



**ECONOMATIC  
DRN/DRM/DRNV/DRNH/AXS  
STEEL SHELL BOILERS**

**INSTALLATION, OPERATION & MAINTENANCE  
DOCUMENTATION**

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**GB120902**

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# STOKVIS

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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 kcal/h and in kW;
- Furnace thermal output in kcal/h and 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.

# TECHNICAL SPECIFICATIONS

## 2. TECHNICAL SPECIFICATIONS

### 2.1. DRN BOILER

N1 - Flow

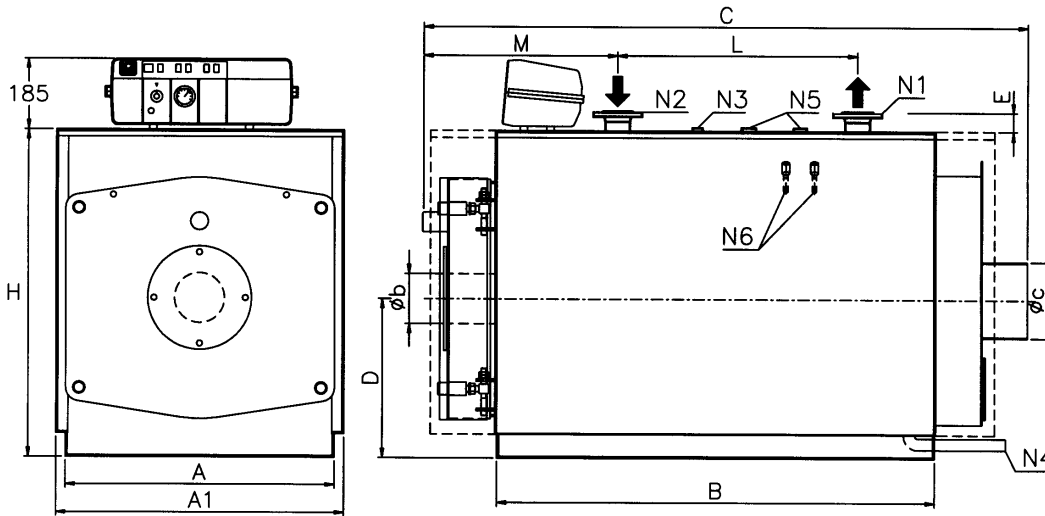
N2 - Return

N3 - Fitting for instruments

N4 - Lower fitting

N5 - Fitting for safety valve, if included (see table)

N6 - Bulb wells



| DRN<br>♦ | HEAT OUTPUT |       | HEAT INPUT nett CV |      | CAPACITY<br>litri | PRESSURE<br>LOSSES<br>WATER SIDE•<br>mbar | COMBUSTION<br>CHAMBER<br>RESISTANCE<br>mbar | WEIGHT<br>kg |
|----------|-------------|-------|--------------------|------|-------------------|---|---|--------------|
|          | kcal/h      | kW    | kcal/h             | kW   |                   |   |   |              |
| 93*      | 80.000      | 93    | 87.740             | 102  | 123               | 10  | 0,8   | 240          |
| 105*     | 90.000      | 105   | 98.570             | 115  | 123               | 12  | 1,0   | 240          |
| 116      | 100.000     | 116   | 109.480            | 127  | 123               | 13  | 1,1   | 240          |
| 151      | 130.000     | 151   | 142.050            | 165  | 172               | 14  | 1,2   | 320          |
| 186      | 160.000     | 186   | 174.620            | 203  | 172               | 15  | 1,6   | 320          |
| 232♦     | 200.000     | 232   | 217.240            | 252  | 300               | 16  | 1,8   | 440          |
| 290♦     | 250.000     | 290   | 270.690            | 314  | 356               | 18  | 2,0   | 500          |
| 349♦     | 300.000     | 349   | 324.930            | 378  | 360               | 20  | 3,0   | 540          |
| 407♦     | 350.000     | 407   | 380.100            | 442  | 360               | 25  | 4,0   | 540          |
| 465♦     | 400.000     | 465   | 433.550            | 504  | 540               | 22  | 3,5   | 800          |
| 581♦     | 500.000     | 581   | 544.750            | 633  | 645               | 27  | 5,0   | 900          |
| 698♦     | 600.000     | 698   | 653.300            | 760  | 855               | 25  | 5,0   | 1140         |
| 814♦     | 700.000     | 814   | 764.500            | 889  | 950               | 32  | 5,0   | 1340         |
| 930♦     | 800.000     | 930   | 875.700            | 1018 | 950               | 39  | 5,5   | 1340         |
| 1046♦    | 900.000     | 1.046 | 980.020            | 1139 | 1200              | 26  | 5,5   | 1760         |
| 1163♦    | 1.000.000   | 1.163 | 1.088.640          | 1265 | 1200              | 30  | 6,0   | 1760         |

| DRN<br>♦ | DIMENSIONS<br>mm |      |      |      |     |    |      |      |     |     |     | FITTINGS<br>DN/in |    |        |        |      |  |
|----------|------------------|------|------|------|-----|----|------|------|-----|-----|-----|-------------------|----|--------|--------|------|--|
|          | A                | A1   | B    | C    | D   | E  | H    | L    | M   | Øb  | Øc  | N1/N<br>2         | N3 | N4     | N5     | N6   |  |
| 93*      | 700              | 750  | 755  | 1195 | 415 | 55 | 855  | 265  | 484 | 130 | 200 | 50                | 1" | 1"     | -      | 1/2" |  |
| 105*     | 700              | 750  | 755  | 1195 | 415 | 55 | 855  | 265  | 484 | 130 | 200 | 50                | 1" | 1"     | -      | 1/2" |  |
| 116      | 700              | 750  | 755  | 1195 | 415 | 55 | 855  | 265  | 484 | 130 | 200 | 50                | 1" | 1"     | -      | 1/2" |  |
| 151      | 750              | 800  | 1000 | 1440 | 440 | 55 | 905  | 475  | 484 | 160 | 250 | 50                | 1" | 1"     | -      | 1/2" |  |
| 186      | 750              | 800  | 1000 | 1440 | 440 | 55 | 905  | 475  | 484 | 160 | 250 | 50                | 1" | 1"     | -      | 1/2" |  |
| 232♦     | 850              | 900  | 1250 | 1690 | 490 | 55 | 1005 | 700  | 484 | 180 | 250 | 65                | 1" | 1"     | -      | 1/2" |  |
| 290♦     | 850              | 900  | 1500 | 1940 | 490 | 55 | 1005 | 980  | 484 | 180 | 250 | 65                | 1" | 1"     | -      | 1/2" |  |
| 349♦     | 890              | 940  | 1502 | 1900 | 500 | 65 | 1015 | 850  | 600 | 225 | 250 | 80                | 1" | 1"     | 1" 1/4 | 1/2" |  |
| 407♦     | 890              | 940  | 1502 | 1900 | 500 | 65 | 1015 | 850  | 600 | 225 | 250 | 80                | 1" | 1"     | 1" 1/4 | 1/2" |  |
| 465♦     | 1110             | 1160 | 1502 | 1950 | 610 | 65 | 1205 | 850  | 660 | 225 | 300 | 80                | 1" | 1" 1/4 | 1" 1/4 | 1/2" |  |
| 581♦     | 1110             | 1160 | 1792 | 2240 | 610 | 65 | 1205 | 1150 | 660 | 225 | 300 | 80                | 1" | 1" 1/4 | 1" 1/4 | 1/2" |  |
| 698♦     | 1240             | 1290 | 1753 | 2255 | 675 | 65 | 1335 | 1100 | 710 | 280 | 350 | 100               | 1" | 1" 1/2 | 1" 1/2 | 1/2" |  |
| 814♦     | 1240             | 1290 | 2003 | 2500 | 675 | 65 | 1335 | 1200 | 710 | 280 | 350 | 100               | 1" | 1" 1/2 | 1" 1/2 | 1/2" |  |
| 930♦     | 1240             | 1290 | 2003 | 2500 | 675 | 65 | 1335 | 1200 | 710 | 280 | 350 | 100               | 1" | 1" 1/2 | 1" 1/2 | 1/2" |  |
| 1046♦    | 1390             | 1440 | 2003 | 2500 | 750 | 65 | 1485 | 1200 | 710 | 280 | 400 | 125               | 1" | 1" 1/2 | 1" 1/2 | 1/2" |  |
| 1163♦    | 1390             | 1440 | 2003 | 2500 | 750 | 65 | 1485 | 1200 | 710 | 280 | 400 | 125               | 1" | 1" 1/2 | 1" 1/2 | 1/2" |  |

• Pressure losses referring to a differential temperature of 12°C.

Maximum boiler operating pressure 5 bar

\* Boiler exempt from fire prevention tests

● One fitting only N5

# TECHNICAL SPECIFICATIONS

## 2.2. DRM BOILER

N1 - Flow

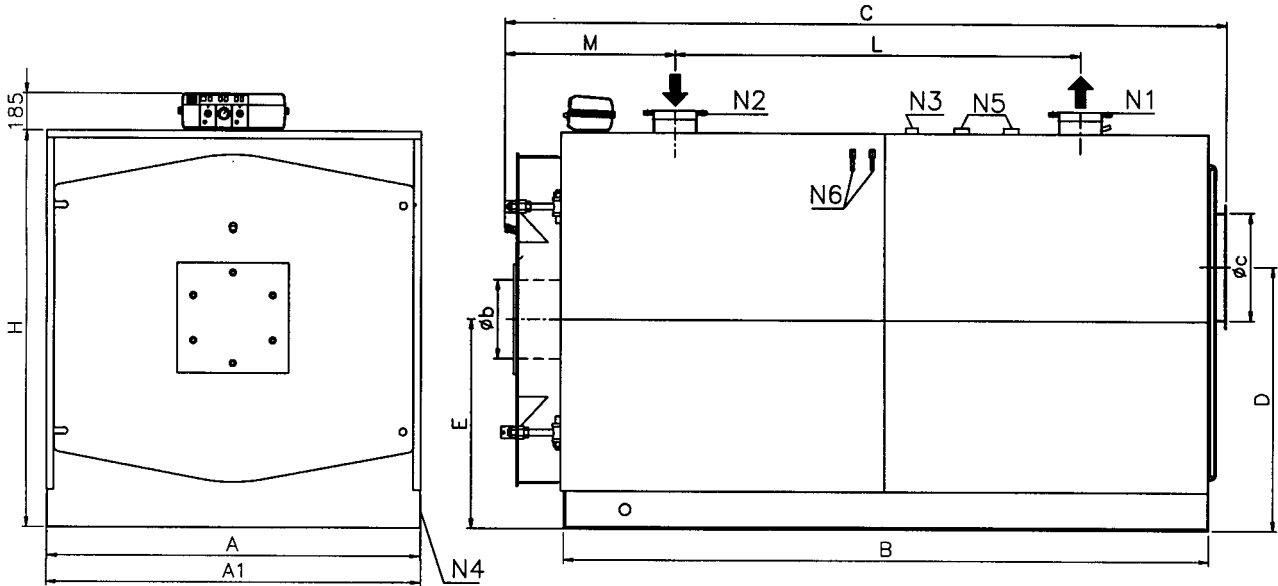
N2 - Return

N3 - Fitting for instruments

N4 - Lower fitting

N5 - Fitting for safety valves

N6 - Bulb wells



| DRM  | HEAT OUTPUT |       | HEAT INPUT nett CV |       | CAPACITY<br>litri | PRESSURE LOSSES<br>WATER SIDE•<br>mbar | COMBUSTION CHAMBER<br>RESISTANCE<br>mbar | WEIGHT<br>kg |
|------|-------------|-------|--------------------|-------|-------------------|--|--|--------------|
|      | kcal/h      | kW    | kcal/h             | kW    |                   |  |  |              |
| 1395 | 1.200.000   | 1.395 | 1.314.410          | 1.528 | 1820              | 28                                     | 6,0                                      | 2540         |
| 1569 | 1.350.000   | 1.569 | 1.479.060          | 1.719 | 2020              | 32                                     | 6,5                                      | 2860         |
| 1744 | 1.500.000   | 1.744 | 1.640.190          | 1.907 | 2200              | 37                                     | 7,0                                      | 3220         |
| 1976 | 1.700.000   | 1.976 | 1.866.900          | 2.170 | 2350              | 35                                     | 6,0                                      | 3680         |
| 2325 | 2.000.000   | 2.325 | 2.196.990          | 2.554 | 2700              | 40                                     | 7,5                                      | 4250         |
| 2907 | 2.500.000   | 2.907 | 2.749.400          | 3.197 | 3600              | 49                                     | 8,0                                      | 5190         |
| 3488 | 3.000.000   | 3.488 | 3.297.590          | 3.834 | 4400              | 60                                     | 9,0                                      | 6150         |

