed;
- i) Check that the gas pipes are not used as earth connections for electrical appliances.

If the boiler is not going to be used for some time, close the fuel supply cock or cocks.

**IMPORTANT: check that the air spaces between the burner draught tube and the manhole are suitably filled with thermoinsulating material (Fig. 5).** The boiler is supplied with a piece of ceramic rope. Should this not suit the burner used, use a braid of different diameter but same material.



KEY:

1. Burner
2. Manhole
3. Thermoinsulating material
4. Flange

All details on the draught tube length (**P6**), the diameter of the burner hole (**Øb**) and the pressurization are included in the par. Technical Specifications.

## 4 ASSEMBLY

### 4.1 CALDER 70 - 400 BOILER CASINGS (Fig. 6)

- Wrap the glass wool around the boiler body leaving the bulb well (P) on the right side exposed.
- Insert the wires connecting the burner to the control panel in the lower slits of panel (1S) and (1D), allowing for the opening direction of the manhole.
- Fit the panel (1S), inserting the upper fold into the square tube and the lower fold to the boiler side frame.
- Fit the upper panel (2S) on the boiler and fit on this panel the control panel; uncoil the thermometer and thermostat capillaries and insert the bulbs in the wells.
- Fit panel (1D) as indicated under point c); fit panel (2D) ensuring that the capillaries are inserted in the slot provided in the panel itself. Securing the control panel.
- Secure the upper panels by screws and close the passage holes with special caps (see figure)

#### Super-isolation (on request)

- Fit panels (3) and (4) connecting them to the side panels.

