

GB **Forced draught gas burners**

Modulating operation



RS BLU

CODE	MODEL	TYPE
3899400 - 3899410	RS 300/M BLU	849T
3899500 - 3899510	RS 400/M BLU	850T
3899100 - 3899110	RS 500/M BLU	856T
20006131	RS 500/M BLU	856T80
20040330	RS 650/M BLU	1123T
3911000 - 3911010	RS 800/M BLU	887T
20008894	RS 800/M BLU	887T80

1	Declarations	3
2	Information and general warnings.....	4
2.1	Information about the instruction manual	4
2.1.1	Introduction.....	4
2.1.2	General dangers.....	4
2.1.3	Other symbols	4
2.1.4	Delivery of the system and the instruction manual	5
2.2	Guarantee and responsibility	5
3	Safety and prevention.....	6
3.1	Introduction.....	6
3.2	Personnel training	6
4	Technical description of the burner	7
4.1	Burner designation	7
4.2	Models available.....	7
4.3	Burner categories - Countries of destination	8
4.4	Technical data	8
4.5	Electrical data.....	9
4.6	Maximum dimensions.....	10
4.7	Firing rates	11
4.8	Test boiler.....	12
4.9	Burner equipment.....	12
4.10	Burner description	13
4.11	Electrical panel description.....	14
4.11.1	Fan motor rotation	14
4.12	RMG88.62C2 control box.....	15
4.13	LKS 310-35 servomotor	16
5	Installation	17
5.1	Notes on safety for the installation	17
5.2	Handling	17
5.3	Preliminary checks	17
5.4	Operating position	18
5.5	Removal of the locking screws from the shutter.....	18
5.6	Preparing the boiler	18
5.6.1	Boring the boiler plate	18
5.6.2	Blast tube length.....	18
5.7	Securing the burner to the boiler	19
5.8	Access to head internal part.....	19
5.9	Probe-electrode position	19
5.10	Combustion head adjustment.....	20
5.11	Gas feeding	22
5.11.1	Gas feeding line	22
5.11.2	Gas train.....	23
5.11.3	Gas train installation.....	23
5.11.4	Gas pressure.....	24
5.12	Electrical wiring	25
5.12.1	Supply cables and external connections passage	25
6	Start-up, calibration and operation of the burner	26
6.1	Notes on safety for the first start-up	26
6.2	Adjustments prior to ignition	26
6.3	Burner start-up	26
6.4	Burner ignition	26

6.5	Servomotor adjustment	27
6.6	Air / fuel adjustment	27
6.6.1	Maximum output adjustment	27
6.6.2	Minimum output adjustment	28
6.6.3	Intermediate output adjustment	28
6.7	Pressure switch adjustment	29
6.7.1	Air pressure switch - check CO	29
6.7.2	Maximum gas pressure switch	29
6.7.3	Minimum gas pressure switch	29
6.8	Operation sequence of the burner	30
6.8.1	Burner start-up	30
6.8.2	Operation	30
6.8.3	Ignition failure	30
6.8.4	Burner flame goes out during operation	30
6.9	Burner start-up cycle diagnostics	31
6.9.1	Resetting of control box and diagnostics use	31
6.9.2	Control box reset	31
6.9.3	Visual diagnostics	31
6.9.4	Software diagnostics	31
6.10	Normal operation / flame detection time	32
7	Maintenance	33
7.1	Notes on safety for the maintenance	33
7.2	Maintenance programme	33
7.2.1	Maintenance frequency	33
7.2.2	Checking and cleaning	33
7.3	Opening the burner	34
7.4	Closing the burner	34
8	Faults - Probable causes - Solutions	35
A	Appendix - Accessories	37
B	Appendix - Electrical panel layout	39

1 Declarations

Declaration of conformity in accordance with ISO / IEC 17050-1

Manufacturer: RIELLO S.p.A.
 Address: Via Pilade Riello, 7
 37045 Legnago (VR)
 Product: Forced draught gas burners
 Model: RS 300/M BLU
 RS 400/M BLU
 RS 500/M BLU
 RS 650/M BLU
 RS 800/M BLU

These products are in compliance with the following Technical Standards:

EN 676

EN 12100

and according to the European Directives:

GAD	2009/142/EC	Gas Devices Directive
MD	2006/42/EC	Machine Directive
LVD	2006/95/EC	Low Voltage Directive
EMC	2004/108/EC	Electromagnetic Compatibility

Such products are marked as follows:



EC-0085BR0480	RS 300/M BLU
EC-0085BR0481	RS 300/M BLU
EC-0085BO0341	RS 500/M BLU
EC-0085BT0337	RS 650/M BLU
EC-0085BT0337	RS 800/M BLU

The quality is guaranteed by a quality and management system certified in accordance with UNI EN ISO 9001.