| DRM  | DIMENSIONS<br>mm |      |      |      |      |      |      |      |     |          |          | FITTINGS<br>DN/in |        |        |        |      |
|------|------------------|------|------|------|------|------|------|------|-----|----------|----------|-------------------|--------|--------|--------|------|
|      | A                | A1   | B    | C    | D    | E    | H    | L    | M   | $\phi b$ | $\phi c$ | N1/N2             | N3     | N4     | N5     | N6   |
| 1395 | 1500             | 1510 | 2265 | 2650 | 1135 | 885  | 1650 | 1300 | 785 | 320      | 400      | 150               | 1"     | 1" 1/2 | 1" 1/2 | 1/2" |
| 1569 | 1500             | 1510 | 2565 | 2950 | 1135 | 885  | 1650 | 1600 | 785 | 320      | 400      | 150               | 1"     | 1" 1/2 | 1" 1/2 | 1/2" |
| 1744 | 1500             | 1510 | 2815 | 3200 | 1135 | 885  | 1650 | 1850 | 785 | 320      | 400      | 150               | 1"     | 1" 1/2 | 1" 1/2 | 1/2" |
| 1976 | 1720             | 1730 | 2615 | 3020 | 1160 | 960  | 1830 | 1550 | 855 | 360      | 500      | 200               | 1" 1/2 | 1" 1/2 | 2"     | 1/2" |
| 2325 | 1720             | 1730 | 3015 | 3420 | 1160 | 960  | 1830 | 1950 | 855 | 360      | 500      | 200               | 1" 1/2 | 1" 1/2 | 2"     | 1/2" |
| 2907 | 1870             | 1880 | 3266 | 3655 | 1335 | 1055 | 2000 | 2050 | 855 | 400      | 550      | 200               | 1" 1/2 | 1" 1/2 | 2"     | 1/2" |
| 3488 | 2000             | 2010 | 3470 | 3850 | 1410 | 1110 | 2110 | 2250 | 855 | 400      | 550      | 200               | 1" 1/2 | 2"     | 2"     | 1/2" |

• Pressure losses referring to a differential temperature of 12°C

Maximum boiler operating pressure 5 bar.

## TECHNICAL SPECIFICATIONS

### 2.3. DRNV 186 - 581 BOILER

N1 - Flow

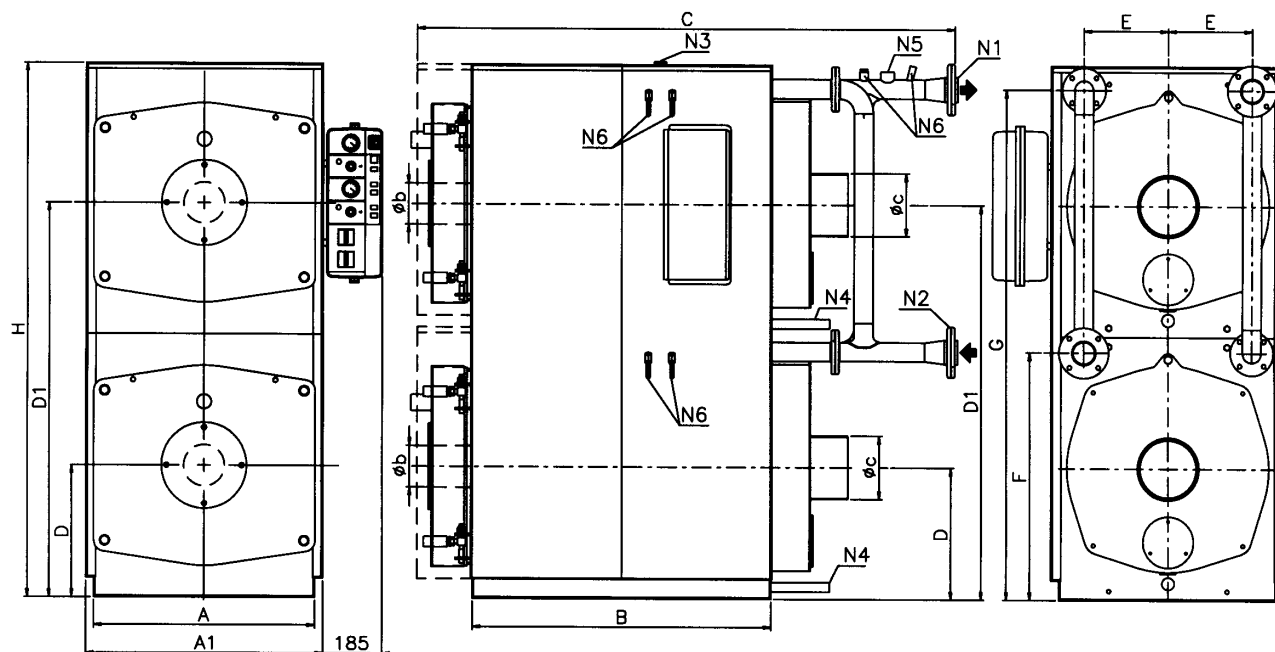
N2 - Return

N3 - Fitting for 2<sup>nd</sup> safety valve (only for type 500)

N4 - Lower fitting

N5 - Fitting for instruments

N6 - Bulb wells



| DRNV | HEAT OUTPUT |     | HEAT INPUT nett CV |     | CAPACITY<br>litres | PRESSURE LOSSES<br>WATER SIDE •<br>mbar | COMBUSTION CHAMBER<br>RESISTANCE<br>mbar | WEIGHT<br>kg |
|------|-------------|-----|--------------------|-----|--------------------|---|--|--------------|
|      | kcal/h      | kW  | kcal/h             | kW  |                    |   |  |              |
| 186  | 160.000     | 186 | 173.760            | 202 | 246                | 12                                      | 0,8                                      | 500          |
| 209  | 180.000     | 209 | 195.500            | 227 | 246                | 14                                      | 1,0                                      | 500          |
| 233  | 200.000     | 233 | 216.310            | 252 | 246                | 15                                      | 1,1                                      | 500          |
| 302  | 260.000     | 302 | 282.380            | 328 | 344                | 16                                      | 1,2                                      | 725          |
| 372  | 320.000     | 372 | 346.670            | 403 | 344                | 17                                      | 1,6                                      | 725          |
| 465  | 400.000     | 465 | 436.990            | 508 | 600                | 18                                      | 1,8                                      | 870          |
| 581  | 500.000     | 581 | 544.750            | 633 | 712                | 20                                      | 2,0                                      | 1116         |

| DRNV | DIMENSIONS<br>mm |     |      |      |     |      |     |     |      |      |     |     | FITTINGS<br>DN/in |          |      |
|------|------------------|-----|------|------|-----|------|-----|-----|------|------|-----|-----|-------------------|----------|------|
|      | A                | A1  | B    | C    | D   | D1   | E   | F   | G    | H    | Øb  | Øc  | N1/N2             | N3/N4/N5 | N6   |
| 186  | 700              | 750 | 755  | 1470 | 415 | 1245 | 270 | 780 | 1610 | 1693 | 130 | 200 | 65                | 1"       | 1/2" |
| 209  | 700              | 750 | 755  | 1470 | 415 | 1245 | 270 | 780 | 1610 | 1693 | 130 | 200 | 65                | 1"       | 1/2" |
| 233  | 700              | 750 | 755  | 1470 | 415 | 1245 | 270 | 780 | 1610 | 1693 | 130 | 200 | 65                | 1"       | 1/2" |
| 302  | 750              | 800 | 1000 | 1745 | 440 | 1320 | 295 | 830 | 1710 | 1793 | 160 | 250 | 80                | 1"       | 1/2" |
| 372  | 750              | 800 | 1000 | 1745 | 440 | 1320 | 295 | 830 | 1710 | 1793 | 160 | 250 | 80                | 1"       | 1/2" |
| 465  | 850              | 900 | 1250 | 2000 | 490 | 1470 | 345 | 930 | 1910 | 1993 | 180 | 250 | 80                | 1"       | 1/2" |
| 581  | 850              | 900 | 1500 | 2250 | 490 | 1470 | 345 | 930 | 1910 | 1993 | 180 | 250 | 80                | 1"       | 1/2" |

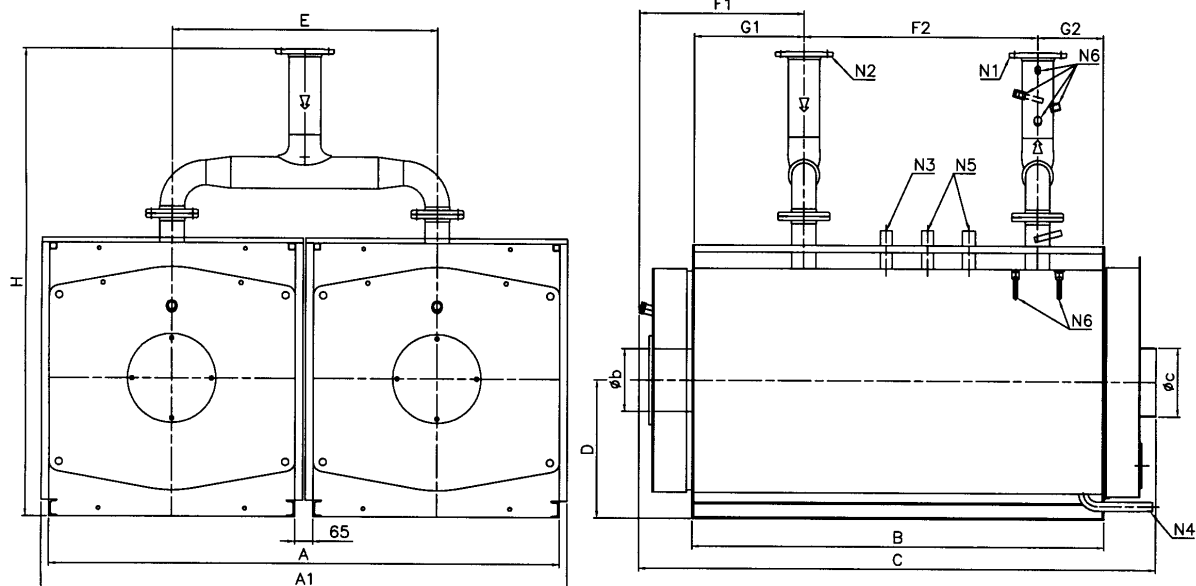
• Pressure losses referring to a differential temperature of 12°C. Maximum boiler operating pressure 5 bar