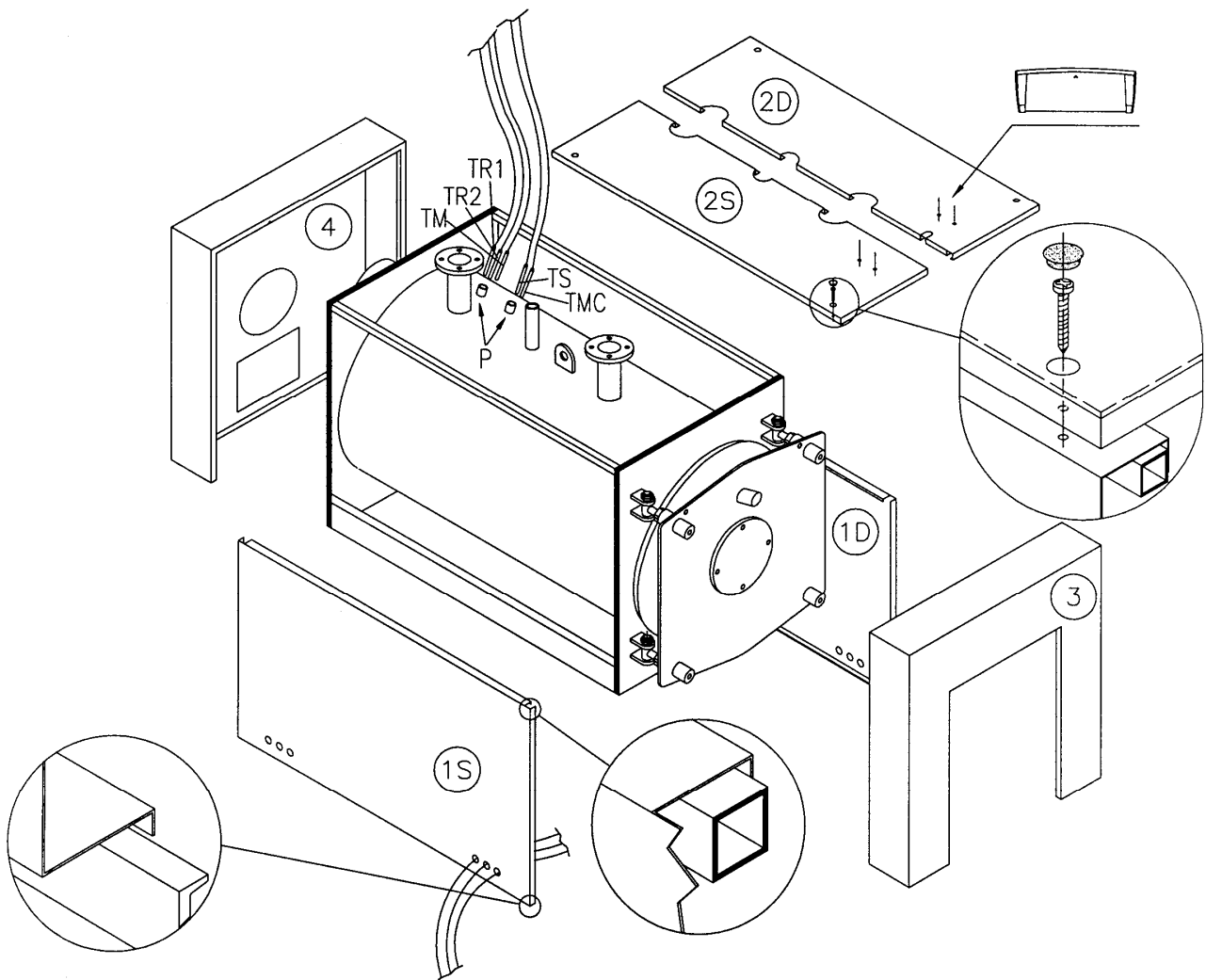


Fig. 6

**Key:** P Bulb wells – TR1-TR2 Regulation thermostats - TS Safety thermostat - TM Circulator consent thermostat - TMC Boiler thermometer.

## 4.2 CALDER 500 - 1300 BOILER CASINGS (Fig. 7)

- Wrap the glass wool around the boiler body leaving the bulb well on the right side exposed.
- Insert the wires connecting the burner to the control panel in the lower slits of panel (1S) and (1D), allowing for the opening direction of the manhole.
- Fit the lower panel (1S), inserting the fold into the square tube and repeat the same procedure with the upper panel (2S).
- Fit the upper panel (3S) on the boiler; fit the control panel on the panel (3S); uncoil the thermometer and thermostat capillaries and insert the bulbs in the wells.
- Fit the panels (1D) (2D) and (3D) ensuring that the capillaries are inserted in the slot provided in the panel (3D); securing the control panel to panel (3D).

### Super-isolation (on request)

- Fit the panels (5S) and (5D), connecting them to the side panels by means of the brackets; fit the front panels (4B) and (4A) connecting them to panels (5S) and (5D). Close the manhole casing by fitting the upper panel (6) secured by screws; close holes with special caps (see figure).
- Fit the panels (8S) and (8D), connecting them to the side panels by means of the brackets; fit the rear panels (9B) and (9A) connecting them to panels (8S) and (8D). Close the smokebox casing by fitting the upper panel (10) secured by screws; close holes with special caps (see figure).