Manufacturer's Declaration

RIELLO S.p.A. declares that the following products comply with the NOx emission limits specified by German standard "1. BImSchV revision 26.01.2010".

Product	Type	Model	Output
Forced draught gas burners	859T	RS 300/M BLU	500 - 3800 kW
	860T	RS 400/M BLU	950 - 4590 kW
	856T	RS 500/M BLU	1000 - 5170 kW
	856T80	RS 500/M BLU	1000 - 5170 kW
	1123T	RS 650/M BLU	1400 - 6500 kW
	887T	RS 800/M BLU	1200 - 8100 kW
	887T80	RS 800/M BLU	1200 - 8100 kW

Legnago, 03.09.2014

Executive General Manager
 RIELLO S.p.A. - Burner Department

Mr. U. Ferretti

Research & Development Director
 RIELLO S.p.A. - Burner Department

Mr. R. Cattaneo

2 Information and general warnings

2.1 Information about the instruction manual

2.1.1 Introduction

The instruction manual supplied with the burner:

- is an integral and essential part of the product and must not be separated from it; it must therefore be kept carefully for any necessary consultation and must accompany the burner even if it is transferred to another owner or user, or to another system. If the manual is lost or damaged, another copy must be requested from the Technical Assistance Service of the area;
- is designed for use by qualified personnel;
- offers important indications and instructions relating to the installation safety, start-up, use and maintenance of the burner.

Symbols used in the manual

In some parts of the manual you will see triangular DANGER signs. Pay great attention to these, as they indicate a situation of potential danger.

2.1.2 General dangers

The **dangers** can be of **3 levels**, as indicated below.



DANGER

Maximum danger level!

This symbol indicates operations which, if not carried out correctly, cause serious injury, death or long-term health risks.



WARNING

This symbol indicates operations which, if not carried out correctly, may cause serious injury, death or long-term health risks.



CAUTION

This symbol indicates operations which, if not carried out correctly, may cause damage to the machine and/or injury to people.

2.1.3 Other symbols



DANGER

DANGER: LIVE COMPONENTS

This symbol indicates operations which, if not carried out correctly, lead to electric shocks with lethal consequences.



DANGER: FLAMMABLE MATERIAL

This symbol indicates the presence of flammable materials.



DANGER: BURNING

This symbol indicates the risks of burns due to high temperatures.



DANGER: CRUSHING OF LIMBS

This symbol indicates the presence of moving parts: danger of crushing of limbs.



WARNING: MOVING PARTS

This symbol indicates that you must keep limbs away from moving mechanical parts; danger of crushing.



DANGER: EXPLOSION

This symbol signals places where an explosive atmosphere is present. An explosive atmosphere is defined as a mixture of dangerous substances with air, under atmospheric conditions, in the form of gases, vapours, mist or dust in which, after ignition has occurred, combustion spreads to the entire unburned mixture.



PERSONAL PROTECTION EQUIPMENT

These symbols indicate the equipment that must be worn and kept by the operator for protection against threats against safety and/or health while at work.



MOUNT CASING

This symbol indicates that it is mandatory to mount casing again after maintenance, cleaning or checks.



ENVIRONMENTAL PROTECTION

This symbol gives indications for the use of the machine with respect for the environment.



IMPORTANT INFORMATION

This symbol indicates important information that you must bear in mind.



This symbol indicates a list.

Abbreviations used

Ch.	Chapter
Fig.	Figure
Page	Page
Sec.	Section
Tab.	Table

2.1.4 Delivery of the system and the instruction manual

When the system is delivered, it is important that:

- the instruction manual is delivered to the user by the system manufacturer, with the recommendation to keep it in the room where the heat generator is to be installed.
- The instruction manual shows:
 - the serial number of the burner;

- the address and telephone number of the nearest Assistance Centre.

- The system supplier must carefully inform the user about:
 - the use of the system;
 - any further tests that may be required before activating the system;
 - maintenance, and the need to have the system checked at least once a year by a representative of the manufacturer or another specialised technician.
- To ensure a periodic check, the manufacturer recommends the drawing up of a Maintenance Contract.

2.2 Guarantee and responsibility

The manufacturer guarantees its new products from the installation date, in accordance with the regulations in force and/or the sales contract. At the moment of the first start-up, check that the burner is integral and complete.



WARNING

Failure to observe the information given in this manual, operating negligence, incorrect installation and carrying out of non authorised modifications will result in the annulment by the manufacturer of the guarantee that it supplies with the burner.

