REZNOR®

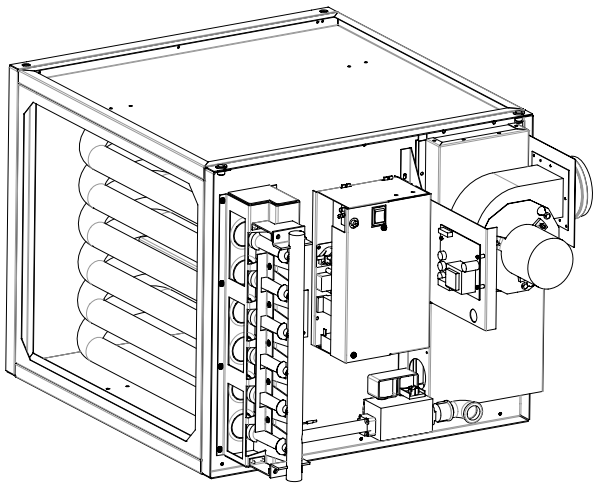
0905RHC4-JLsz--EN

Application instructions

RHC 4011, 4015, 4018, 4024, 4030 & 4036 RJL/DJL

Jacket-less, Gas-fired, Balanced-flue, Power-vented, Air heater

This document applies when installing into an air handler or as part of an air handling system



(RHC 4030)

Applies to

Belarus, Bulgaria, China, Czech Republic, Croatia, Cyprus, Denmark, England, Estonia, Finland, Greece, Hungary, Iceland, Latvia, Lithuania, Montenegro, New Zealand, Norway, Poland, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Turkey, Ukraine

These appliances meet the following EC Directives
Dir. 2009/142/EC:GAD
Dir. 2004/108/EC:EMC
Dir. 2006/95/EC:LVD
Dir. 2006/42/EC:MD (annex II, sub B)

Please read this document carefully prior to commencing building into an air handler.

Subject to modifications

Reznor Europe N.V. – J&M Sabbestraat 130 – B 8930 Menen
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EC Declaration of incorporation
Ban on putting into service

Reznor Europe N.V.
J. & M. Sabbestraat 130
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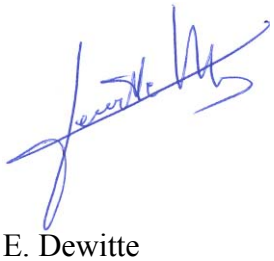
Herewith declares that:

Power-vented gas fired air heaters type:
RHC 4000 RJL or RHC 4000 DJL
Models **4011 – 4015 – 4018 – 4024 – 4030 – 4036**

- Are in conformity with the provisions of the 2009/142/EC (GAD), 2006/95/EC (LVD) - 2004/108/EC (EMC) directives.

- Are destined to be incorporated in other machines (air-handlers) or to be combined with other machines (air-handling systems), and are for this reason not entirely in compliance with the machinery directive.
  Proper integration into the air-handling systems is required to comply with the prescribed machinery directive.



E. Dewitte
Approvals and Certifications

Menen 1st June, 2004

INDEX

1. DEFINITIONS

1.1 **Jacket-less**:
A gas-fired air heater supplied as a skeleton appliance e.g. without case or cover**.**

1.2 **Module:**
The jacket-less gas fired air heater.

1.3 **Constructor:**
The undertaking, which builds a module into another casing e.g. an air handler.

1.4 **Appliance;**
The end product of the constructor.

1.5 **Compartment**:
The section of an appliance into which the module is installed.

1.6 **B22 Appliance**:
An appliance where the air for combustion is taken from within the area where the gas burner is operated.

1.7 **C12 Appliance**:
An appliance where the air for combustion is taken from outdoors via a duct terminating horizontally from the appliance.

1.8 **C32 Appliance:**
An appliance where the air for combustion is taken from outdoors via a duct terminating from the appliance vertically.

1.9 **Dew point**:
The condition, when the temperature is such that the water vapour in the combustion products condenses out.

2. BASIC INFORMATION

2.1 The instructions contained in this document apply to model RHC 4000 RJL and/or RHC 4000 DJL gas fired fan assisted warm air heaters (sizes 4011, 4015, 4018, 4024, 4030, 4036).

2.2 Models RHC 4000 RJL (sizes 4011, 4015, 4018, 4024, 4030, 4036) are intended for use as outdoor (roof top) systems.

Models RHC 4000 DJL (sizes 4011, 4015, 4018, 4024, 4030, 4036) are intended for use indoors and may be used as:
B22: vertically or horizontally flue heaters
C12: horizontal vent balanced flue heaters
C32: vertical vented balanced flue heaters

2.3 The gas category for use : see table 8.

2.4 All models may only be used when installed within a closed compartment, e.g. an air handler.

2.5 Dimensions : we refer to the figures 1, 2 and 3.
All dimensions are in mm
(25.4mm= 1inch)**.**

☞ATTENTION
ONLY RECOGNIZED AIR HANDLER MANUFACTURERS ARE AUTHORIZED TO BUILD-IN THE HEATER MODULE. PLEASE CONTACT YOUR DISTRIBUTOR.

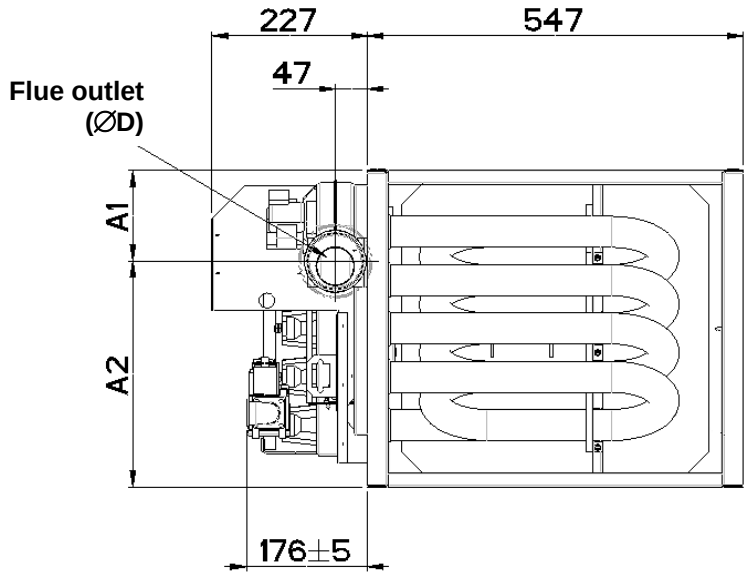
☞DANGER
ANY OTHER APPLICATION IS FORBIDDEN AND DANGEROUS. FAILURE TO COMPLY WILL RESULT IN SEVERE PERSONAL INJURY OR DEATH AND OR PROPERTY DAMAGE.

Note: Manufacturer warranties do not apply in such circumstances.

Figure 1 : Dimensions RHC 4011 - 4015

Figure 1A

BACK VIEW



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	∅ D mm
DJL 4011/15	80
RJL 4011/15	100

Figure 1B

TOP VIEW

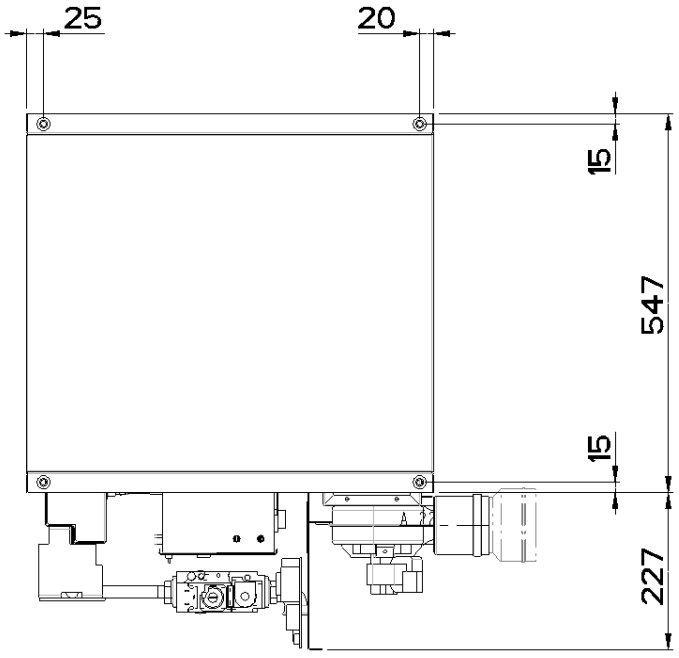

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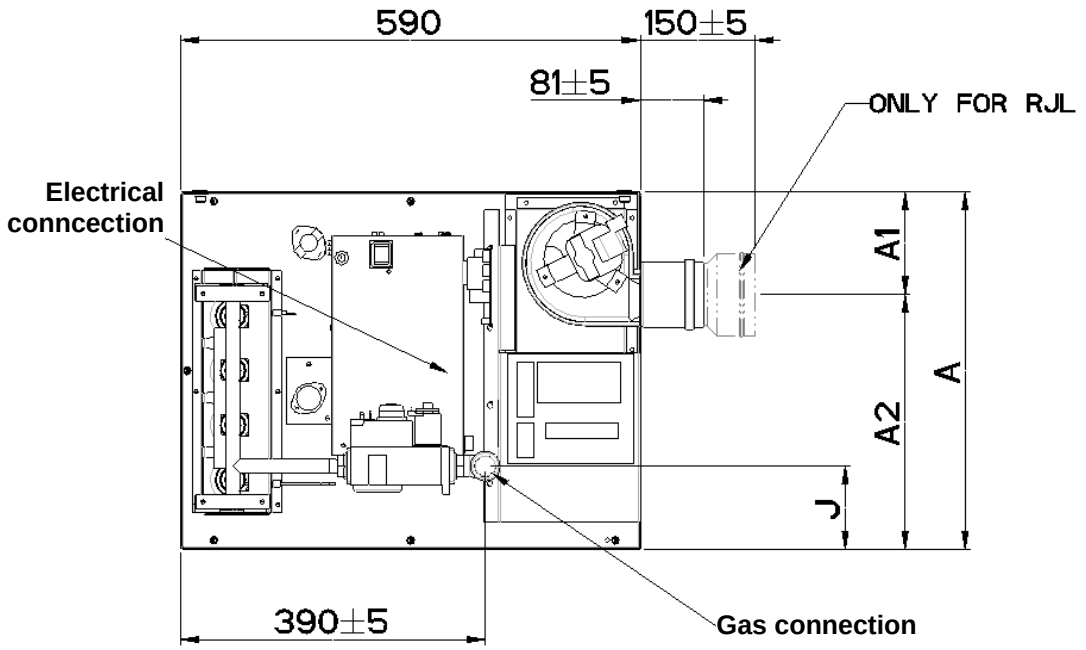
Figure 1C