## TECHNICAL SPECIFICATIONS

### 2.4. DRNH 698 - 1163 BOILER

N1 - Flow  
N2 - Return  
N3 - Fitting for instruments

N4 - Lower fitting  
N5 - Fitting for safety valves  
N6 - Bulb wells



| DRNH                          | Type   | 698     | 814     | 930     | 1163      |
|-------------------------------|--------|---------|---------|---------|-----------|
| Heat output                   | kcal/h | 600.000 | 700.000 | 800.000 | 1.000.000 |
|                               | kW     | 698     | 814     | 930     | 1163      |
| Heat input nett CV            | kcal/h | 649.860 | 760.200 | 867.100 | 1.088.560 |
|                               | kW     | 756     | 884     | 1008    | 1266      |
| Working efficiency            | %      | 92,33   | 92,08   | 92,26   | 91,86     |
| 2 modules total capacity      | lt     | 720     | 720     | 1080    | 1290      |
| 2 modules total weight        | kg     | 1080    | 1080    | 1600    | 1800      |
| Pressure losses water side •  | mbar   | 20      | 25      | 22      | 27        |
| Combustion chamber resistance | mbar   | 3       | 4       | 3,5     | 5         |
| <b>Dimensions:</b>            |        |         |         |         |           |
| <b>A</b>                      | mm     | 1845    | 1845    | 2285    | 2285      |
| <b>A1</b>                     | mm     | 1901    | 1901    | 2341    | 2341      |
| <b>B</b>                      | mm     | 1502    | 1502    | 1502    | 1792      |
| <b>C</b>                      | mm     | 1890    | 1890    | 1950    | 2240      |
| <b>D</b>                      | mm     | 500     | 500     | 610     | 610       |
| <b>E</b>                      | mm     | 955     | 955     | 1175    | 1175      |
| <b>F1</b>                     | mm     | 600     | 600     | 663     | 663       |
| <b>F2</b>                     | mm     | 850     | 850     | 850     | 1150      |
| <b>G1</b>                     | mm     | 400     | 400     | 400     | 400       |
| <b>G2</b>                     | mm     | 240     | 240     | 240     | 230       |
| <b>H</b>                      | mm     | 1690    | 1690    | 1880    | 1900      |
| <b>Øb</b>                     | mm     | 225     | 225     | 225     | 225       |
| <b>Øc</b>                     | mm     | 250     | 250     | 300     | 300       |
| <b>Fittings:</b>              |        |         |         |         |           |
| <b>N1/N2</b>                  | DN     | 100     | 100     | 100     | 125       |
| <b>N3</b>                     | in     | 1"      | 1"      | 1"      | 1"        |
| <b>N4</b>                     | in     | 1"      | 1"      | 1"1/4   | 1"1/4     |
| <b>N5</b>                     | in     | 1"1/4●  | 1"1/4●  | 1"1/4   | 1"1/4     |
| <b>N6</b>                     | in     | 1/2"    | 1/2"    | 1/2"    | 1/2"      |

● Pressure losses referring to a differential temperature of 12°C  
● One fitting only N5

Maximum boiler operating pressure 5 bar

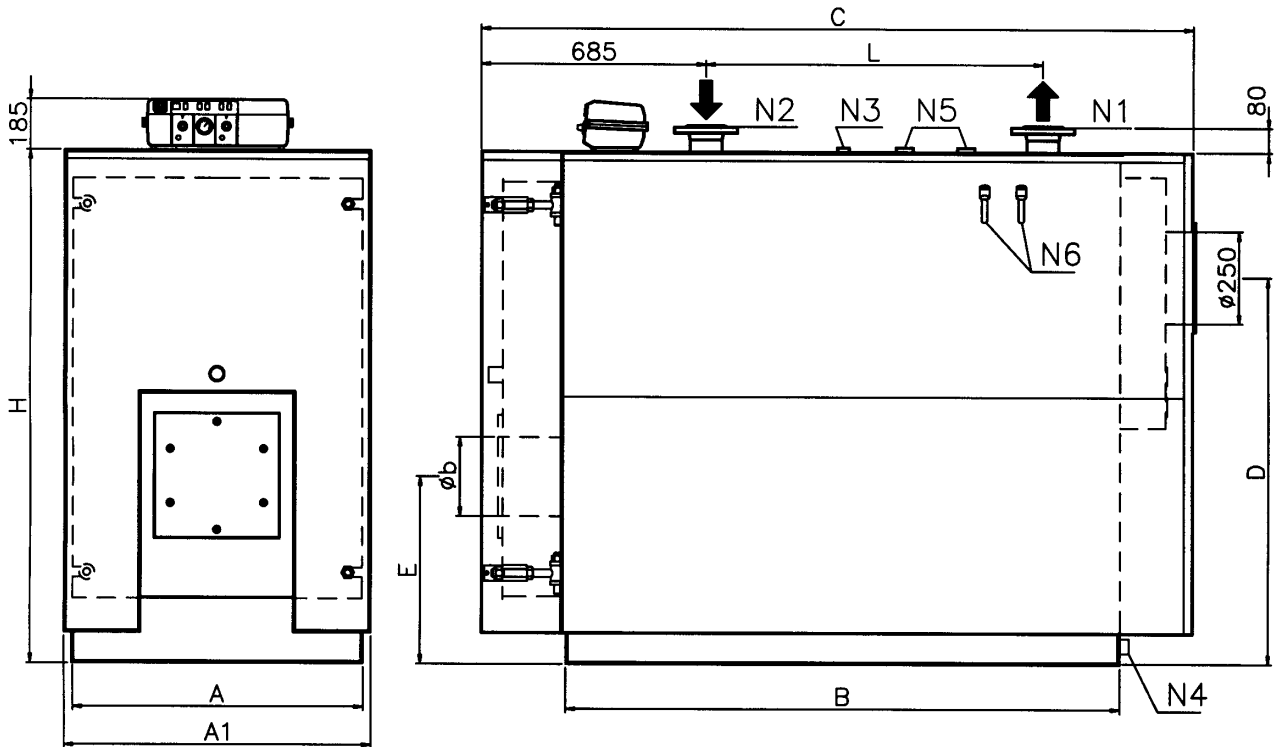


## TECHNICAL SPECIFICATIONS

### 2.5. AXS BOILER

N1 - Flow  
 N2 - Return  
 N3 - Fitting for instruments

N4 - Lower fitting  
 N5 - Fitting for safety valve/valves  
 N6 - Bulb wells



| AXS | HEAT OUTPUT |     | HEAT INPUT nett CV |     | CAPACITY<br>litres | PRESSURE LOSSES<br>WATER SIDE •<br>mbar | COMBUSTION CHAMBER<br>RESISTANCE<br>mbar | WEIGHT<br>kg |
|-----|-------------|-----|--------------------|-----|--------------------|---|--|--------------|
|     | kcal/h      | kW  | kcal/h             | kW  |                    |   |  |              |
| 232 | 200.000     | 232 | 217.240            | 252 | 320                | 16                                      | 2,0                                      | 780          |
| 290 | 250.000     | 290 | 270.690            | 314 | 320                | 18                                      | 2,5                                      | 780          |
| 349 | 300.000     | 349 | 324.930            | 378 | 390                | 20                                      | 3,0                                      | 980          |
| 407 | 350.000     | 407 | 385.260            | 448 | 390                | 25                                      | 4,0                                      | 980          |

| AXS | DIMENSIONS<br>mm |     |      |      |     |     |      |     |     |     | FITTINGS<br>DN/in |       |    |      |
|-----|------------------|-----|------|------|-----|-----|------|-----|-----|-----|-------------------|-------|----|------|
|     | A                | A1  | B    | C    | D   | E   | H    | I   | L   | Øb  | N1/N2             | N3/N4 | N5 | N6   |
| 232 | 700              | 750 | 1410 | 1900 | 900 | 440 | 1200 | 685 | 800 | 180 | 65                | 1"    | 1" | 1/2" |
| 290 | 700              | 750 | 1410 | 1900 | 900 | 440 | 1200 | 685 | 800 | 180 | 65                | 1"    | 1" | 1/2" |
| 349 | 750              | 800 | 1460 | 1950 | 950 | 460 | 1290 | 685 | 850 | 225 | 80                | 1"1/4 | 1" | 1/2" |
| 407 | 750              | 800 | 1460 | 1950 | 950 | 460 | 1290 | 685 | 850 | 225 | 80                | 1"1/4 | 1" | 1/2" |

• Pressure losses referring to a differential temperature of 12°C. Maximum boiler operating pressure 5 bar

### 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 table below 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.

**Table of connection pipe diameter**

| BOILER TYPE |             | Ø in mm |
|-------------|-------------|---------|
| DRN         | 93 - 116    | 200     |
| DRN         | 151 - 407   | 250     |
| DRN         | 465 - 581   | 300     |
| DRN         | 698 - 930   | 350     |
| DRN         | 1046 - 1163 | 400     |
| DRM         | 1395 - 1744 | 400     |
| DRM         | 1976 - 2325 | 500     |
| DRM         | 2907 - 3488 | 550     |
| DRNV        | 186 - 233   | 200     |
| DRNV        | 302 - 372   | 250     |
| DRNH        | 465 - 581   | 300     |
| AXS         | 230 - 407   | 250     |

## 3.2. HYDRAULIC CONNECTION

### 3.2.1 HOT WATER HEATING SYSTEM WITH CLOSED EXPANSION VESSEL - Furnace output $\leq$ 300.000 kcal/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:
  - N4a re-circulation (backend protection pump)
  - N4b expansion vessel fitting
  - N4c filling/drain
- N6 - Bulb wells (thermometer, pump consent thermostat, regulation thermostat, safety thermostat).