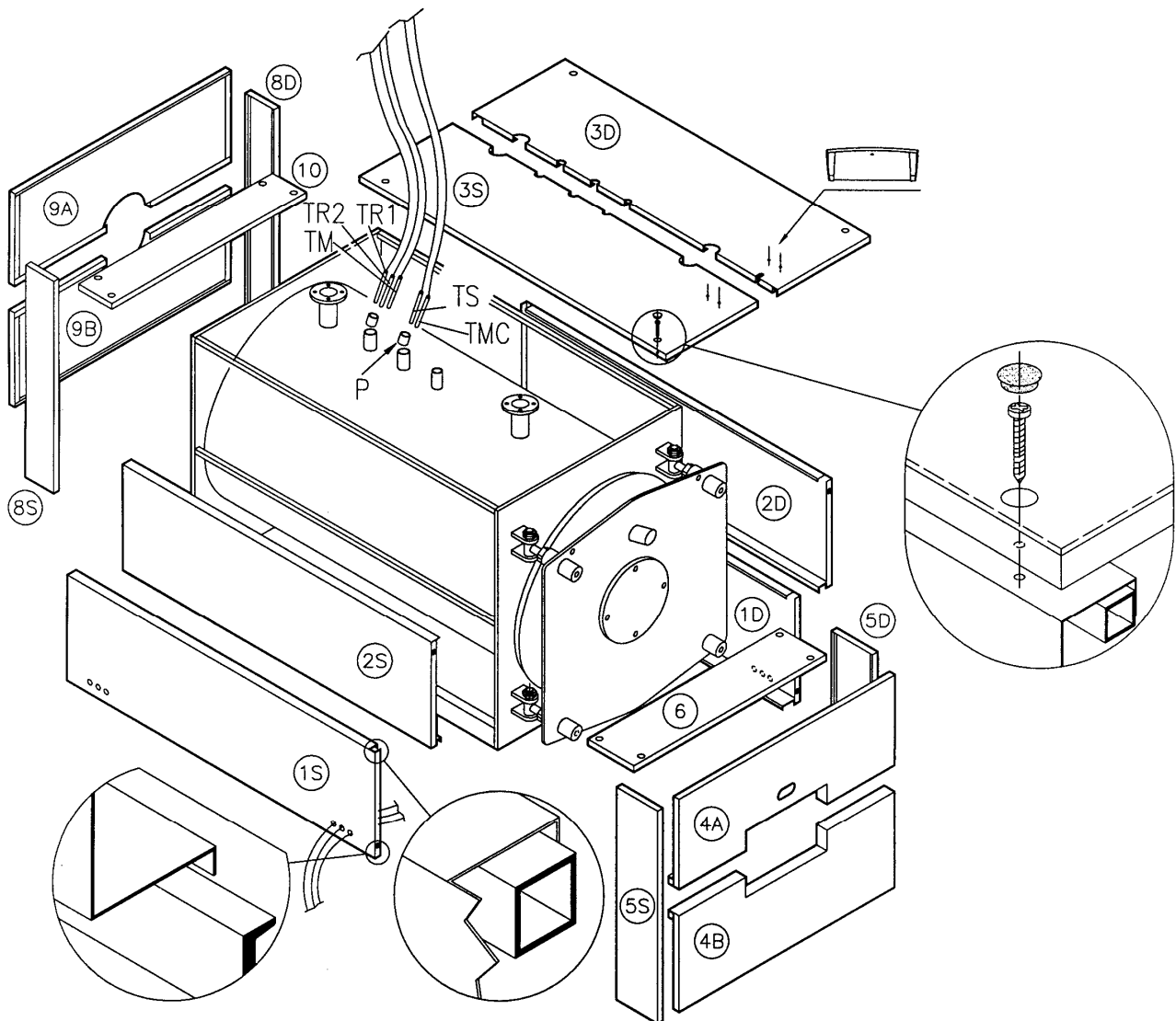


Fig. 7

**Key:** P Bulb wells – TR1-TR2 Regulation thermostats – TS Safety thermostat - TM Circulator consent thermostat - TMC Boiler thermometer.

## 5 START UP

**WARNING:** Before start up insert wholly turbolators into the smoke tubes ensuring that they have been pushed inside for at least 100 mm.

### 5.1 PRELIMINARY CHECKS

Before starting the boiler, check that:

- The **rating plate** specifications and power supply network (electricity, water, gas or fuel oil) specifications correspond;
- The burner **power range** is compatible with the power of the boiler;
- The boiler room also contains the instructions for the burner;
- The **flue gas exhaust pipe** is operating correctly;
- The **air inlet supply** is well dimensioned and free from any obstacle;
- The **manhole**, the **smokebox** and the **burner plate** are closed in order to provide a complete flue gas seal;
- The system is **full of water** and that any **air pockets** have therefore been eliminated;
- The **anti-freeze** protections are operative;
- The water **circulation pumps** are operating correctly.
- The expansion vessel and the safety valve(s) have been connected correctly (with no interception) and are properly operating.
- Check the electrical parts and thermostat operation.

### 5.2 WATER TREATMENT

The most common phenomena that occur in heating systems are:

#### - Scaling

Scale obstructs heat transfer between the combustion gases and the water, causing an abnormal increase in the temperature of the metal and therefore reducing the life of the boiler.

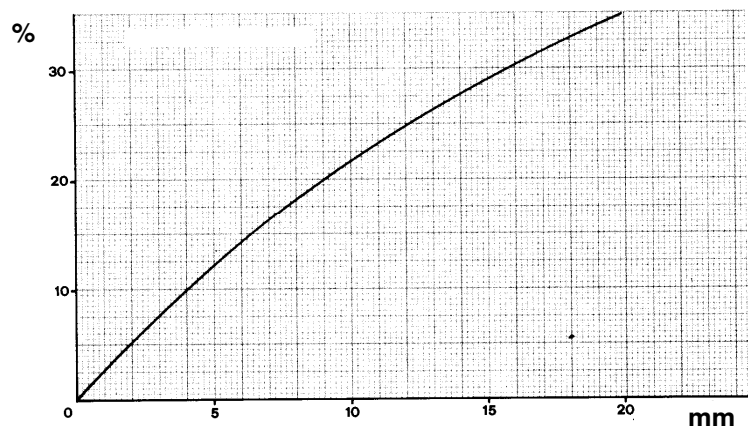
Scale is found mostly at the points where the wall temperature is highest and the best remedy, at construction level, is to eliminate areas that overheat.