SIDE VIEW



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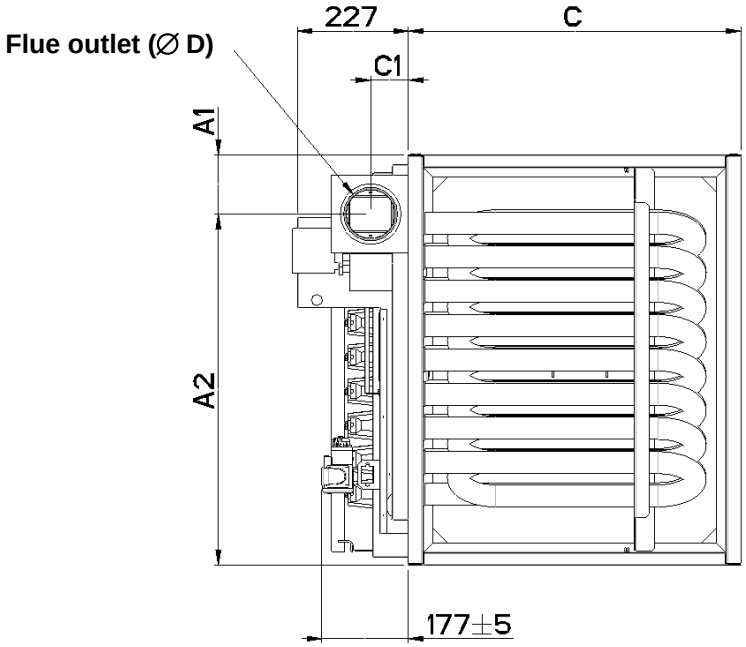
Type	A (mm)	A1 (mm)	A2 (mm)	J (mm)
RHC 4011 DJL	305	131	174	100
RHC 4011 RJL	305	131	174	100
RHC 4015 DJL	458	131	327	106
RHC 4015 RJL	458	131	327	106

Figure 2 : Dimensions RHC 4018 – 4036 RJL/DJL

Figure 2A



BACK VIEW

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	∅ D mm
DJL/RJL 4018/24/30	100
RJL 4036	100
DJL 4036	130

Figure 2B

TOP VIEW

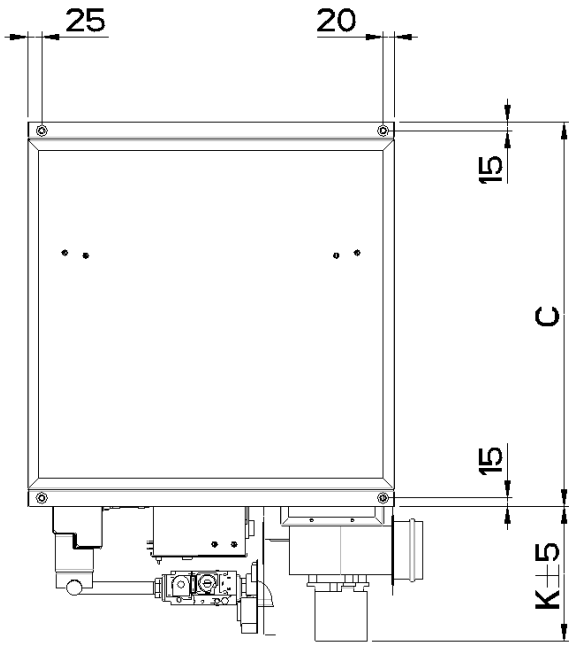

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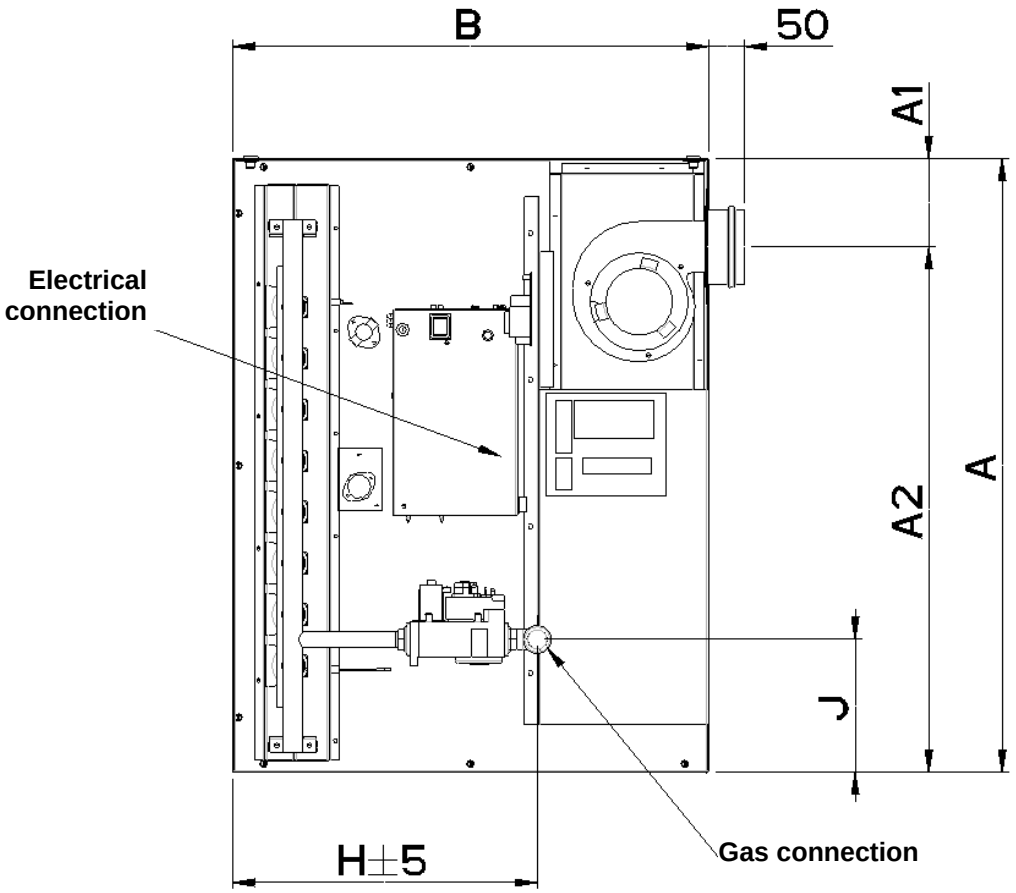
Figure 2C

SIDE VIEW



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Dimensions (mm)									
Type RHC	**A**	**A1**	**A2**	**B**	**C**	**C1**	**H**	**J**	**K**
4018 DJL	458	121	337	590	547	65	400	106	225
4018 RJL	458	121	337	590	547	65	400	106	225
4024 DJL	559	121	438	648	677	65	425	112	225
4024 RJL	559	121	438	648	677	65	425	112	225
4030 DJL	559	121	438	648	677	65	425	112	225
4030 RJL	559	121	438	648	677	65	425	112	225
4036 DJL	837	121	716	648	677	80	425	181	230
4036 RJL	837	121	716	648	677	80	425	181	230

3.0 PRACTICAL APPLICATION

Heat exchanger compartment size.

3.1.1 The duct section or air handler compartment must be sized in accordance with the dimensions given in table 1 with reference to figure 3.

Mounting flanges on the modules RHC 4000 RJL & DJL allow easy installation.