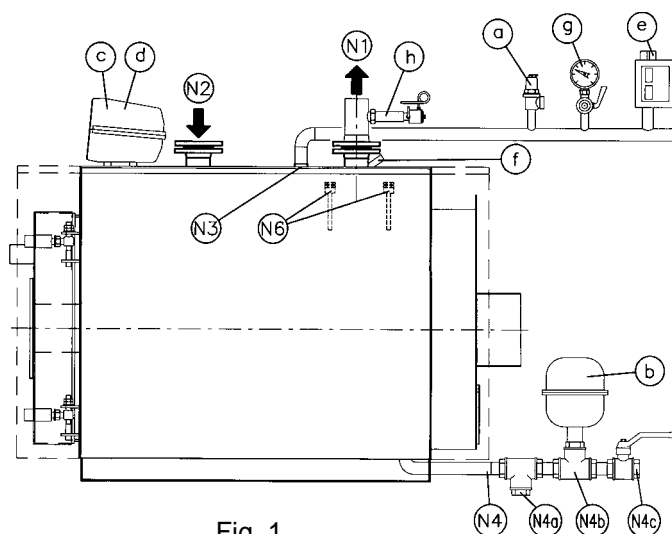


Fig. 1

### 3.2.2. HOT WATER HEATING SYSTEM WITH CLOSED EXPANSION VESSEL - Furnace output $>$ 300,000 kcal/h - pressure 5 bar (Fig. 2)

The generator must be provided with:

- a - 1 safety valve
- 2 safety valves if output is  $>$  500,000 kcal/h
- b - Expansion vessel
- c - Regulation thermostats
- d - 1st safety thermostat
- e - 2nd 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:
  - N4a re-circulation (backend protection pump)
  - N4b expansion vessel fitting
  - N4c Filling/drain
- N5 - Safety valves fitting
- N6 - Bulb wells (thermometer, pump consent thermostat, regulation thermostat, safety thermostat)

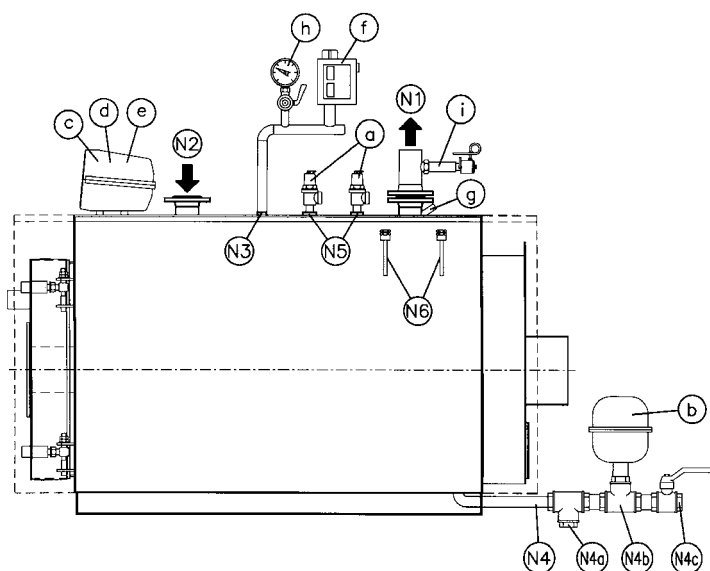


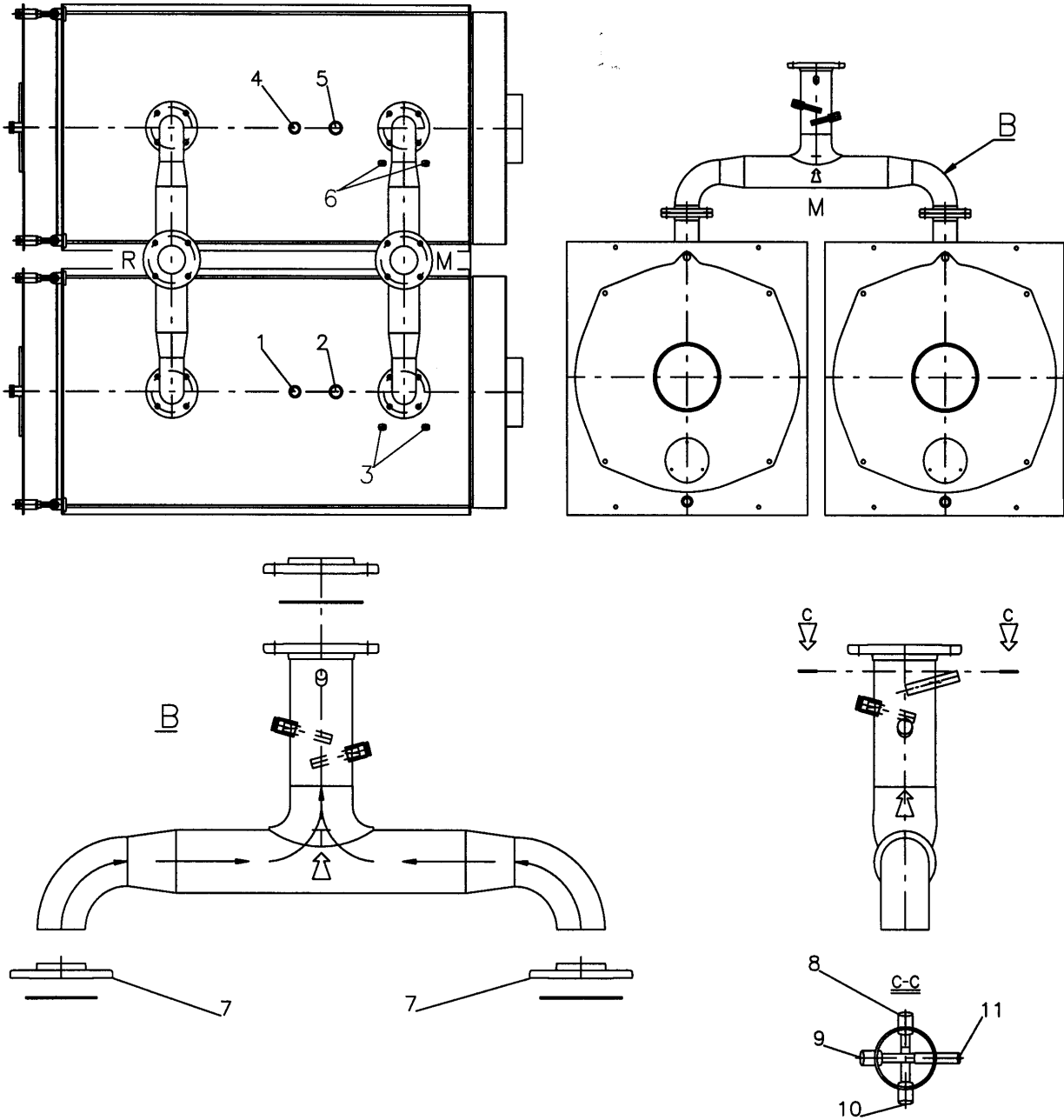
Fig. 2

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.

# INSTALLATION

## 3.2.3. DRNH 698-1163 POSITIONING INSTRUMENTS



### Key

1. Pressure switch fitting
  2. 1<sup>st</sup> safety valve fitting or thermal drainage 1<sup>st</sup> safety
  3. 1<sup>st</sup> boiler circulator consent thermostat bulb wells and 1<sup>st</sup> boiler thermometer
  4. Manometer fitting with control manometer flange
  5. 2<sup>nd</sup> safety valve fitting or thermal drainage 1<sup>st</sup> safety
  6. 2<sup>nd</sup> boiler circulator consent thermostat bulb wells and 2<sup>nd</sup> boiler thermometer
  7. Flanges to weld after the definitive and correct positioning of the boilers
  8. 1<sup>st</sup> and 2<sup>nd</sup> boiler fuel valve bulbs well
  9. 1<sup>st</sup> and 2<sup>nd</sup> boiler safety thermostats bulb wells
  10. 1<sup>st</sup> and 2<sup>nd</sup> boiler bi-thermostats bulbs well, digital regulator thermal-resistance (optional)
  11. Temperature test bulb wells
- M. Flow  
R. Return

## INSTALLATION

### 3.3. ELECTRICAL CONNECTION

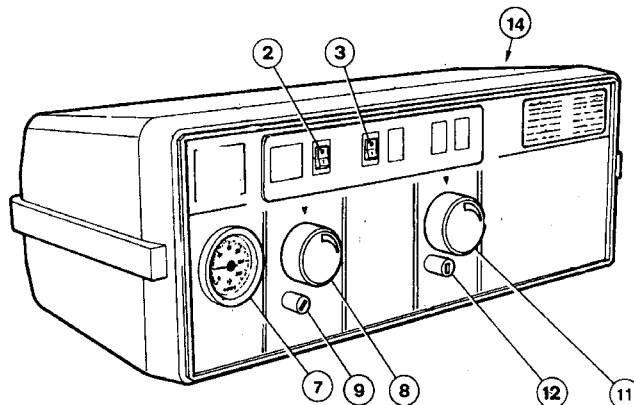
Electrical systems of thermal plants designed only for heating purposes **must comply with numerous legal regulations which apply both in general as well as specifically to each application or fuel type.**

### 3.4 DRN/DRM/AXS CONTROL PANEL (Fig. 3)

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

- 2 - Burner switch
- 3 - Pump switch
- 7 - Boiler thermometer
- 8 - Burner 1st stage thermostat
- 9 - 1st safety thermostat
- 11 - Burner 2nd stage thermostat
- 12 - 2nd safety thermostat \*
- 14 - Circulator consent thermostat

Fig. 3



The upper part of the control panel can be removed 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 (TS1 and TS2)** have a fixed setting of 100 (+0/-6)°C and can be manually reset in accordance with Ministerial Decree 1/12/75 «R».

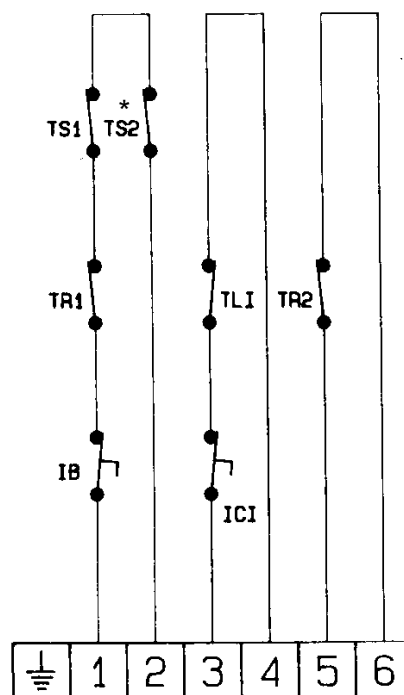
**Circulator consent thermostat (TL1)** has a fixed setting of 50°C with a working range of 6°C: at start-up, with the heating system cold, this permits higher boiler temperatures to be maintained thus reducing the risk of flue gas condensation.

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

#### 3.4.1. DRN/DRM/AXS WIRING DIAGRAM

**Key**

- IB Burner switch
- ICI System circulator switch
- TR1 Regulation thermostat (1st flame) 60÷90°C 2000 mm
- TR2 Regulation thermostat (2nd flame) 60÷90°C 2000 mm
- TS1 1<sup>st</sup> safety thermostat 100 (+0/-6)°C 2000 mm
- TS2\* 2<sup>nd</sup> safety thermostat 100 (+0/-6)°C 2000 mm
- TLI Circulator consent thermostat 50°C fixed 2000 mm
- 1-2 Burner consent (1<sup>st</sup> flame)
- 3-4 Circulator consent
- 5-6 Burner consent (2<sup>nd</sup> flame)



\* Only for furnace output > 300,000 kcal/h

### 3.5. DRNV&H OPERATING PRINCIPLES

The boiler consists of 2 units of same capacity and one only control panel for both units. Each unit can work independently and the boiler can be operated partially. This means that all panel controls (burner switches, thermostats and thermometers) have been doubled. See paragraph 4.5 on connection. As an example, bi-thermostats TR1 and TR2 can be adjusted so that there is a 10°C intervention difference between each other (do not forget that knobs have a 60° to 90° regulation range with a ¼ turn rotation). Flow water temperature after 2 equal flows have been mixed corresponds to mean temperature displayed by the 2 thermostats of each unit

#### 3.5.1. DRNV&H CONTROL PANEL (Fig. 4)

The standard control panel is made of plastic with IP40 protection degree and houses the regulation and safety instruments:

- 1 - Main switch
- 2 - 1<sup>st</sup> boiler burner switch
- 3 - 2<sup>nd</sup> boiler burner switch
- 4 - Plant circulation switch
- 7 - 1<sup>st</sup> boiler thermometer (TM1)
- 8 - 1<sup>st</sup> boiler regulation bi-thermostat (TR1)
- 9 - 1<sup>st</sup> boiler safety thermostat (TS1)
- 10 - 2<sup>nd</sup> boiler thermostat (TM2)
- 11 - 2<sup>nd</sup> boiler regulation bi-thermostat (TR2)
- 12 - 2<sup>nd</sup> boiler safety thermostat (TS2)
- 13 - 1<sup>st</sup> and 2<sup>nd</sup> hour meter
- 14 - 1<sup>st</sup> boiler Circulator consent thermostat (TL1)
- 15 - 2<sup>nd</sup> boiler Circulator consent thermostat (TL2)

The upper part of the control panel can be removed 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.