In particular, the rights to the guarantee and the responsibility will no longer be valid, in the event of damage to things or injury to people, if such damage/injury was due to any of the following causes:

- incorrect installation, start-up, use and maintenance of the burner;
- improper, incorrect or unreasonable use of the burner;
- intervention of unqualified personnel;
- carrying out of unauthorised modifications on the equipment;
- use of the burner with safety devices that are faulty, incorrectly applied and/or not working;
- installation of untested supplementary components on the burner;
- powering of the burner with unsuitable fuels;
- faults in the fuel supply system;
- use of the burner even following an error and/or an irregularity;
- repairs and/or overhauls incorrectly carried out;
- modification of the combustion chamber with inserts that prevent the regular development of the structurally established flame;
- insufficient and inappropriate surveillance and care of those burner components most likely to be subject to wear and tear;
- the use of non-original components, including spare parts, kits, accessories and optional;
- force majeure.

The manufacturer furthermore declines any and every responsibility for the failure to observe the contents of this manual.

3 Safety and prevention

3.1 Introduction

The burners have been designed and built in compliance with current regulations and directives, applying the known technical rules of safety and envisaging all the potential danger situations.

It is necessary, however, to bear in mind that the imprudent and clumsy use of the equipment may lead to situations of death risk for the user or third parties, as well as the damaging of the burner or other items. Inattention, thoughtlessness and excessive confidence often cause accidents; the same applies to tiredness and sleepiness.

It is a good idea to remember the following:

- The burner must only be used as expressly described. Any other use should be considered improper and therefore dangerous.

In particular:

it can be applied to boilers operating with water, steam, diathermic oil, and to other users expressly named by the manufacturer;

the type and pressure of the fuel, the voltage and frequency of the electrical power supply, the minimum and maximum deliveries for which the burner has been regulated, the pressurisation of the combustion chamber, the dimensions of the combustion chamber and the room temperature must all be within the values indicated in the instruction manual.

- Modification of the burner to alter its performance and destinations is not allowed.
- The burner must be used in exemplary technical safety conditions. Any disturbances that could compromise safety must be quickly eliminated.
- Opening or tampering with the burner components is not allowed, apart from the parts requiring maintenance.
- Only those parts envisaged by the manufacturer can be replaced.



The manufacturer guarantees safety and proper functioning only if all burner components are intact and positioned correctly.

3.2 Personnel training

The user is the person, body or company that has acquired the machine and intends to use it for the specific purpose. He is responsible for the machine and for the training of the people working around it.

The user:

- undertakes to entrust the machine exclusively to suitably trained and qualified personnel;
- undertakes to inform his personnel in a suitable way about the application and observance of the safety instructions. With that aim, he undertakes to ensure that everyone knows the use and safety instructions for his own duties;
- Personnel must observe all the danger and caution indications shown on the machine.
- Personnel must not carry out, on their own initiative, operations or interventions that are not within their province.
- Personnel must inform their superiors of every problem or dangerous situation that may arise.
- The assembly of parts of other makes, or any modifications, can alter the characteristics of the machine and hence compromise operating safety. The manufacturer therefore declines any and every responsibility for any damage that may be caused by the use of non-original parts.