3.1.2 The heating module may only be fitted as shown in figure 4.
Alternative attitudes are **not** allowed.

Figure 3 : Compartment dimensions key reference Table 1

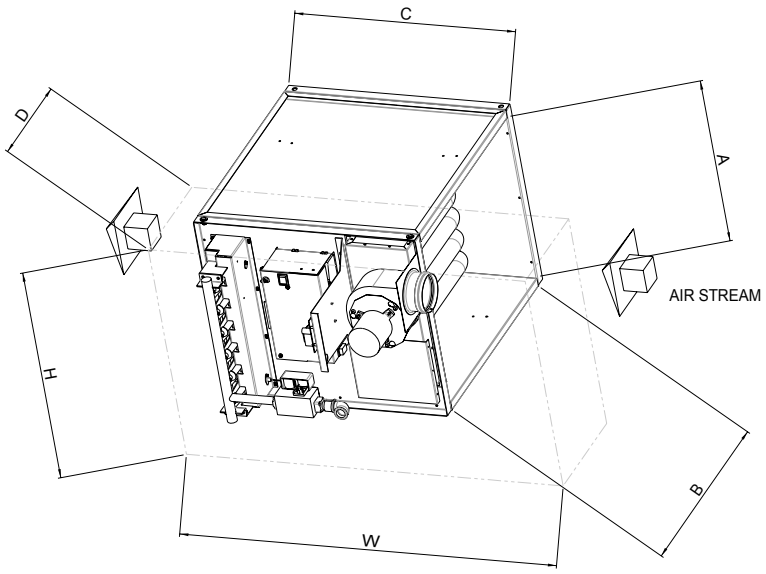

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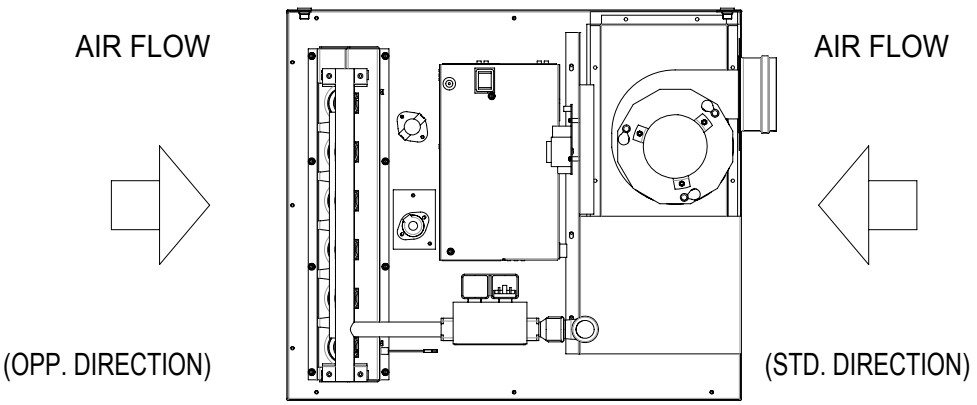
Table 1. Dimensions of enclosures (duct channel) for RHC 4000 heating modules re. fig 3

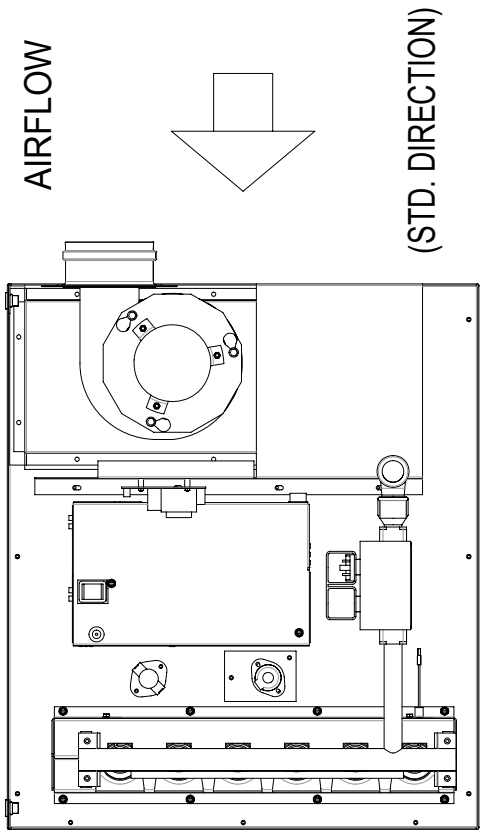
MODEL DJL/RJL	A	B	C	D		H	W
				Min.	Max		
4011	265	487	590	315	373	400	1100
4015	418	487	590	315	373	550	1100
4018	418	487	590	315	393	550	1050
4024	509	617	648	315	393	650	1100
4030	509	617	648	315	393	650	1100
4036	787	617	648	330	408	1000	1100

Figure 4 : Installation possibilities for RHC 4000 air heater modules

VERTICAL ARRANGEMENT TOP



HORIZONTAL ARRANGEMENT TOP



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4.0 LIMITATIONS FOR USE

4.1 Heat exchanger compartment

4.1.1 **Minimum airflow requirement** :
RHC 4000 RJL & DJL air heaters may be used for either push through or pull through air heaters. **The minimum airflow duty through the heating section enclosure (see fig. 3 – table 1) must be observed as indicated in table 2.**

4.1.2 **Maximum airflow**
Special attention must be given to ensure that the temperature rise of the air, passing through the enclosure (duct channel) around the heat exchanger tubes, is high enough to avoid condensation forming within the tubes. This condensation forming could occur by super cooling of the products of combustion. Such condensation can be the source of severe corrosion and damage to tubes or part of the tubes.

Figure 5 indicates the probability of condensation forming within the tubes reference :
- the temperature rise of the air through the enclosure around the tubes (see table 1- fig. 3).
- the inlet air temperature passing over the heat exchanger.

In function of the expected minimum inlet air temperature, the minimum required temperature rise (to avoid condensation) must be derived from the chart shown in figure 5.

Example
- expected minimum inlet temperature= -5°C
- minimum required temperature rise shown on the chart = +13°K

Table 2 indicates the heat output (kW) of the different models.
The maximum allowable airflow [through the enclosure (duct channel) around the tubes] can be calculated as follows :

$$V_{max}(m^3/h) = \frac{\text{heat output (kW)} \times 1000}{\Delta T_{minimum} \times 0{,}3423}$$

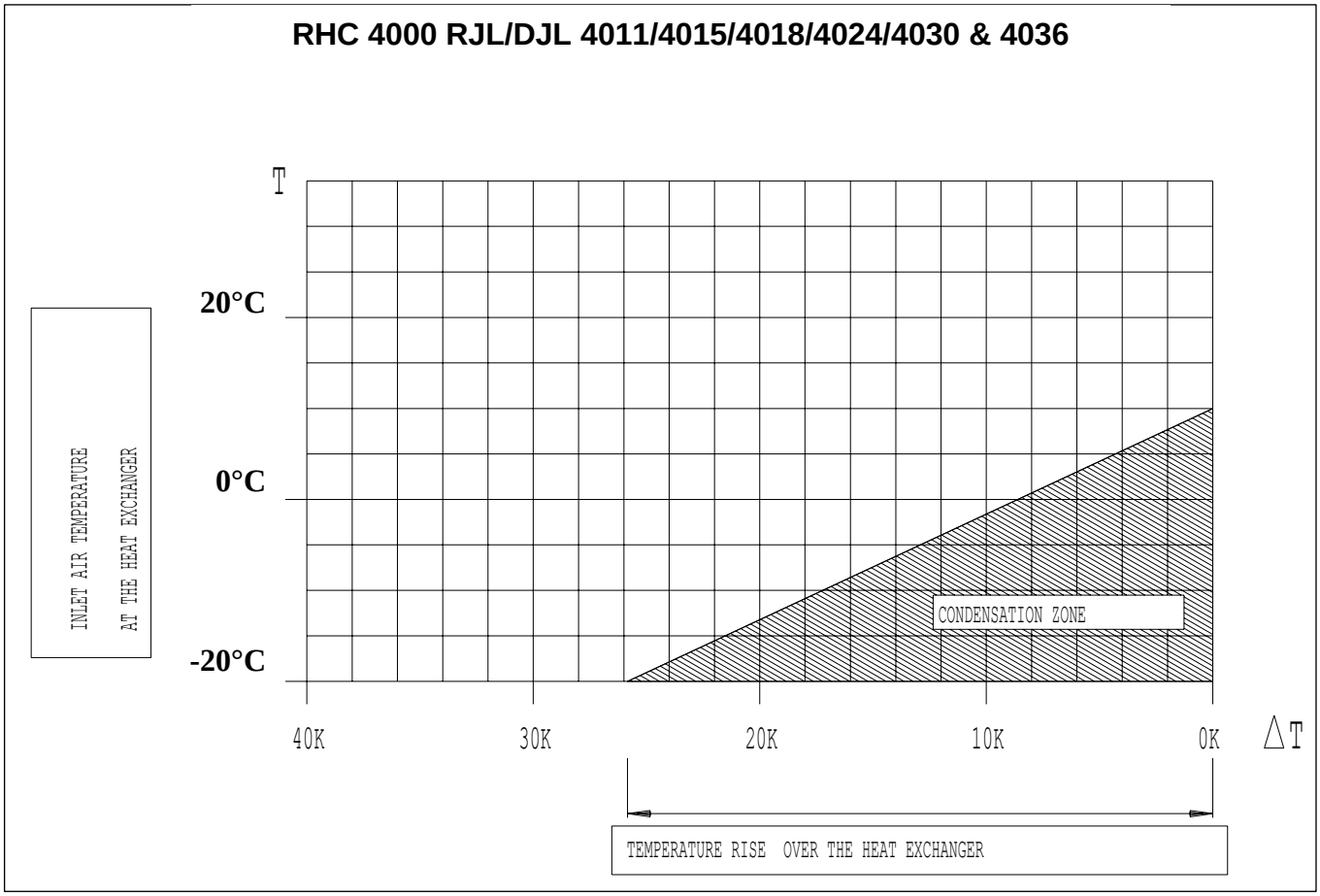
Example
ΔTmin = 13K
Model 4036 at 100% heat output : 35.80kW
Results into Vmax = 8045m³/h

Remark :
For air heaters with the option 2 stage gas valve (50% minimum heat input) or the option modulating gas valve (30% minimum heat input) attention must be given to determine the maximum allowable airflow in function of the appropriate heat input.