**The regulation bi-thermostats (TR1 and TR2)** have an operating range from 60° to 90° and can be set by the user by means of the front knob. The temperature differential of each bi-thermostat is fixed and approx. 7°C.

**Safety thermostats (TS1 and TS2)** have a fixed setting of 100 (+0/-6)°C and can be manually reset in accordance with Ministerial Decree 1/12/75 «R».

**Circulator consent thermostats (TL1 and TL2)** have 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..

**Note:** both hour meters start each time their own burner starts. It is recommended that the numbers displayed by both hour meters are monitored . This helps guarantee that burners have almost the same number of working hours.

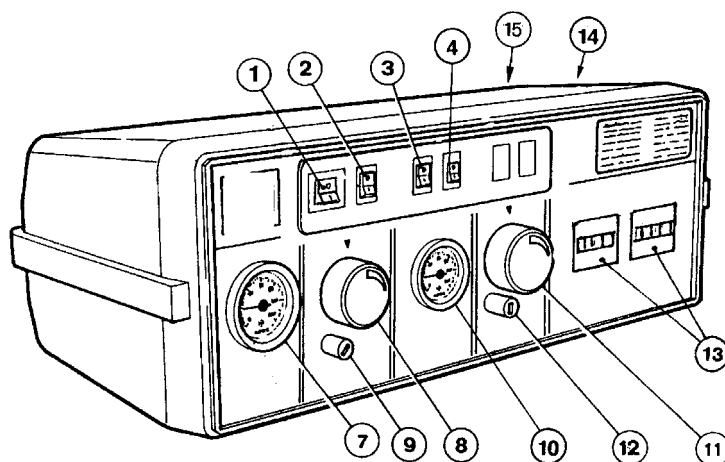
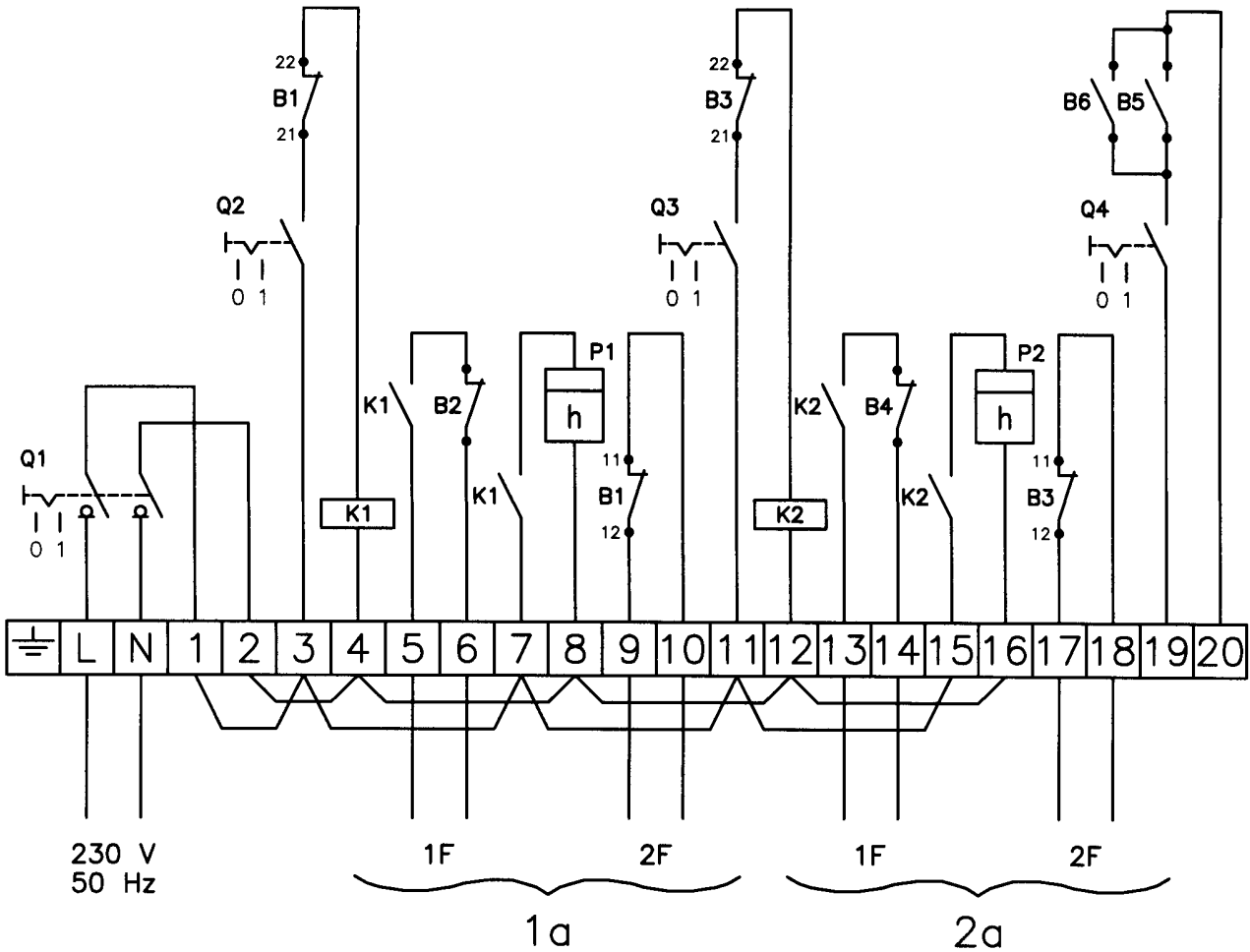


Fig. 4

# INSTALLATION

## 3.5.2. DRNV&H WIRING DIAGRAM

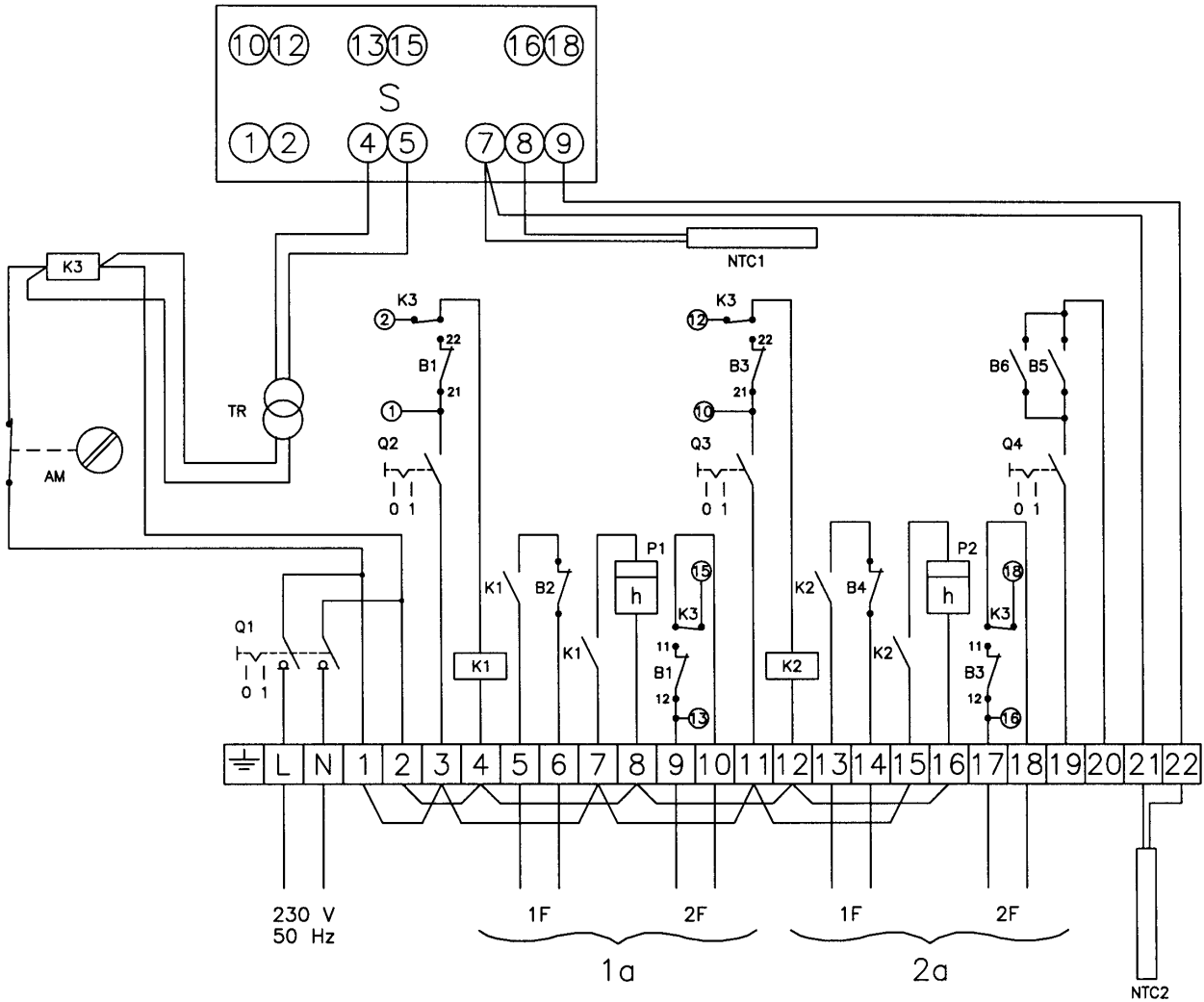


### Key

- |   |   |
|---|---|
| <b>B1</b> 1 <sup>st</sup> boiler bi-thermostat          | 1500 mm (50÷90°C $\Delta t_{1F/2F}=7^{\circ}\text{C}$ ) |
| <b>B2</b> 1 <sup>st</sup> boiler safety thermostat      | 2000 mm (100°-6°C)                                      |
| <b>B3</b> 2 <sup>nd</sup> boiler thermostat             | 1500 mm (50÷90°C $\Delta t_{1F/2F}=7^{\circ}\text{C}$ ) |
| <b>B4</b> 2 <sup>nd</sup> boiler safety thermostat      | 2000 mm (100°-6°C)                                      |
| <b>B5</b> 1 <sup>st</sup> boiler lower limit thermostat | 2000 mm (50°C)  |
| <b>B6</b> 2 <sup>nd</sup> boiler lower limit thermostat | 2000 mm (50°C)  |
| <b>K1</b> 1 <sup>st</sup> burner auxiliary circuit      |   |
| <b>K2</b> 2 <sup>nd</sup> burner auxiliary circuit      |   |
| <b>P1</b> 1 <sup>st</sup> boiler - Burner hour meter    |   |
| <b>P2</b> 2 <sup>nd</sup> boiler - Burner hour meter    |   |
| <b>Q1</b> Main switch                                   |   |
| <b>Q2</b> 1 <sup>st</sup> burner switch                 |   |
| <b>Q3</b> 2 <sup>nd</sup> burner switch                 |   |
| <b>Q4</b> Plant circulator switch                       |   |
| <b>1F</b> 1 <sup>st</sup> Flame                         |   |
| <b>2F</b> 2 <sup>nd</sup> Flame                         |   |
| <b>1a</b> Upper boiler                                  |   |
| <b>2a</b> Lower boiler                                  |   |