Scale creates an insulating layer which reduces the thermal transfer of the generator, affecting system efficiency. This means that the heat produced by burning the fuel is not fully exploited and is lost to the flue.

#### Scale diagram

#### Key

% % fuel not used  
mm mm scale



#### - Corrosion on the water side

Corrosion of the metal surfaces of the boiler on the water side is due to the passage of dissolved iron through its ions ( $Fe^{+}$ ). In this process the presence of dissolved gases and in particular of oxygen and carbon dioxide is very important. Corrosion often occurs with softened or demineralised water which has a more aggressive effect on iron (acid water with  $Ph < 7$ ): in these cases, although the system is protected from scaling, it is not protected against corrosion and the water must be treated with corrosion inhibitors.

### 5.3 FILLING THE SYSTEM

**The water must enter the system as slowly as possible and in a quantity proportional to the air bleeding capacity of the components involved. Filling times vary depending on the capacity and characteristics of the system but should never be less than 2 or 3 hours.**

In the case of a system with closed expansion vessel, water must be let in until the pressure gauge indicator reaches the static pressure value pre-set by the vessel.

Heat the water to maximum temperature and never over  $90^{\circ}C$ . During this operation the air contained in the water is released through the automatic air separators or through manual bleed valves. The water discharged from the system with elimination of the air is made up by the automatic or manual filling valve.

## 6 OPERATION

### 6.1 OPERATING CHECKS

The heating system must be correctly operated to ensure perfect combustion as far as possible with reduced emissions of carbon monoxide, unburnt hydrocarbons and soot into the atmosphere, and to avoid hazards and damage to people and goods.

Guide to combustion values:

FUELS	%CO <sub>2</sub>	Flue gases temperature	% CO
Gas	10	190 °C	0 – 20 ppm
Gas oil	13	195 °C	10 – 80 ppm
Heavy oil	13.5	200 °C	50 – 150 ppm

A diagram is provided in which the system efficiency is obtained according to the flue gas temperature, the ambient temperature and the percentage of carbon dioxide (CO<sub>2</sub>). Dispersions through the boiler casings are not considered.

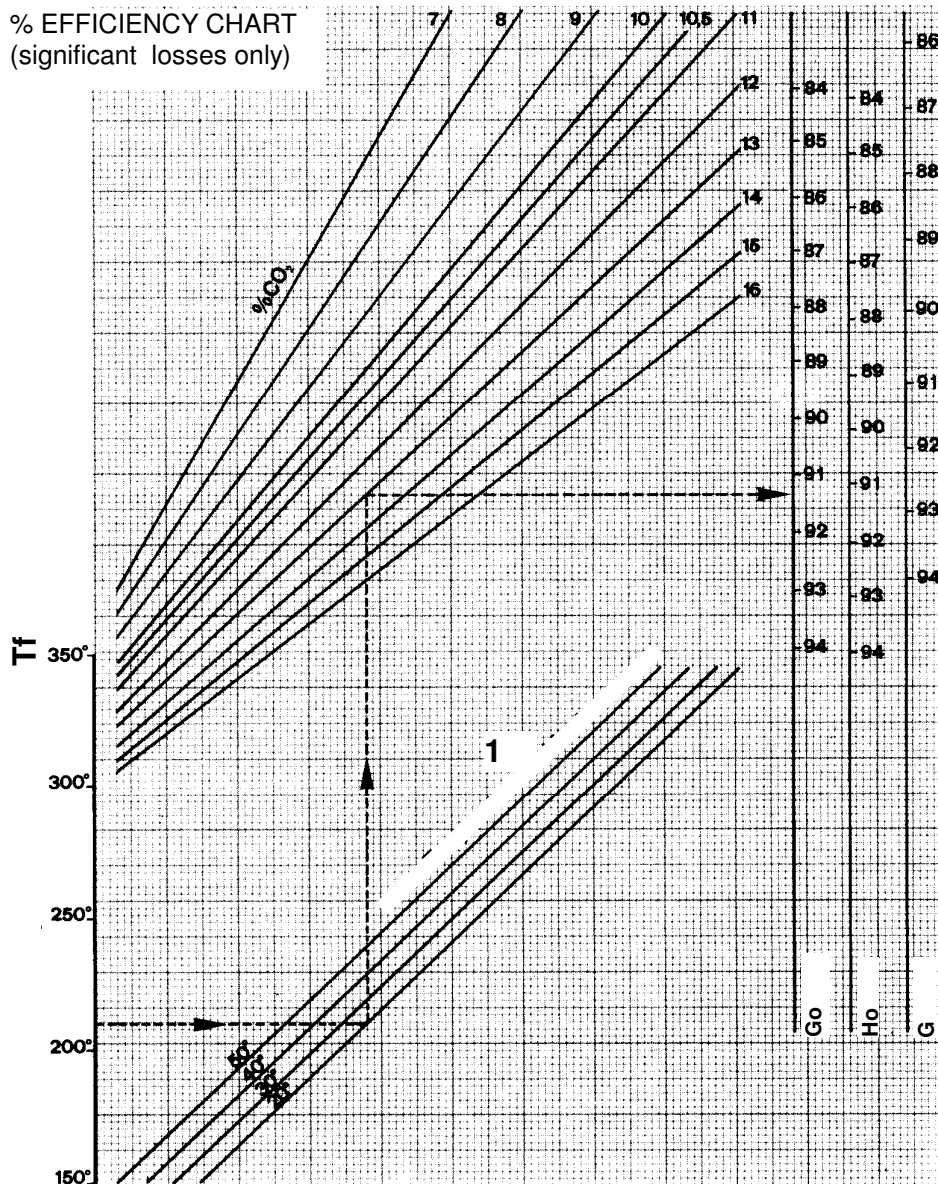
Example:

Fuel used .....GAS OIL

%CO<sub>2</sub>.....13 %

Ambient temperature.....20 °C

Efficiency.....91.4 %



Key:

**T<sub>f</sub>** Flue gas temperature – **T<sub>a</sub>** Ambient temperature °C – **Go** Gas oil – **Ho** Heavy oil – **G** Gas

Pressurisation values should be included in the range given in the table of technical specifications.

#### **WARNING**

**The differential temperature between boiler flow and return must not exceed 15°C in order to prevent thermal shock to the boiler structures. The temperature of the return water must be above 55°C in order to protect the boiler from corrosion due to condensation of the flue gases on cold surfaces; for this purpose it is useful to install a 3 or 4-way mixing valve. The guarantee does not cover damages caused by condensate.**

**A recirculation pump (anticondensate pump) must be installed to mix the cold returns. This pump should have a minimum flow rate equal to approximately 5 m<sup>3</sup>/h or equal to 1/3 or 1/4 of the heating system pump flow rate.**

It is necessary to keep the burner switch always switched on in order to maintain water temperature equal approximately to the value set through the thermostat.

**If the flue gas seal is poor in the front part of the boiler (manhole and burner plate) or the back part (smokebox), the closing tie rods of the individual parts must be adjusted; if this is not sufficient, the seals must be replaced.**

#### **CAUTION**

**Do not open the manhole and do not remove the smokebox while the burner is working. Always wait few minutes after the burner has been switched off until the insulating parts are cooler.**

## **6.2 CLEANING AND SERVICING**

Close fuel supply and disconnect the electrical mains before starting any cleaning and servicing operations.

As economic running depends on cleaning of the exchange surfaces and regulation of the burner, the following operations should be performed:

- Clean the tube bundle and turbolators with the appropriate tube-brush every month for heavy oil-fired boilers, every three months for gas oil-fired boilers and once a year for gas-fired boilers. Cleaning schedule depends on plant features.

Quick cleaning can be performed by opening the front manhole only, taking the turnolators out and cleaning the tubes with a tube-brush. For more thorough cleaning, the smokebox must be removed to eliminated carbon deposits from the rear side.

- Have the burner calibration checked by professionally qualified personnel;
- Have the water circulating in the system analysed and provide for adequate treatment to avoid the formation of scale which initially reduces the efficiency of the boiler and in the long term will permanently damage it, making it unserviceable;
- Check that the refractory castings in contact with the flue gases are in perfect condition and if not, replace them;
- Periodically check the efficiency of the system regulation and safety instruments

## **CALDER AND CALDER PLUS BOILERS**

comply with the CE certificate and with the following regulations (or harmonised regulations):

EN 60335-1, EN 303-1, pr EN 303-3

In accordance with the boards regulations:

- Gas Directive 90/396/CEE
- Low Voltage Directive 73/23/CEE (modified by 93/68)
- Efficiency Directive 92/42/CEE
- EMC Directive 89/336/CEE