Table 2 : Airflow duty

MODEL DJL/RJL	Min. air volume required through enclosure m^3/h	Heat output 100% - 1 stage kW	Heat output 50% - 2 stage kW	Heat output 30% - modulating kW
4011	1465	10.80	5.40	3.24
4015	1940	14.50	7.25	4.35
4018	2270	18.00	9.00	5.40
4024	2880	24.00	12.00	7.20
4030	3290	29.80	14.90	8.94
4036	5281	35.80	17.90	10.74

Figure 5 : Dew-point occurrence chart (condensation zone)



Warning
Use of RHC 4000EURO-C heating modules for purposes other than those described above could result in severe personal injury or death and cause property damage.

The manufacturer warranties are void if departure from the intended use is undertaken.

Warning
This heating module may not be used where the air handler/heating system in which it is installed will be used where, flammable substances/vapours exist or where the atmosphere contains chlorinated or halogenated hydrocarbons, silicones, aluminium oxides, etc.
The manufacturer warranties are void if these restrictions are not observed

4.2 By-pass

For application where the air duty exceeds that required to maintain the criteria stated above then, a parallel by-pass is required to conduct the excess air around the heat exchanger.
Such a by-pass should be so designed and constructed so that the air flow (m³/h) across the enclosure (duct channel) around the tube is maintained between the minimum and maximum figures.
The recommended by-passes per type of unit are shown in figure 11.
We refer also to §11.0.

4.3 ①Important remark

The air velocity needs to be equal over the total area of the heating section so that even distribution is achieved over the entire heat exchanger tube assembly.

Attention :
Special attention is necessary assessing air velocities especially in a push through system, baffles and or an air-stream diverter/s may be necessary to ensure an even distribution of the airflow.

Part or the whole of the tubes may become damaged or can be the source of poor combustion if the air velocity as recommended above is not applied.

5.0 BURNER & CONTROLS SECTION

5.1 The following conditions must be observed when applying the heating module with its burner controls.

5.1.1 An enclosure containing RHC 4000 heating modules shall be so constructed that it is fully protected against the rigours of the environment in which it is intended to operate.

5.1.2 When applied as an RJL (roof top/outdoor unit) the enclosure into which it is fitted,must comply with protection grade IP 45.

5.1.3 Access to compartments enclosing the burner and its controls must be provided with panels, doors, etc. that are intended to be opened only by the use of a tool (key).
Such panels must be designed to ensure that after repeated removal and replacement their integrity is not jeopardised, i.e. seals and insulate etc. remain serviceable.

5.1.4 Openings from the outside of the air handler, e.g. gas and electrical services, shall not be larger than to permit a ball of 16 mm diameter to pass with a pressure of 5N.

5.1.5 Dimensions (mm) of control cabinet.
With reference to figure 3, the dimensions of the control cabinet must be in accordance with table 1.

CAUTION :
Alterations to the burner and/or its controls, any other electrical apparatus supplied as part of the heating module or changing of the settings as supplied is strictly forbidden to do so is in contravention of the E.C. gas appliance directive 1990.

5.1.6 Thermal insulation used in the construction of a heating module enclosure shall maintain its insulating properties under the influence of heat mechanical stress and ageing, it shall be non-combustible and resistant against vermin. Ensure that any insulation is securely fixed and will not obstruct combustion air pathways.
Asbestos or materials containing asbestos may not be used.
All materials used in association with RHC 4000 modules must be in accordance with the combustibility requirements of ISO 1182 1990.

5.1.7 Where appliances containing RHC 4000 modules are intended to be installed at a height of 1,8 m above floor level, doors, panels etc. intended to be removed for servicing shall be provided with hinges, or restraining devices to prevent falling from above during servicing. Access panels must be readily capable of correct and easy removal and assembly; this feature is particularly appropriate to square dimensioned elements.

NOTE: Provision must be made to view the burner to ensure its operation under normal operating conditions. Viewing ports may be necessary.
Ensure no flammable substances are in the immediate environment of the heating module.

6.0 GAS CONNECTION (¾")

6.1 National requirements and regulations for the installation of gas must be respected for all countries into which the appliance is delivered. Gas connections may only be carried out be appropriately qualified persons.

6.1.2 Clearances around connections shall be adequate so as to afford access to allow the use of tools to connect and disconnect the gas service connections.

6.1.3 Threads use for gas pipes and fittings shall comply with ISO 7.1 1994.

6.1.4 Copper pipes and fittings may not be used. Solder which has a melting point of less than 450° C neither solder or alloys containing cadmium shall not be used.

6.1.5 All gas services to the heating module shall be equipped with an isolation tap which shall be of the 90° turn type and shall be provided with a positive stop and it should be fitted adjacent to the heating module. Such taps when installed in a vertical position shall be so that in the event of a falling handle the valve will be in the closed condition, the open and closed positing shall be readily distinguishable. The valve shall be easy to operate when required.

7.0 ELECTRICAL EQUIPMENT

7.1.0 The RHC 4000 heating module has been fully tested prior to leaving the manufacturer. The constructor shall not make changes to the wiring supplied with the module. Electrical connections may only be made using the terminals provided and strictly in accordance with wiring diagram provided with the module.

7.1.1 RHC 4000 electrical controls **are** phase sensitive 230V 1N 50 Hz. The appliance must be **earthed** after the installation has been completed and earth continuity test must be carried out.

7.1.2 The electrical equipment of the module complies with the requirements of: EN 60335-1, EN60730-1 and EN61058-1 or to relevant amendments. The constructor must also comply with these requirements when fitting the module.

7.1.3 The protection of jacket less appliances conforms to protection code IP 20. The constructor must ensure that protection to at least IP 45 is fulfilled and mark his data/rating plate accordingly.

NOTE: IP 45 provides:

a) Personal protection against contact with electrical components within the construction;

b) Degree of protection within the construction against ingress of water.

7.1.4 The constructor shall test and inspect fully the total appliance prior to supply including the following:

- Earth continuity (re: CENELEC 289)
- Dielectric strain (re: CENELEC 289)
- Function of all electrical components and securities and operational inspection
- Heat input and test for good and clean combustion
- Auxiliary equipment to be supplied as part of the appliance
- Soundness of the total gas circuit

8.0 COMBUSTION CIRCUIT RHC 4000 RJL

8.1.1 Inlets for combustion air and flue outlets shall be so designed so that when an appliance is finally installed their termination shall be at least 500mm above deck/ground level.

8.1.2. The heating modules are delivered with all parts necessary for the construction of the jacket so that combustion can take place in a full save manner.
Consequently included with the heating module are :

- Dia 100 terminal outlet length 300mm (PN°60 50712 300)
- 90° elbow with sealing ring (dia 100) (PN 60 50733 100)
- Flue outlet combustion air inlet panel assembly (PN 81 74076)
- Gas tube sealing ring (PN 06 22783 125)

The 90° elbow, the terminal outlet and the flue outlet panel assy must be installed according to figure 6. All sealing must be correctly placed in the tubes to avoid flowing back of combustion products to the burner. As indicated, the flue outlet panel assy (PN 81 74076) must be integrated in the side panel of the controls compartment. The dimensions of the required opening in this side panel and its position relative to the mounting flange of the RHC 4000 RJL heating module are indicated in figure 6b. It is recommended to properly seal the flue outlet panel assy. When installing, respect top and bottom of the flue outlet/combustion air inlet. The protection cap (PN 60 50712 300) must be fitted in a horizontal plane.

Figure 6. : General arrangement combustion air inlet and flue products outlet RHC 4011-4036 RJL/DJL