## INSTALLATION

### 3.5.3. DRNV&H WIRING DIAGRAM WITH DIGITAL REGULATOR (optional)



#### Key

|             |   |   |
|-------------|---|---|
| <b>B1</b>   | 1 <sup>st</sup> boiler bi-thermostat          | 1500 mm (60÷90°C $\Delta t_{1F/2F}=7^{\circ}\text{C}$ ) |
| <b>B2</b>   | 1 <sup>st</sup> boiler safety thermostat      | 2000 mm (100°-6°C)                                      |
| <b>B3</b>   | 2 <sup>nd</sup> boiler thermostat             | 1500 mm (60÷90°C $\Delta t_{1F/2F}=7^{\circ}\text{C}$ ) |
| <b>B4</b>   | 2 <sup>nd</sup> boiler safety thermostat      | 2000 mm (100°-6°C)                                      |
| <b>B5</b>   | 1 <sup>st</sup> boiler lower limit thermostat | 2000 mm (50°C)  |
| <b>B6</b>   | 2 <sup>nd</sup> boiler lower limit thermostat | 2000 mm (50°C)  |
| <b>K1</b>   | 1 <sup>st</sup> burner auxiliary relay        |   |
| <b>K2</b>   | 2 <sup>nd</sup> burner auxiliary relay        |   |
| <b>K3</b>   | AUT/MAN relay                                 |   |
| <b>P1</b>   | 1 <sup>st</sup> boiler - Burner hour meter    |   |
| <b>P2</b>   | 2 <sup>nd</sup> boiler - Burner hour meter    |   |
| <b>Q1</b>   | Main switch                                   |   |
| <b>Q2</b>   | 1 <sup>st</sup> burner switch                 |   |
| <b>Q3</b>   | 2 <sup>nd</sup> burner switch                 |   |
| <b>Q4</b>   | Plant circulator switch                       |   |
| <b>1F</b>   | 1 <sup>st</sup> Stage                         |   |
| <b>2F</b>   | 2 <sup>nd</sup> Stage                         |   |
| <b>1a</b>   | Boiler 1                                      |   |
| <b>2a</b>   | Boiler 2                                      |   |
| <b>TR</b>   | Transformer 230 V – 12 V                      |   |
| <b>NTC1</b> | Heating flow sensor                           |   |
| <b>NTC2</b> | Outside sensor                                |   |
| <b>AM</b>   | AUT/MAN changeover switch                     |   |
| <b>S</b>    | Regulator                                     | transmitted:  |
|             |   | 1-2 1 <sup>st</sup> stage boiler 1                      |
|             |   | 13-15 2 <sup>nd</sup> stage boiler 1                    |
|             |   | 10-12 1 <sup>st</sup> stage boiler 2                    |
|             |   | 16-18 2 <sup>nd</sup> stage boiler 2                    |



## INSTALLATION

### 3.6 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.

### 3.7 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:

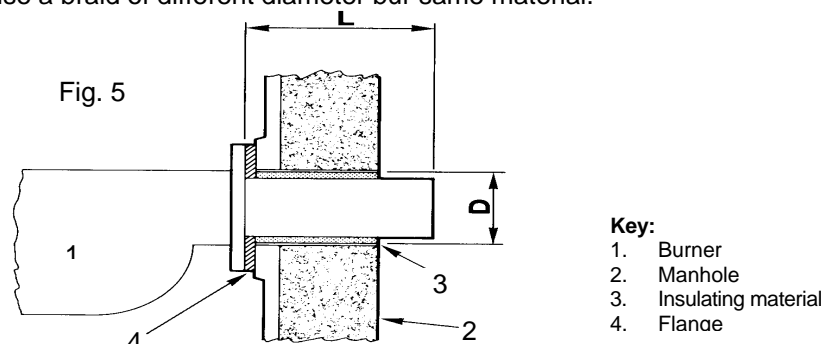
- a) check the internal and external seal of the fuel supply system;
- b) regulate the fuel flow according to the power required by the boiler;
- c) check that the boiler is fired by the correct type of fuel;
- d) check that the fuel supply pressure is within the values specified on the burner rating 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 insulating 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.



| BOILER TYPE |           | L – draught tube length (in mm) | D – burner hole diameter (in mm) |
|-------------|-----------|---------------------------------|----------------------------------|
| DRN         | 93 -116   | 200 - 250                       | 130                              |
| DRN         | 151-186   | 200 - 250                       | 160                              |
| DRN         | 232-290   | 200 - 250                       | 180                              |
| DRN         | 349-407   | 230 - 280                       | 225                              |
| DRN         | 465-581   | 270 - 320                       | 225                              |
| DRN         | 698-1163  | 270 - 320                       | 280                              |
| DRM         | 1395-1744 | 350 - 400                       | 320                              |
| DRM         | 1976-2325 | 500 - 550                       | 360                              |
| DRM         | 2907-3488 | 550 - 600                       | 400                              |
| DRNV        | 186-233   | 200 - 250                       | 130                              |
| DRNV        | 302-372   | 200 - 250                       | 160                              |
| DRNV        | 465-581   | 200 - 250                       | 180                              |
| DRNH        | 698-814   | 230 - 280                       | 225                              |
| DRNH        | 930-1163  | 270 - 320                       | 225                              |
| AXS         | 230-290   | 200 - 250                       | 180                              |
| AXS         | 349-407   | 270 - 320                       | 225                              |

4. ASSEMBLY

4.1. DRN 93 - 407 BOILER CASINGS (Fig. 8)

- a) Wrap the rock wool around the boiler body leaving the bulb well (P) on the right side exposed.
- b) Fit the panel (1S), inserting the upper fold into the square tube and the lower fold to the boiler side frame.
- c) 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.
- d) Fit panel (1D) as indicated under point b); fit panel (2D) ensuring that the capillaries are inserted in the slot provided in the panel itself.
- e) Secure the upper panels by screws and close the passage holes with special caps (see figure)

Super-isolation (on request)

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

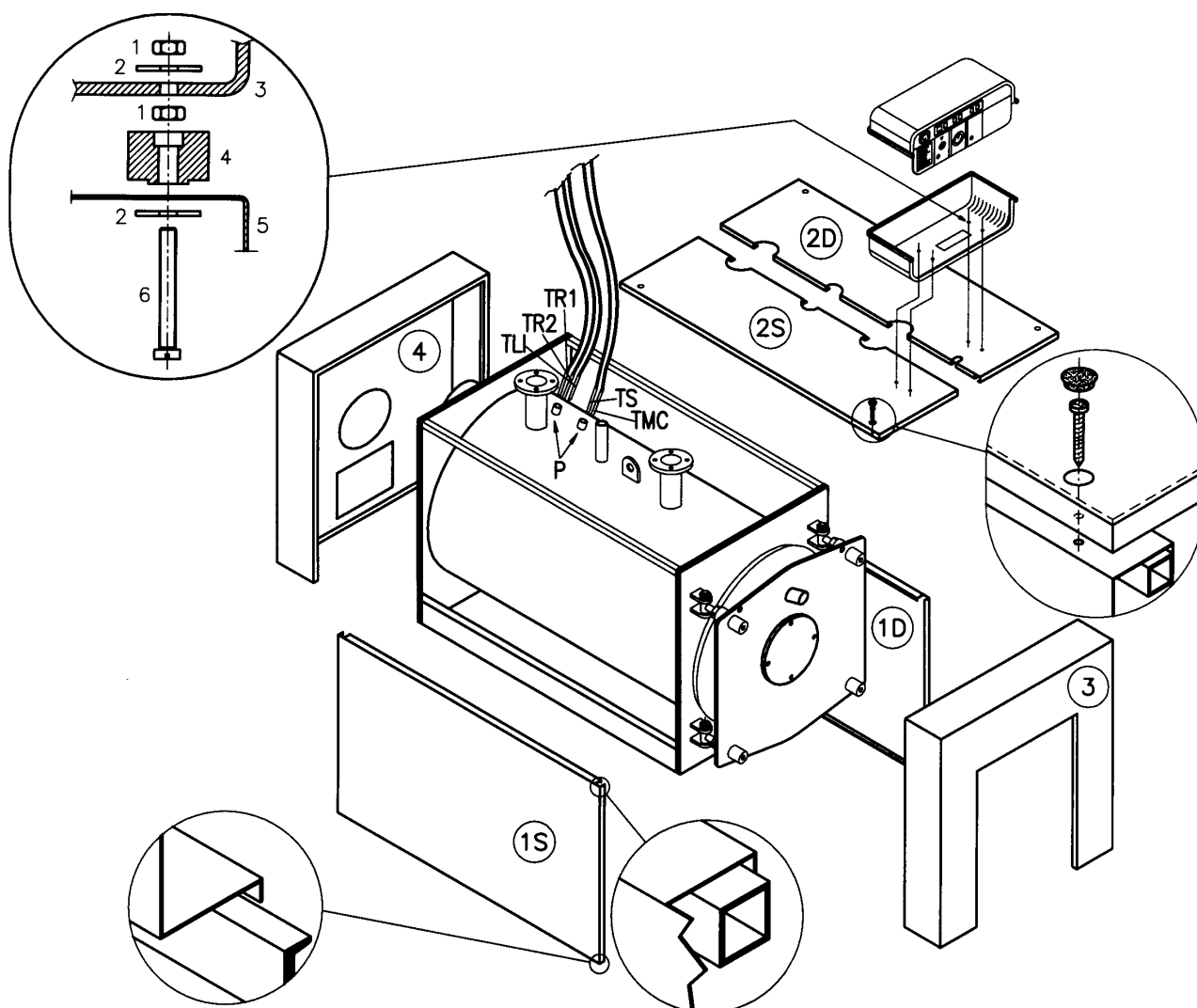


Fig. 8

**Key:** P Bulb wells – TR1-TR2 Regulation thermostats - TS Safety thermostat - TLI Circulator consent thermostat - TMC Boiler thermometer.  
 1 Nut - 2 Washer - 3 Plastic panel - 4 Spacer - 5 Shelf - 6 Screw

**4.2. DRN 465 - 1163 BOILER CASINGS (Fig. 9)**

- a) Wrap the rock wool around the boiler body leaving the bulb well on the right side exposed.
- b) Fit the lower panel (1S), inserting the fold into the square tube and repeat the same procedure with the upper panel (2S).
- c) 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.
- d) 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)**

- e) 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).
- f) 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).

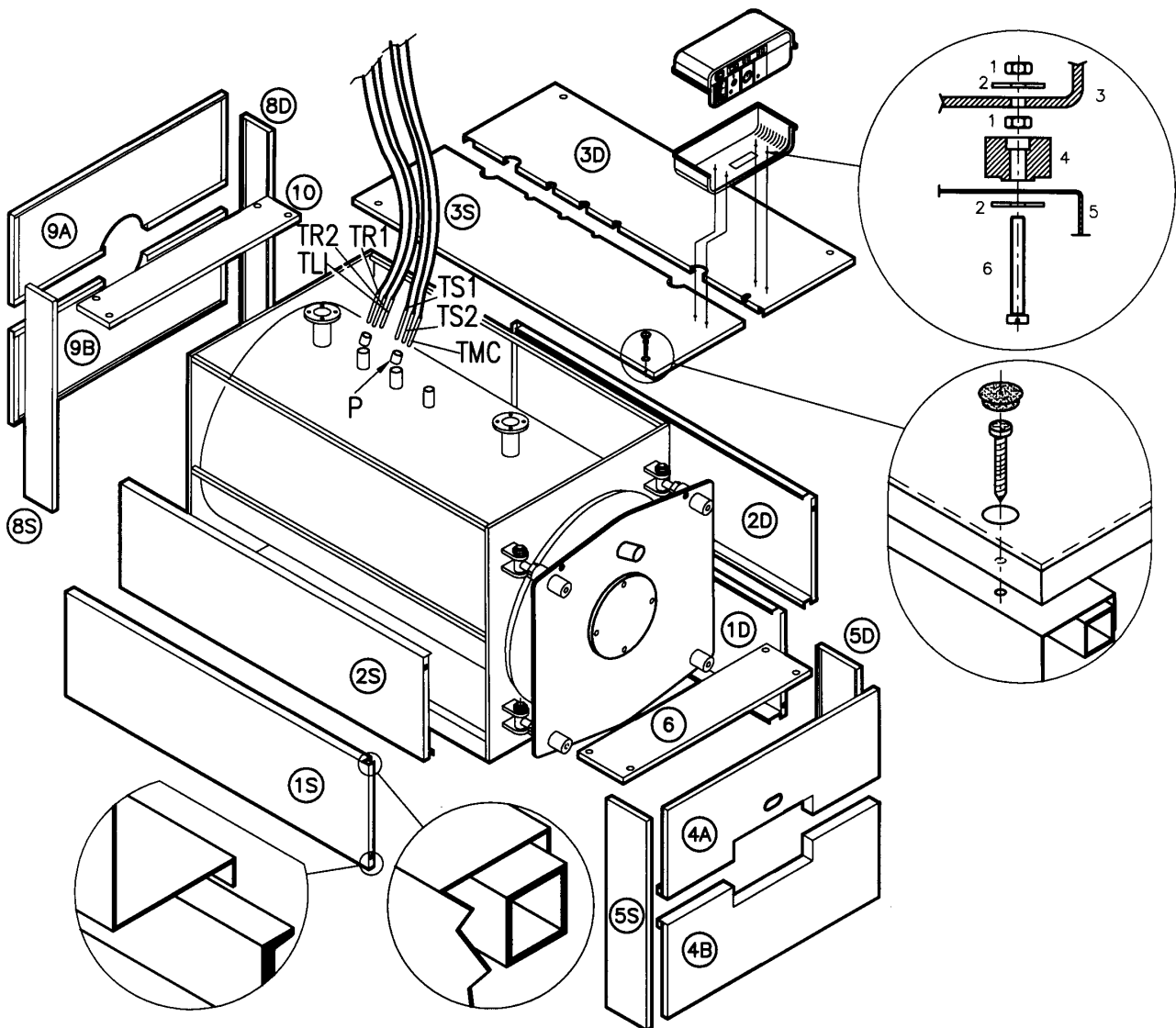


Fig. 9

**Key:** P Bulb wells – TR1-TR2 Regulation thermostats – TS1-TS2 Safety thermostats - TLI Circulator consent thermostat - TMC Boiler thermometer.  
 1 Nut - 2 Washer - 3 Plastic panel - 4 Spacer - 5 Shelf - 6 Screw

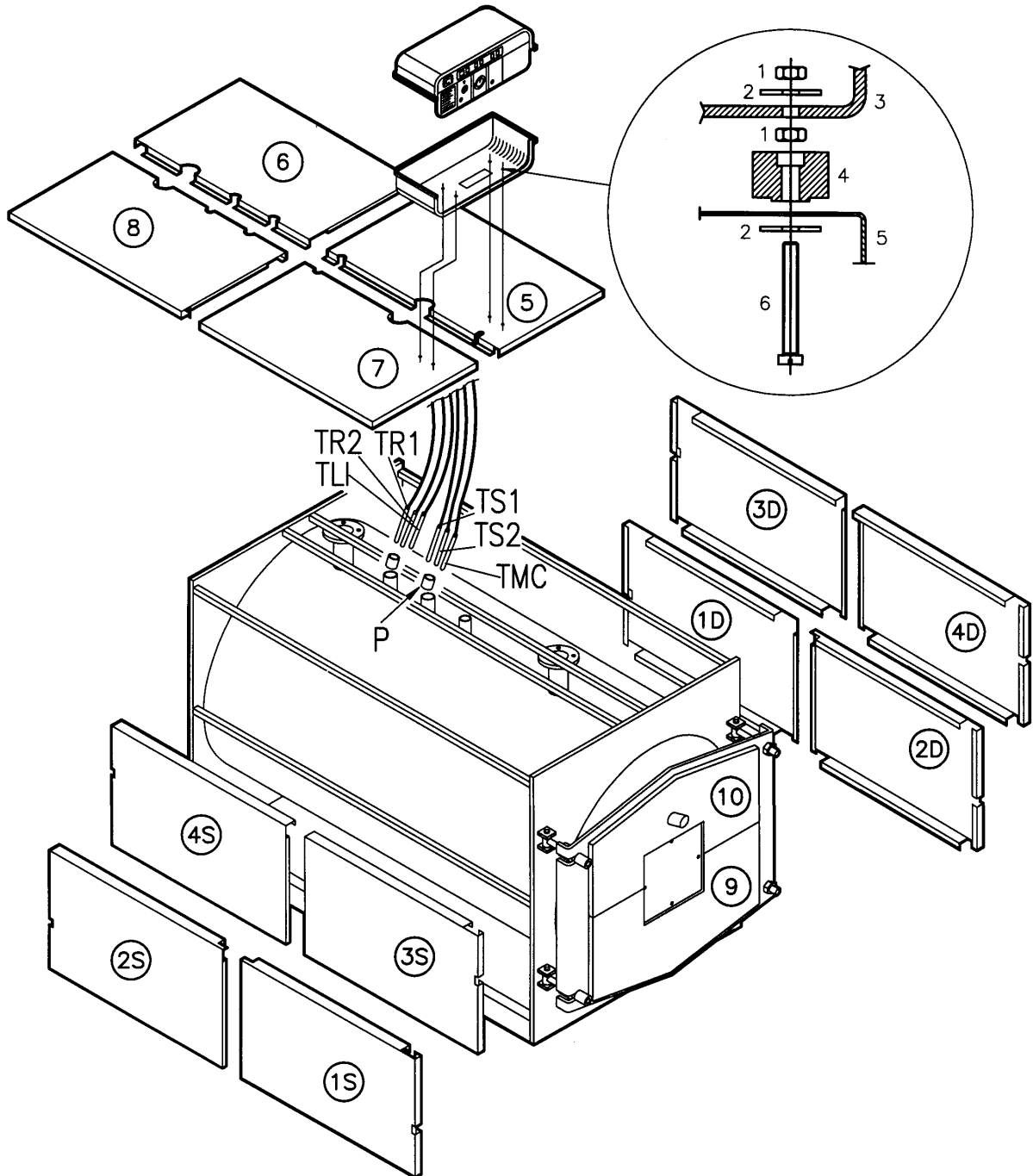
**4.3. DRM BOILER CASINGS (Fig. 10)**

- a) Wrap the rock wool around the boiler body leaving the bulb well on the right side exposed.
- b) Fit lower panels (1S) and (1D) inserting the fold into the square and repeat the same procedure with lower panels (2S) and (2D).
- c) Fit upper panels (3S) and (3D) inserting the fold into the square and repeat the same procedure with upper panels (4S) and (4D).
- d) Fit upper panels (5) and (6) on the boiler; fit the control panel on panel (5); uncoil the thermometer and thermostat capillaries ensuring that they are inserted in the slot provided; insert the bulbs in the wells (P).
- e) Fit panels (7) and (8) securing the control panel to panel (7).

**Super-isolation (on request)**

- f) Fit the panels (9) and (10) secured by screws.

Fig. 10



**Key:** P Bulb wells - TR1-TR2 Boiler regulation thermostats – TS1-TS2 Safety thermostats - TLI Circulator consent thermostat - TMC Boiler thermometer.  
 1 Nut - 2 Washer - 3 Plastic panel - 4 Spacer - 5 Shelf - 6 Screw

## 4.4. DRNV&H BOILER CASINGS (Fig. 11)

- a) Wrap the rock wool around the boiler body leaving the bulb well (P) on the right side exposed.
- b) Open control panel and, through the casing holes (P1 or P2) insert bulbs in their wells (see figure). Fit the control panel as illustrated in the drawing.
- c) Fit panels (P1, P2, P3 and P4) inserting the upper fold into the square tube and the lower fold to the boiler side frame.
- d) Fit panel (P5).
- e) Fit the control panel with electrical connections

**NOTE:** FOR THE POSITIONING OF THE DRNH 698 - 1163 BOILER'S BULBS SEE PAR. 3.2.3.

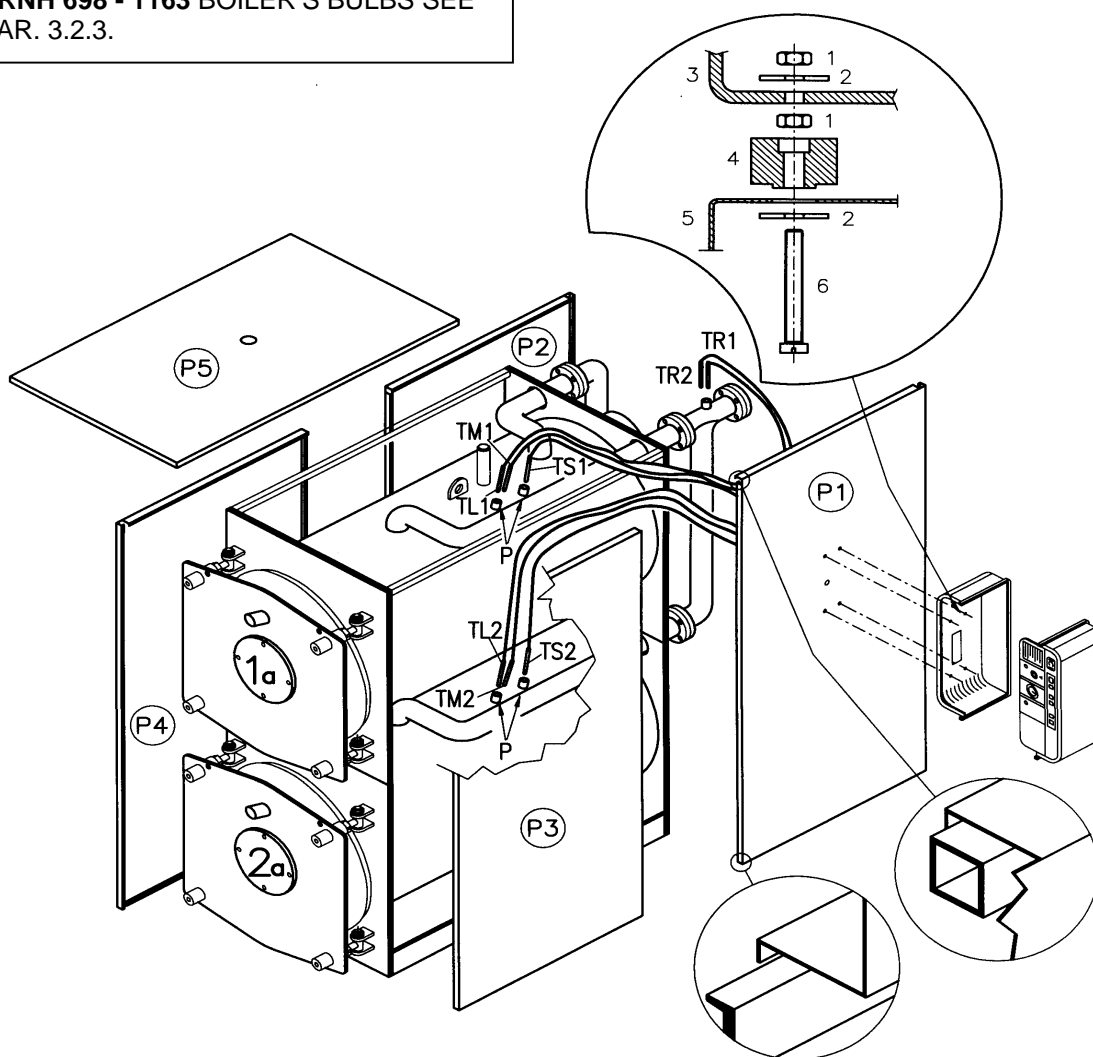


Fig. 11

**Key:** P Bulb wells - TR1 1<sup>st</sup> boiler regulation thermostat - TR2 2<sup>nd</sup> boiler regulation thermostat - TS1 1<sup>st</sup> boiler safety thermostat - TS2 2<sup>nd</sup> boiler safety thermostat - TL1 1<sup>st</sup> boiler circulation consent thermometer - TL2 2<sup>nd</sup> boiler circulation consent thermometer - TM1 1<sup>st</sup> boiler thermometer - TM2 2<sup>nd</sup> boiler thermometer.  
 1 Nut - 2 Washer - 3 Plastic panel - 4 Spacer - 5 Shelf - 6 Screw