Figure 6a

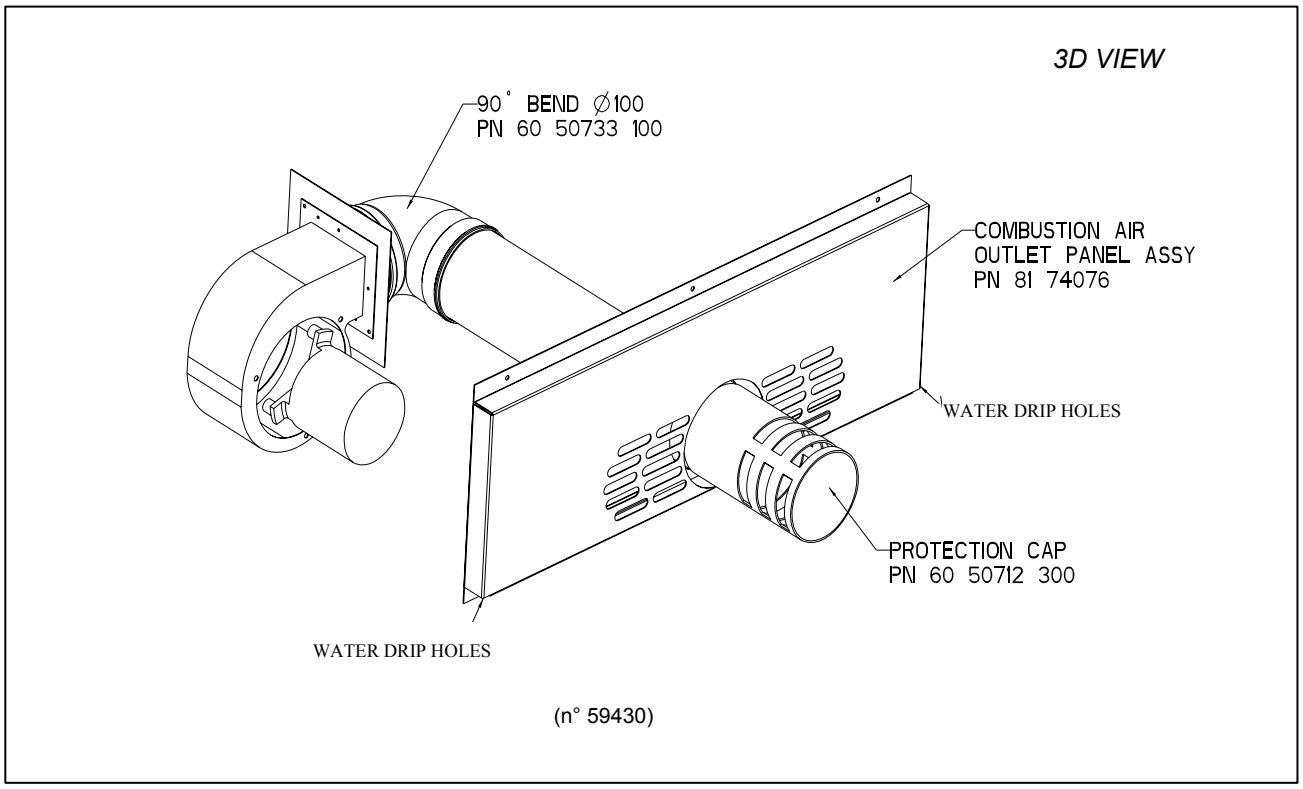


Figure 6b

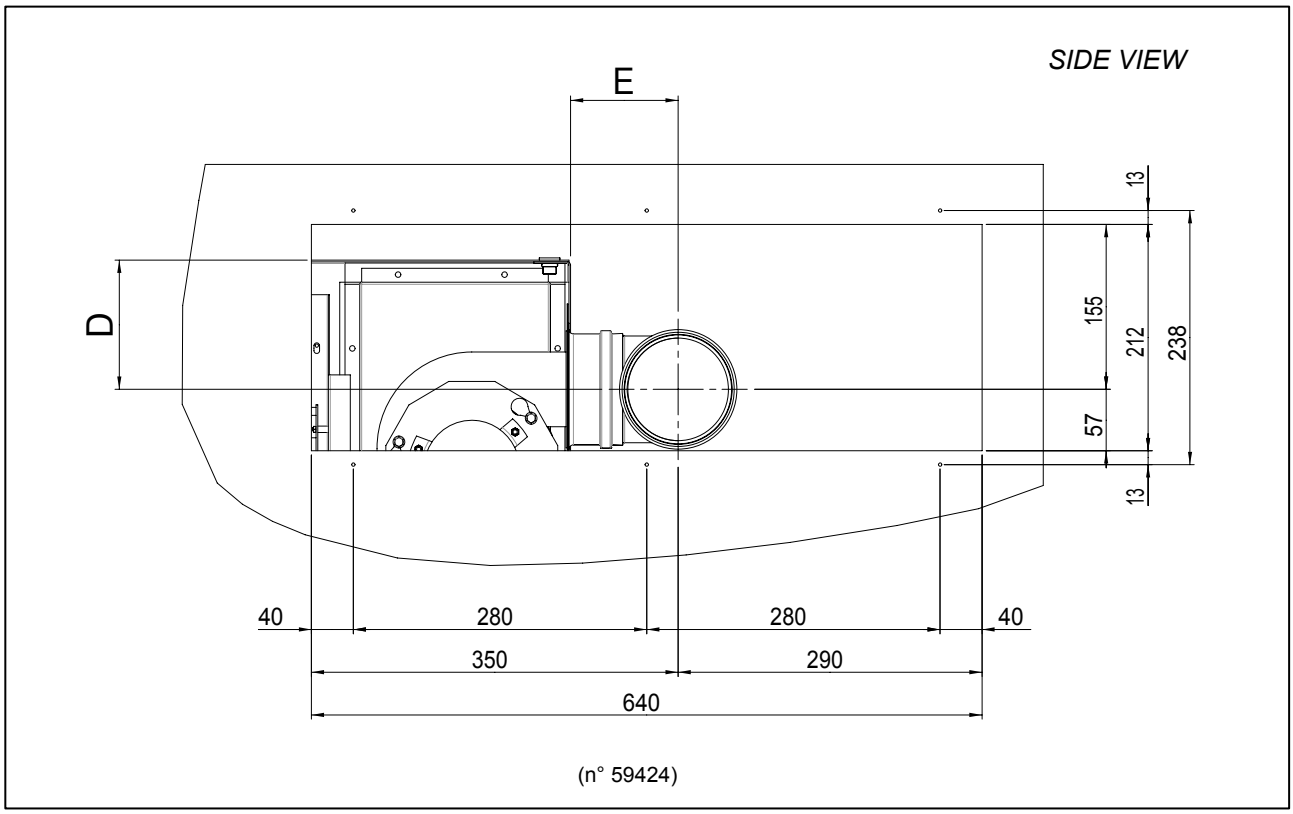


Figure 6c

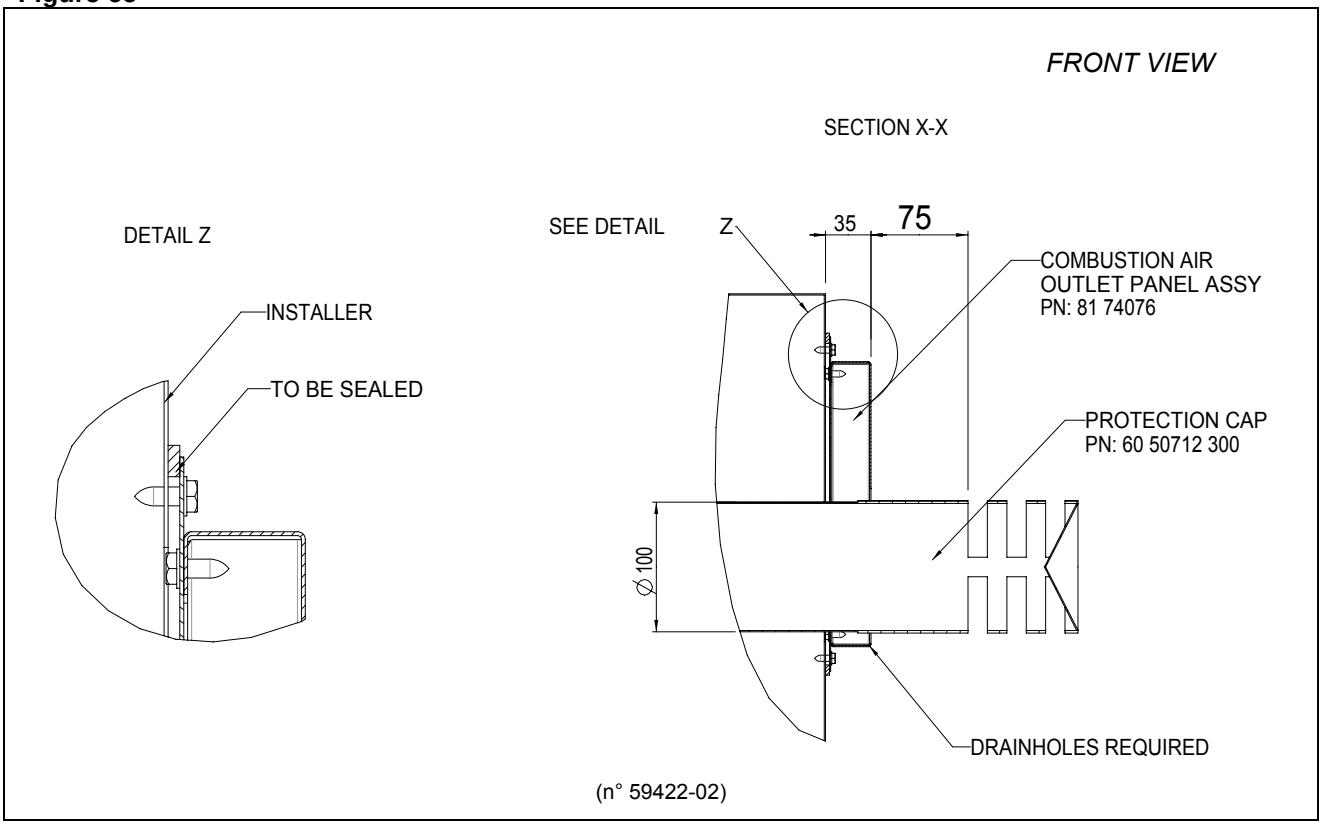


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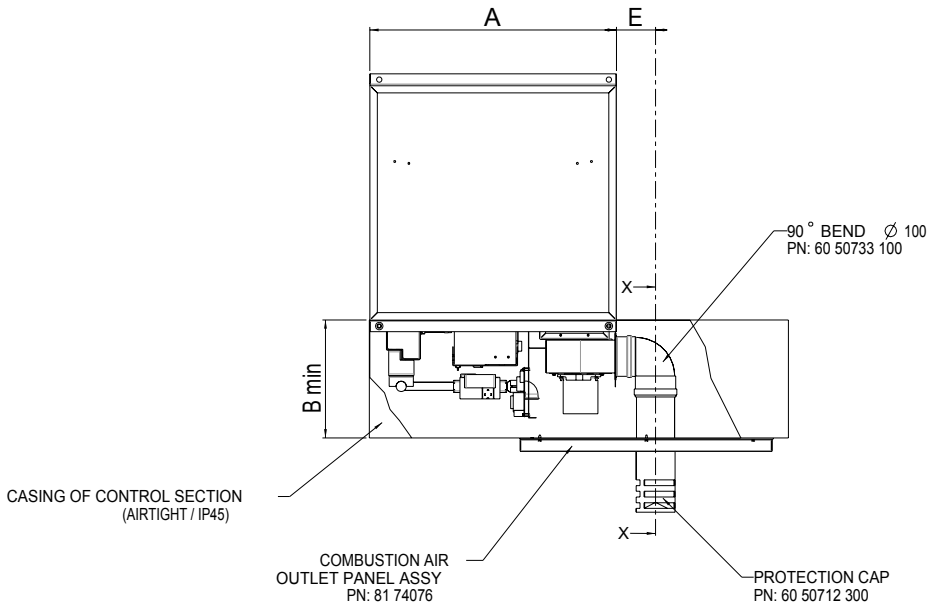
Figure 6d



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RJL (dim. in mm)	A	B	D	E
4011-15	590	315	131	200
4018	590	315	121	105
4024-30	648	315	121	105
4036	648	330	121	105

8.1.3 The protection cap (PN 60 50712 300) of heavy wall aluminium duct supplied must be placed so as to fit exactly between the elbow on the combustion fan and the outlet terminal.
If required this protection cap must be cut to length in order to respect the dimension 75.0mm (fig. 6c / front view).
However, when the depth of the control compartment exceeds the maximum value indicated in table 1, a seamless duct ∅100 of heavy wall aluminium and a sealing ring are to be used to extend the length of the protection cap (PN 60 50712 300). The absolute maximum allowable extension to the protection cap (std. length 300mm) is 700mm.

8.1.4 Attention must be given to properly seal the mounting flange of the heating module (see figure 6d).
Note: Other flue arrangements than those described and supplied with the heating module are not permitted.

8.1.5 A gas service inlet (PVC) sealing ring is also provided for the appliance for size R ¾".
The hole size required for the seal ring in the casing is 50 mm diameter.
All cables and wires passing through the casing of the burner/controls section should be via strain relief bushings. It is recommended that sealing is accomplished by the use of the sealed ring type.
Connections between the burner module controls compartment must be effectively sealed from the appliance air-stream so the pressure within the combustion circuit remains at ambient within the compartment.

9.0 COMBUSTION SYSTEM RHC 4000 DJL

9.1.1 The DJL Modules are provided with flue outlets sized as per table 3.

Table 3 : Flue sizes

DJL	Flue diameter (mm)
4011	80
4015	80
4018	100
4024	100
4030	100
4036	130

9.1.2 If the DJL model is to be installed as a type C12 or C32 appliance, the burner and controls cabinet must be sealed so as to ensure air leakage does not exceed that stated in table 4.

9.1.3 The heating modules are delivered with all parts necessary to properly seal the combustion circuit.
Consequently, are included within the heating module :
- 90° elbow with sealing ring
  PN 60 50733 080 (dia 80) (mod. 4011/15)
  PN 60 50733 100 (dia 100) (mod. 4018/24/30)
  PN 60 50733 130 (dia 130) (mod. 4036)
- gas tube sealing ring (PN 06 22783 125)
- 2 'teflon' sealing rings
  PN 06 22786 084 (dia 80) (mod. 4011/15**)**
  PN 06 22786 104 (dia 100) (mod. 4018/24/30)
  PN 06 22786 134 (dia 130) (mod. 4036)

As shown in figure 7a these sealing rings must be fitted in the outer casing to form a seal around the combustion air inlet pipe and the flue outlet pipe. The centre distance between the pipes must be respected as per table 5 and the flue outlet must always be above the combustion air inlet.
Figure 7b indicates the hole size required in the outer casing and the position of these holes relative to the mounting flange of the RHC 4000 DJL heating module.

Table 4 : Maximum cabinet air-leakage rates

DJL	Heat input kW	Allowed leakage m^3/h @ 50Pa
4011	13,20	6,60
4015	17,60	8,80
4018	22,00	11,00
4024	29,30	14,65
4030	36,60	18,30
4036	44,00	22,00

Figure 7 : Combustion air inlet - outlet dimension requirements (see also table 7)

Figure 7a

3D VIEW

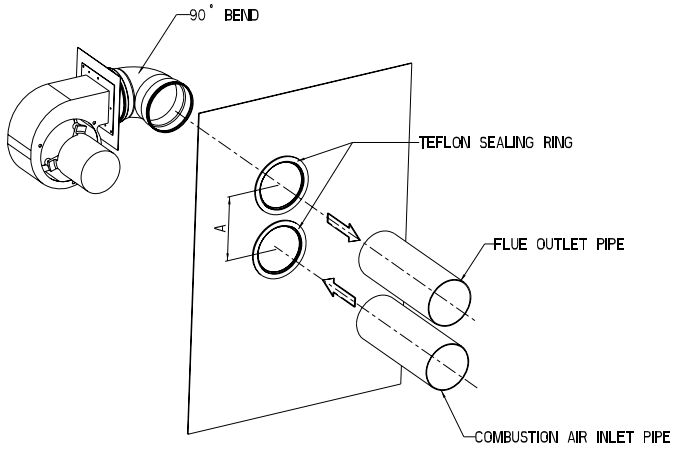

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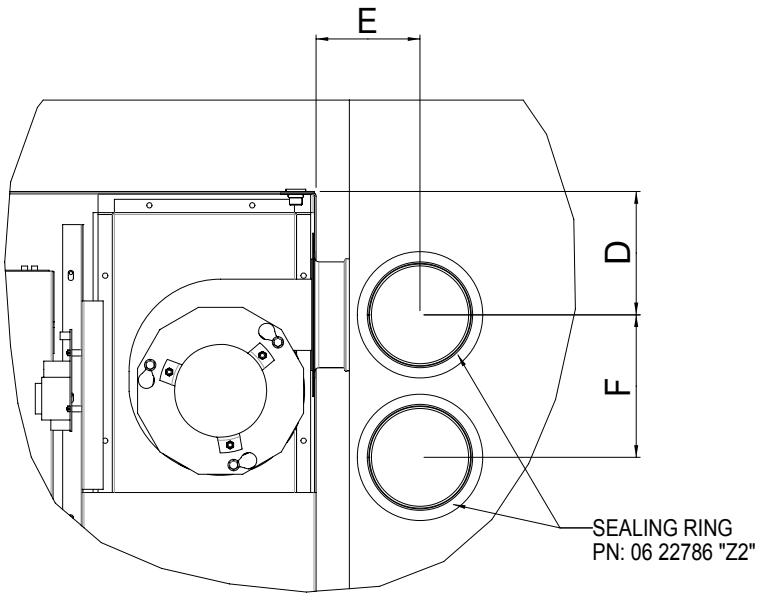
Figure 7b

SIDE VIEW



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(dimensions see table 6)

Table 5 : Centre distances combustion air inlet flue outlet (refer to fig. 7)

Model DJL	Connection Ø mm	Centre distance F mm	Cabinet hole size required for sealing ring mm
4011	80	120	92
4015	80	120	92
4018	100	140	112
4024	100	140	112
4030	100	140	112
4036	130	225	142

9.1.4 The combustion air inlet duct must not pass through the cabinet panel by more than 50 mm.

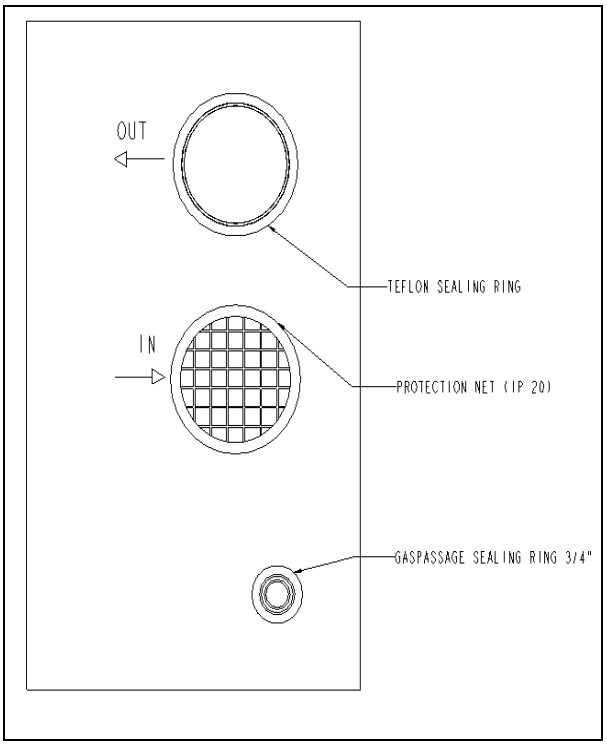
9.1.5 When the DJL model is to be used as a type B22 appliance i.e. combustion air being taken from the space to be heated, a protection grille complying with IP 20 must be installed at the inlet point of the cabinet (see figure 8)

9.1.6 Attention must be given to properly seal the mounting flange of the heating module (see figure 9).

9.1.7 A gas service inlet (PVC) sealing ring is also provided for the appliance for size R ¾".
The hole size required for this seal ring in the casing is 50 mm diameter.
All cables and wires passing through the casing of the burner/controls section should be via strain relief bushings. It is recommended that sealing is accomplished by the use of the sealed ring type.
Connections between the burner module controls compartment must be effectively sealed from the appliance air-stream so the pressure within the combustion circuit remains at ambient within the compartment.