## ASSEMBLY

### 4.5. AXS BOILER CASINGS (Fig. 12)

- a) Wrap the rock wool around the boiler body leaving the bulb well on the right side exposed.
- b) Fit the lower panel (1S), inserting the fold into the square tube and repeat the same procedure with the upper panel (2S).
- c) 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.
- d) 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).
- e) Fit the panels (4S) and (4D), connecting them to the side panels by means of the brackets; fit the front panel (5) connecting it to panels (4S) and (4D). Close the manhole casing by fitting the upper panel (6).
- f) Fit the back panel (7), connecting it to the side panels by means of the brackets.

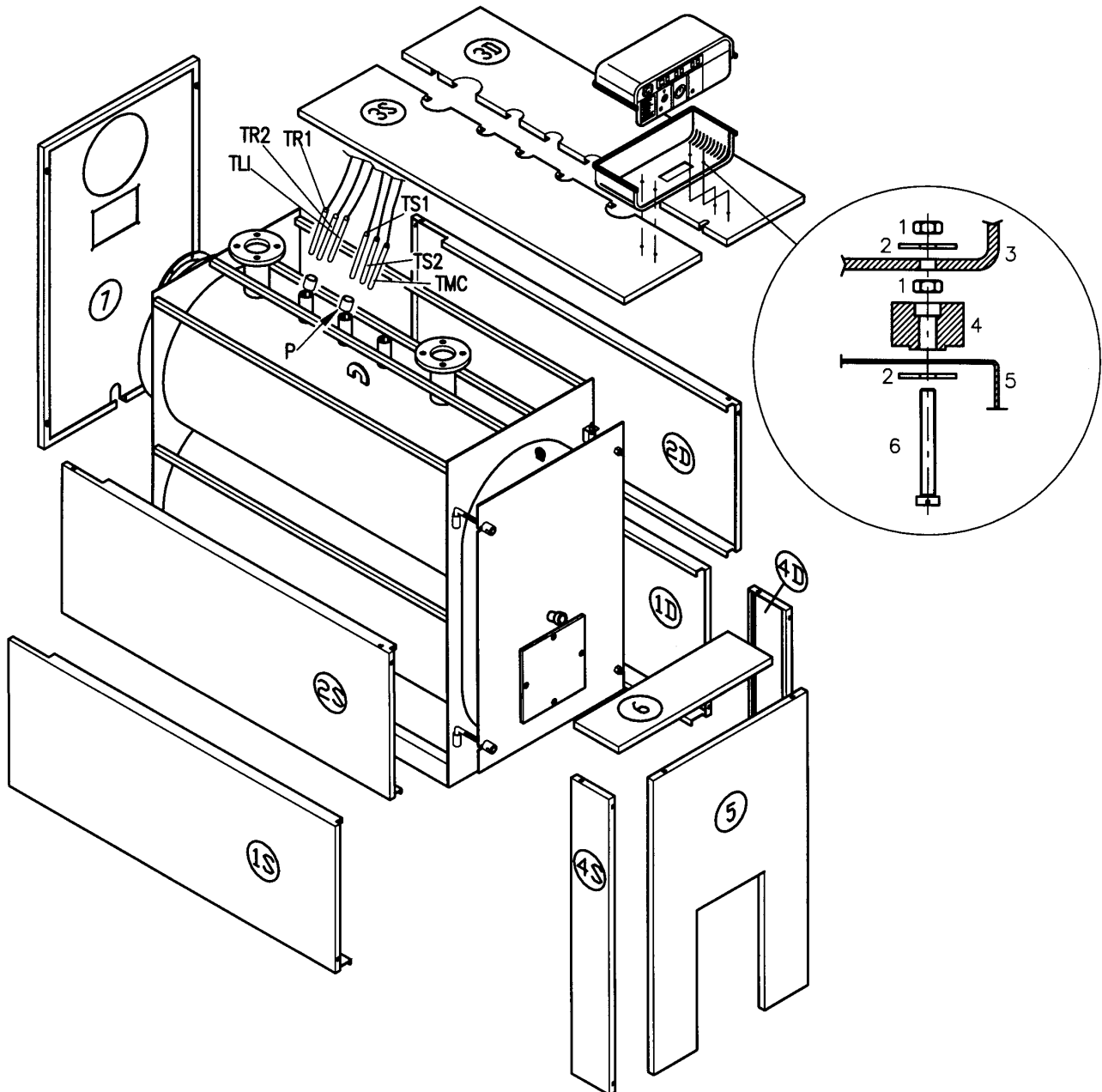


Fig.12

**Key:** P Bulb wells – TR1-TR2 Regulation thermostats – TS1-TS2 Safety thermostats - TLI Circulator consent thermostat - TMC Boiler thermometer.  
 1 Nut - 2 Washer - 3 Plastic panel - 4 Spacer - 5 Shelf - 6 Screw

## OPERATION

### 5. START UP

**WARNING:** Before start up insert the turbulators into the smoke tubes ensuring that they have been pushed inside for at least a further 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.

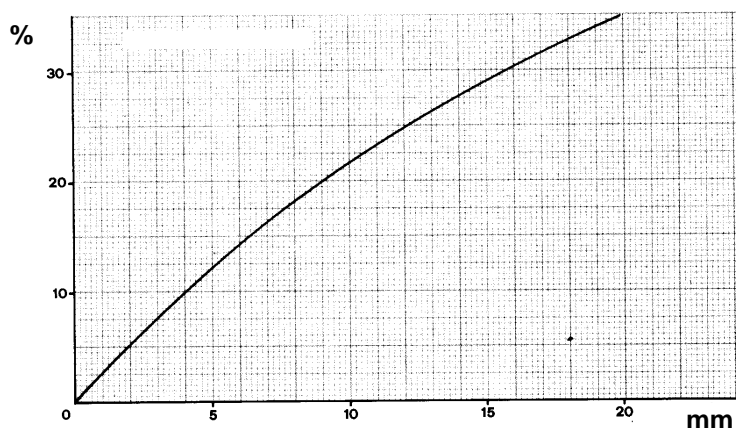
Scale creates an insulating layer which reduces the thermal transfer of the generator, affecting system efficiency. This means that the heat produced by burning the fuel is not fully exploited and is lost to the flue.

##### 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.

## OPERATION

### 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.

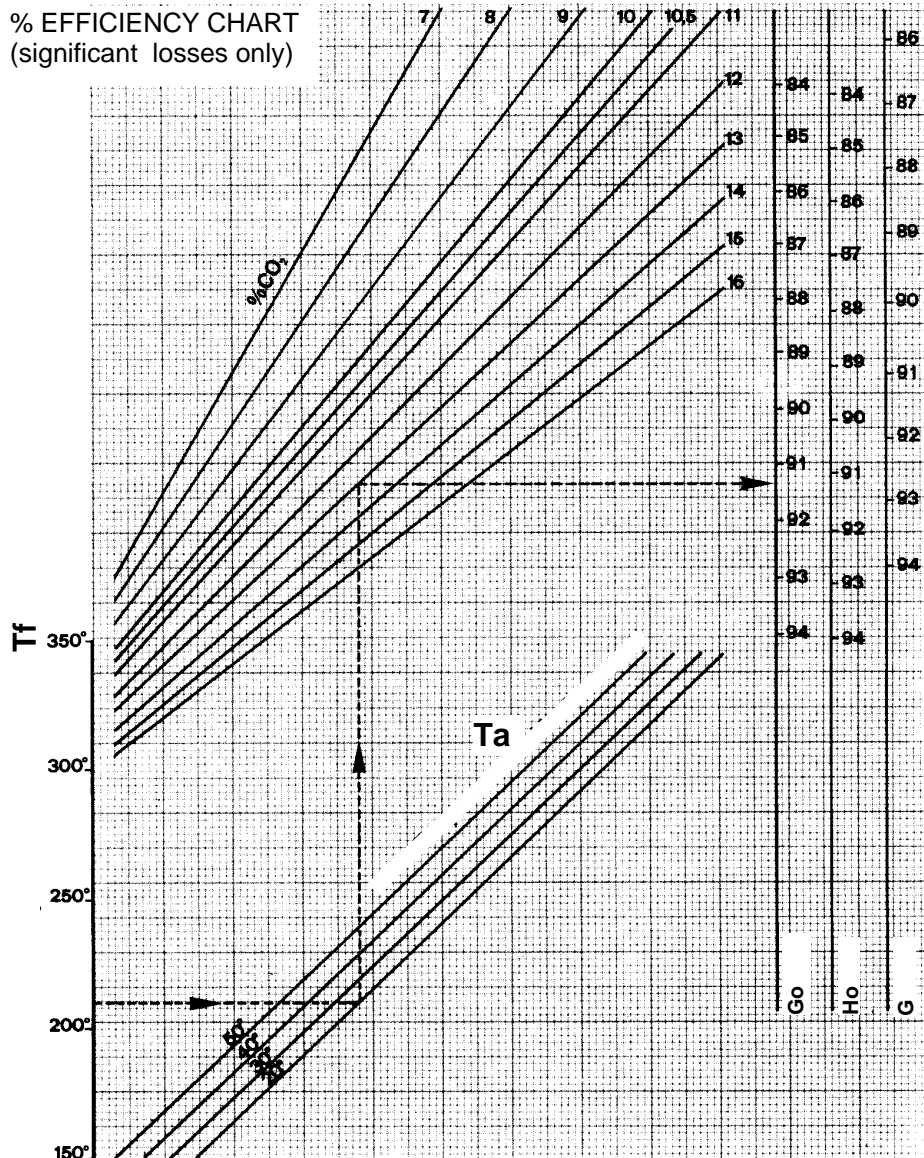
Example:

Fuel used .....GAS OIL

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

Ambient temperature.....20 °C

Efficiency.....91.4 %



Key:

Tf Flue gas temperature – Ta Ambient temperature °C – Go Gas oil – Ho Heavy oil – G Gas



## OPERATION

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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 (back end protection 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 turbulators 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 turbulators out and cleaning the tubes with a tube-brush. For more thorough cleaning, the smokebox must be removed to eliminate 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.