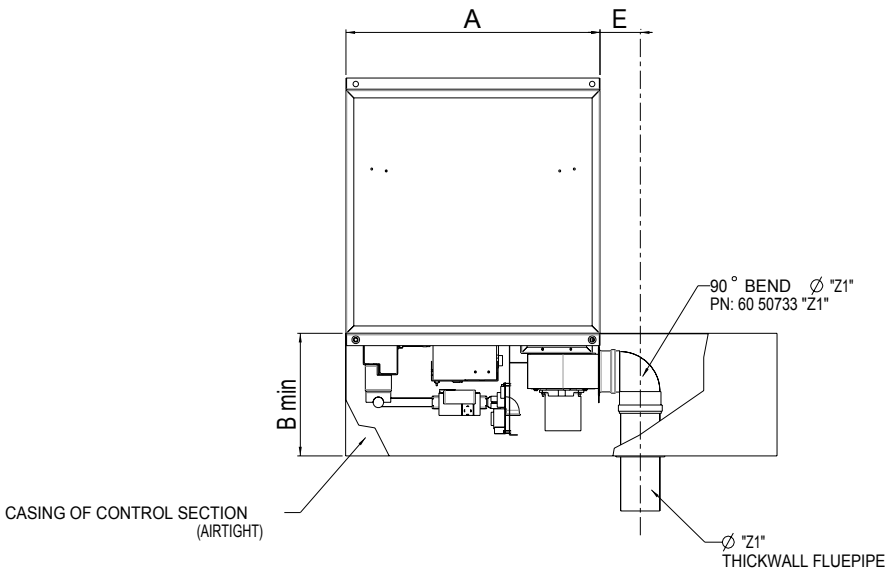
9.1.8 A viewing port for the purpose of ascertaining the operation of the burner should be included. The viewing port may be located behind a door or panel provided that when the door or panel is opened the combustion circuit remains in its **"sealed"** condition so that burner operation is not upset.

Figure 8:
Arrangement for class B22 appliance & gas service inlet



NOTE:
POOR COMBUSTION LEADING TO A HAZADROUS SITUATION CAN RESULT FROM EITHER POSITIVE OR NEGATIVE PRESSURES WITHIN THE COMBUSTION CIRCUIT.

Figure 9



(n° 59426-01)

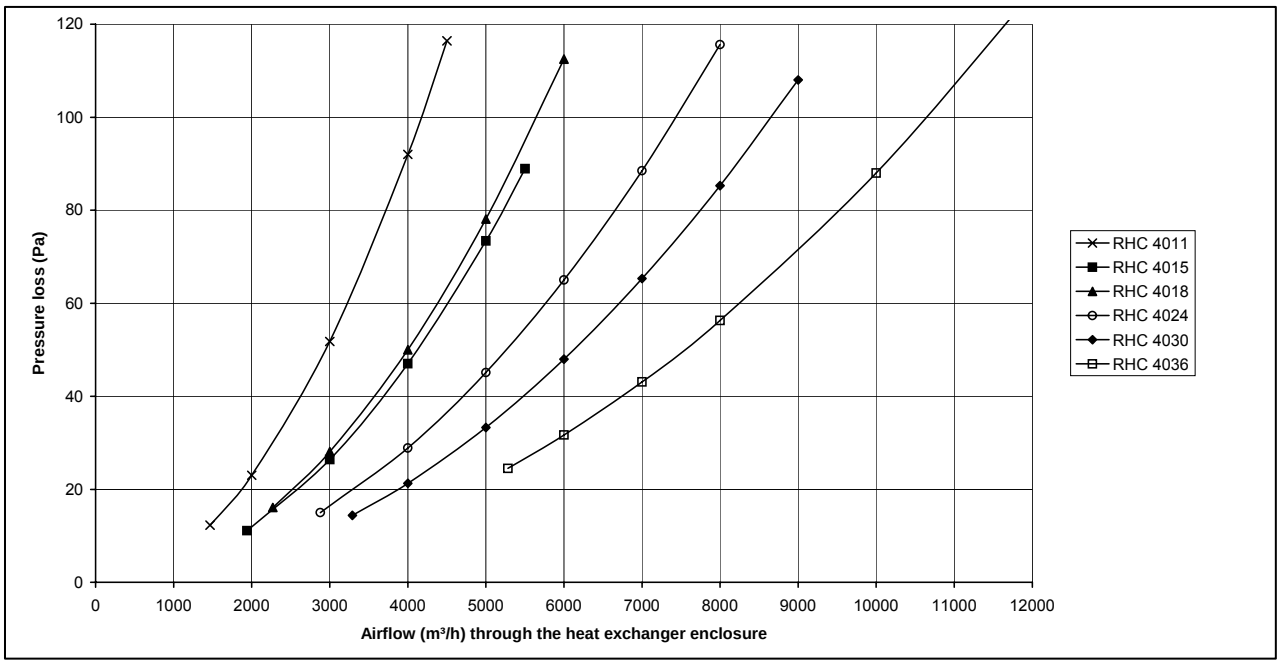
Table 6

DJL (all in mm)	A	B	D	E	F
4011-4015	590	315	131	125	120
4018	590	315	121	105	140
4024-4030	648	315	121	105	140
4036	648	330	121	178	225

10. PRESSURE DROP THROUGH HEATING MODULE

The chart below indicates the pressure drop over the heating module versus the total air volume through the heating enclosure (see fig. 3, table 1). The figures can be used straight ahead if no bypass is added to the application and for airflow conditions as indicated in figure 3.

Figure 10 : Pressure drop through RJL/DJL 4011/15/18/24/30/36 heating module



11.0 HEATING SECTION WITH BY-PASS CHANNELS

In parallel with the heating section enclosure (see fig. 3, table 1) a bypass channel can be made. This might be needed to reduce the pressure drop over the heating section

In case of using a bypass, the recommended by-pass dimensions are shown in fig. 11. The table shows dimensions of by-pass. In this case the air flow anymore though the heating section enclosure will not be equal to the total air flow, as part of the air flow will be through the bypass channel.
The recommended by-pass dimensions are such that when applying them, the resulting air flow over the heating section will be equal to the minimal air duty, as shown in table 2 (or table 6). In fact, the recommended dimensions are maximal allowable dimensions for the by-pass.

In absence of a by-pass, total airflow will be equal to air flow over heating section.

To use the pressure drop curves without by-pass, this can simply be done by putting the total air flow on the figure, and extract the pressure drop directly from it.
In case the recommended by-pass dimensions are respected, the pressure drop can be extracted from the figures by using the minimal air flow, as showed in table 2, and always corresponding the left edge of the x-axis in the pressure drop figures.
This means that in case the by-pass dimensions are between 0 (or none) and recommended dimensions, the air flow over the heating section (which has to be used in the pressure drop figures) will be somewhere between the total air flow and the minimal allowed air flow.

To calculate this air flow, following interpolation rule should be applied :
With

Q_{min} = Minimal recommended air flow (table 2) (m³/s)
Q_{tot} = Total Air Flow (m³/s)
x_1 = Largeur bypass recommandée (= largeur bypass max.) (voir figure 11) (mm)
x_2 = Largeur bypass appliquée (mm)

Then Q_{HS} (air flow over heating section) can be calculated as :

$$Q_{HS} = \frac{Q_{tot}}{\frac{x_2}{x_1} \times \left(\frac{Q_{tot}}{Q_{\min}} - 1 \right) + 1}$$

As explained above, the air flow Q_{HS} over the heating section must be used in figures 10 & 11, to extract the correct pressure drop over the heat exchanger.

Example :
Application on RHC 4011 RJL/DJL
By-Pass = 300 mm wide x 310 mm high,

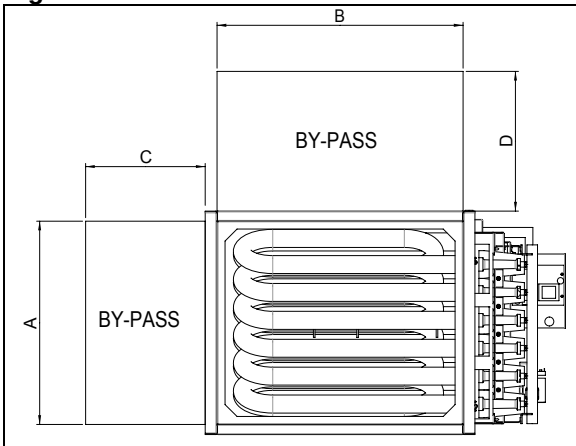
► *Total Air Flow 1 m³/s.*

From table 2, the minimal air flow for this unit is 1465 m³/h, corresponding to 1465/3600 or 0,4 m³/s.
The recommended by-pass width for this air flow is 465 mm (x_1).

Filling in all these values in above formula results in :

$$Q_{HS} = \frac{1}{\frac{300}{465} \times \left(\frac{1}{0,4} - 1 \right) + 1} = 0,508\ m^3/s$$

Figure 11



Mod	Dim. A	Dim. B	Dim. C	Dim. D
4011	265	487	To be calculated as per section 11.2	
4015	418	487		
4018	418	487		
4024	509	617		
4030	509	617		
4036	787	617		

11.1 By-pass requirements

11.1.1 Referring to section 4.2, a by-pass duct in parallel with the heat exchanger enclosure might be required.

11.1.2 Such by-pass duct might also be required to reduce the pressure loss over the heating section, particularly at higher airflows.

11.1.3 When a by-pass duct is applied, a portion of the total airflow is guided through the by-pass duct and the remaining airflow is guided through the heat exchanger enclosure.

11.1.4 The by-pass duct dimensions must be properly determined in order to ensure that the airflow through the heat exchanger enclosure always meets the minimum airflow requirements as mentioned in table 7

Table 7

Model	V (m³)
4011	1465
4015	1940
4018	2270
4024	2880
4030	3290
4036	5281

11.2 Calculation of recommended maximum by-pass

11.2.1 This calculation is applicable for total airflow conditions above V (table 7).

A) <u>The by-pass can either be mounted on top of the heat exchanger or besides the heat exchanger</u>.

The recommended maximum by-pass dimensions for a given air flow (V_{tot}) can be calculated as follows : (V_{tot} is the air flow expressed in m³/s).

a) <u>By-pass besides heat exchanger</u> :

Model	factor R1	factor R2
4011	$782.^{6}$	$-318.^{4}$
4015	$631.^{4}$	$-340.^{2}$
4018	$442.^{4}$	$-279.^{0}$
4024	$460.^{4}$	$-368.^{3}$
4030	$409.^{0}$	$-373.^{6}$
4036	$409.^{3}$	$-600.^{3}$

Dimension C (mm) = (R1 x V_{tot}) + R2

b) <u>By-pass on top of heat exchanger</u> :

Model	factor R1	factor R2
4011	$495.^{0}$	$-201.^{5}$
4015	$528.^{1}$	$-284.^{7}$
4018	$433.^{4}$	$-273.^{3}$
4024	$356.^{4}$	$-285.^{2}$
4030	$362.^{5}$	$-331.^{5}$
4036	$459.^{4}$	$-673.^{9}$

Dimension D (mm) = (R1 x V_{tot}) + R2

B) <u>Example</u> :

RHC 4036
<u>with</u> :
- total air flow = $2.^{50}$m³/s = 9000 m³/h
- by-pass besides heat exchanger

<u>Result</u> :
- dimension A = 696mm
- R1 = $409.^{30}$
- R2 = $-600.^{30}$
- dimension C = ($409.^{30}$ x $2.^{50}$) – $600.^{30}$

C = 423.mm

<u>Note</u>
In this case $1.^{47}$m³/s (= 5281m³/h) (see table 7) flows through the heat exchanger enclosure.
The remaining $1.^{03}$m³/s (=3719m³/h) flows through the by-pass duct
($2.^{50}$m³/s – $1.^{47}$m³/s = $1.^{03}$m³/s)

C) <u>Pressure loss</u> :
In this case the total pressure loss over the RHC 4000 module with by-pass can be extracted from figure 10. The airflow through the heat exchanger enclosure must be applied to determine the total pressure drop.

<u>Example</u> :
- Airflow through the heat exchanger enclosure = $1.^{47}$ m³/s (5281m³/h)
- Total pressure drop = 25 Pa (approx.) (see fig. 10).

11.3 Calculation of alternative by-pass dimension

Due to space restrictions it may not be possible to use the above mentioned maximum dimension by-pass.
In this case a smaller by-pass can be applied. Obviously, this smaller by-pass will result in higher portion of the total air flow through the heat exchanger enclosure and consequently in a higher total pressure drop

A) To calculate this air flow through the heat exchanger enclosure, following interpolation rule should be applied :

With :

V =Recommended airflow (table 7) (m³/s)
V_{tot} =Total air flow (m³/s)
x_1 =Recommended by-pass (dim C or D) (as calculated in section 11.2).
x_2 =Applied by-pass dim. (mm)

Then V_{HS} (air flow through heat exchanger enclosure can be calculated as :

$$V_{HS} = \frac{V_{tot}}{\frac{x_2}{x_1} \times \left(\frac{V_{tot}}{V} - 1 \right) + 1}$$

As explained above, the air flow V_{HS} through the heat exchanger enclosure must be used in figures 10 & 11 to extract the correct total pressure drop over the RHC module with by-pass.

The air flow V_{HS} may not exceed the maximum airflow allowed according to section 4.1.2 to avoid supercooling of the flue gases.

B) Example .

RHC 4036
with :
- Total air flow : 2.50m³/s (9000m³/h)
- Expected min. inlet temp. : -5°C
- Recommended max. dim C = 423mm (see above 2B)
- Applied by-pass dim. C = 300mm

Then :
x1 = 423mm
x2 = 300mm
Vtot = 2.50m³/s
V = $1.^{47}$m³/s (5281m³/h) (see table 6)

Result :

$$V_{HS} = \frac{2.^{50}}{\frac{300}{423.^{00}} \times \left(\frac{2.^{50}}{1.^{47}} - 1 \right) + 1} = 1.^{67} m^3/s \ (6012 m^3/h)$$

Consequently, $1.^{67}$m³/s (6012m³/h) flows through the heat exchanger enclosure and the remaining $0.^{83}$m³/s (=2988m³/h) (= $2.^{50}$m³/s – $1.^{67}$m³/s) flows through the by-pass channel.

From section 4.1.2 the maximum allowable airflow through the heating module enclosure is 8045 m³/h (for this example).
We notice the 6012 m³/h is still below this maximum allowable figure. Consequently there is no probability of condensation forming within the tubes.

C) Pressure drop :

The total pressure drop can be derived from fig. 10 & 11. Use the air flow through the heat exhanger enclosure to determine the total pressure drop. (@6012 m³/h)
Result : 32Pa (approx) (see fig. 10).

12. TECHNICAL DATA

Table 8 : Gas categorie

Country	Gas category
Belarus	II2H3+
Bulgaria	I2H or I3B/P
China	II2H3+
Czech republic	II2H3+
Croatia	II2H3P
Cyprus	II2H3+
Denmark	II2H3 B/P
England	II2H3+
Estonia	II2H3+
Finland	II2H3 B/P
Greece	II2H3+
Hungary	II2HS3P
Iceland	II2H3+
Latvia	II2H3+
Lithuania	II2H3+

Country	Gas category
Montenegro	II2H3+
New Zealand	II2H3+
Norway	II2H3 B/P
Poland	II2E3P
Portugal	II2H3+
Romania	II2H3P
Russian Federation	I2H or I3P
Serbia	II2H3+
Slovakia	II2H3+
Slovenia	II2H3+
Spain	II2H3+
Sweden	II2H3 B/P
Turkey	II2H3+
Ukraine	I2H or I3P

Table 9 : Model RHC 4000 RJL/DJL specifications

Model	Heat input		Heat output	Gas rate [3]		Power Consumption
				G20	G31	
	kW gros[1]	kW net[2]	kW	m³/h	kg/h	kW
4011	13.00	11.91	10.84	1.26	0.94	0.153
4015	17.60	15.85	14.42	1.68	1.26	0.153
4018	22.00	19.81	17.85	2.10	1.57	0.153
4024	29.30	26.38	24.01	2.79	2.10	0.153
4030	36.60	33.00	29.80	3.49	2.61	0.153
4036	44.00	39.60	36.04	4.20	3.14	0.153

1. GCV (Hs)
2. NCV (Hi)
3. Natural gas G20 gross calorific value 10,48 kW m^3 @ 15 °C, 1013,25 mbar
   Butane gas G30 gross calorific value 13,7 kW/kg
   Propane gas G31 gross calorific vale 14,0 kW/kg

Table 10 : Injector size and burner pressure

Belarus, China, Croatia, Czech Republic, Cyprus, England,Estonia, Greece, Iceland, Latvia, Lithuania, Montenegro, New Zealand, Portugal, Serbia, Slovenia, Slovakia, Spain , Turkey

		Model	4011	4015	4018	4024	4030	4036
Nat. Gas G20	Injector	quantity	3	4	5	5	6	8
	Injector size	mm	1,85	1,85	1,85	2,20	2,20	2,20
		marking	185	185	185	220	220	220
	Burner pressure (1)	mbar	9,00	8,90	9,00	7,90	8,80	7,50
	Inlet pressure	mbar	20					
Prop. Gas G31	Injector	quantity	3	4	5	5	6	8
	Injector size	mm	1,00	1,00	1,00	1,15	1,20	1,15
		marking	100	100	100	115	120	115
	Burner pressure (1)	mbar	36,90	36,80	36,90	36,50	36,50	36,00
	Inlet pressure	mbar	37					

Romania, Poland, Bulgaria, Denmark, Finland, Norway, Sweden

		Model	4011	4015	4018	4024	4030	4036
Nat. Gas G20	Injector	quantity	3	4	5	5	6	8
	Injector size	mm	1,85	1,85	1,85	2,20	2,20	2,20
		marking	185	185	185	220	220	220
	Burner pressure (1)	mbar	9,00	8,90	9,00	7,90	8,80	7,50
	Inlet pressure	mbar	20					
Prop. Gas G31	Injector	quantity	3	4	5	5	6	8
	Injector size	mm	1,00	1,00	1,00	1,15	1,20	1,15
		marking	100	100	100	115	120	115
	Burner pressure (1)	mbar	29,90	29,80	29,90	29,50	29,50	28,00
	Inlet pressure	mbar	30					

Hungary, Russian Federation, Ukraine

		Model	4011	4015	4018	4024	4030	4036
Nat. Gas G20	Injector	quantity	3	4	5	5	6	8
	Injector size	mm	1,85	1,85	1,85	2,20	2,20	2,20
		marking	185	185	185	220	220	220
	Burner pressure (1)	mbar	9,00	8,90	9,00	7,90	8,80	7,50
	Inlet pressure	mbar	20(*)					
Prop. Gas G31	Injector	quantity	3	4	5	5	6	8
	Injector size	mm	0,90	0,90	0,90	1,00	1,05	1,00
		marking	90	90	90	10	105	100
	Burner pressure (1)	mbar	49,90	49,50	49,70	49,80	49,60	48,30
	Inlet pressure	mbar	50					

(*): Inlet pressure for Hungary = 25mbar

(1) : with open service door