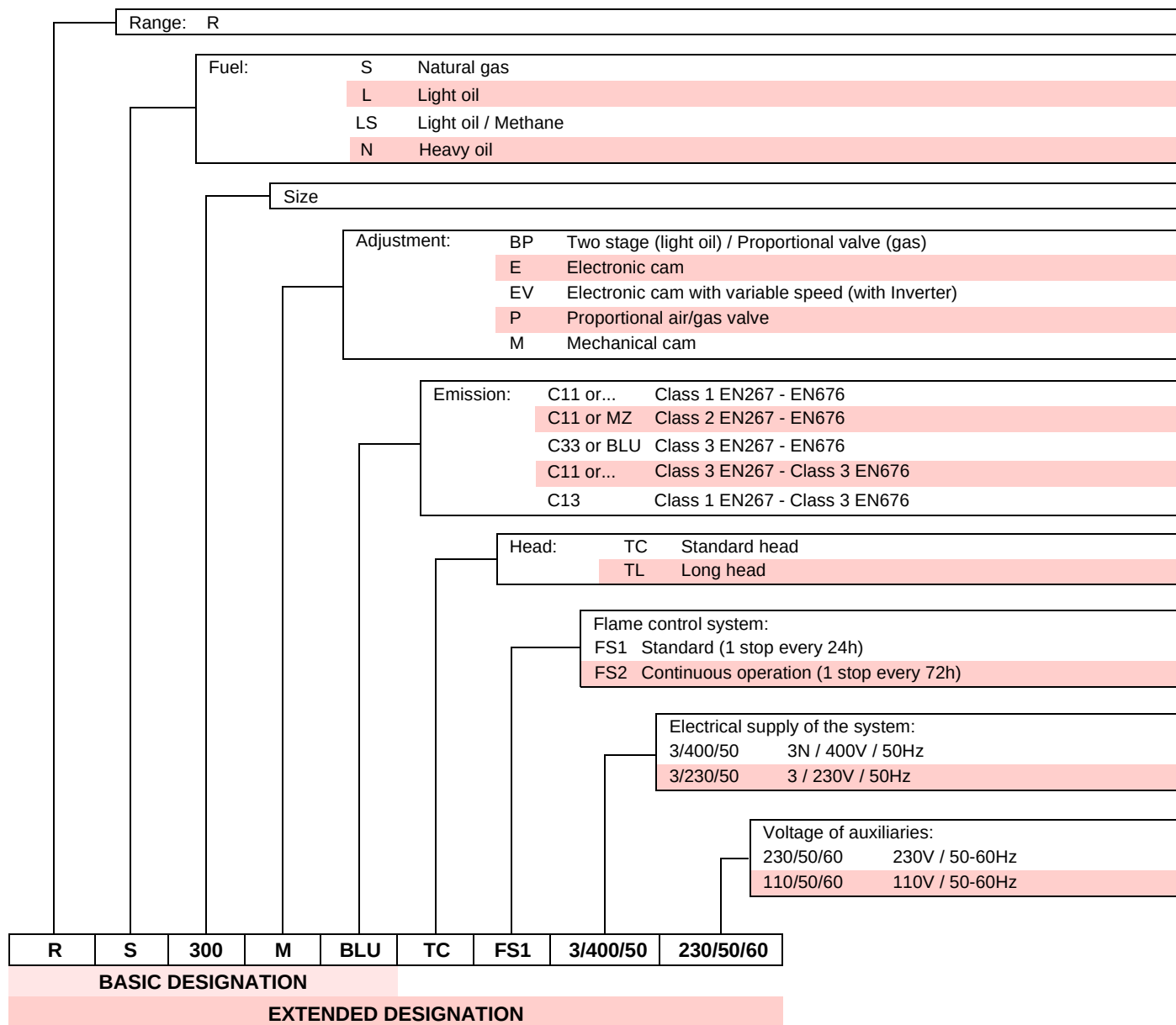
In addition:



- the user must take all the measures necessary to prevent unauthorised people gaining access to the machine;
- the user must inform the manufacturer if faults or malfunctioning of the accident prevention systems are noticed, along with any presumed danger situation.
- Personnel must always use the personal protective equipment envisaged by legislation and follow the indications given in this manual.

4 Technical description of the burner

4.1 Burner designation



4.2 Models available

Designation	Voltage	Start-up	Code
RS 300/M BLU	3/400/50	Direct	3899400 - 3899410
RS 400/M BLU	3/400/50	Star/Delta	3899500 - 3899510
RS 500/M BLU	3/400/50	Star/Delta	3899100 - 3899110
RS 500/M BLU	3/380/60	Star/Delta	20006131
RS 650/M BLU	3/400/50	Star/Delta	20040330
RS 800/M BLU	3/400/50	Star/Delta	3911000 - 3911010
RS 800/M BLU	3/380/60	Star/Delta	20008894

Tab. A

4.3 Burner categories - Countries of destination

Gas category		Destination country
I _{2H}		SE - FI - AT - GR - DK - ES - GB - IT - IE - PT - IS - CH - NO
I _{2ELL}		DE
I _{2L}		NL
I _{2Er}		FR
I _{2E(R)B}		BE
I _{2E}		LU - PL

Tab. B
4.4 Technical data

Model			RS 300/M BLU	RS 400/M BLU	RS 500/M BLU	RS 650/M BLU	RS 800/M BLU
Type			859T	860T	856T	1123T	887T
Power ⁽¹⁾	min - max	kW	500/1350 ÷ 3800	950/1830 ÷ 4590	1000/2500 ÷ 5170	1410/3020 ÷ 6500	1200/3500 ÷ 8100
Output ⁽¹⁾							
Fuels			Natural gas: G20 (methane gas) - G21 - G22 - G23 - G25				
Gas pressure at max. output ⁽²⁾ - Gas: G20/G25		mbar	23.3/32.7	34.3/40.2	37.6/56.1	44.8/64.4	45.5/81.2
Operation			Intermittent				
Standard applications			Boilers: water, steam, diathermic oil				
Ambient temperature		°C	0 - 40				
Combustion air temperature		°C max	60				
Burner weight		Kg	225	236	250	300	300
Noise levels ⁽³⁾	Sound pressure	dB(A)	82	85	88	90,1	88,1
	Sound power		93	96	99	101,1	99,1

Tab. C

Model			RS 500/M BLU	RS 800/M BLU
Type			856T80	887T80
Power ⁽¹⁾	min - max	kW	1000/2500 ÷ 5170	1200/3500 ÷ 8100
Output ⁽¹⁾				
Fuels			Natural gas: G20 (methane gas) - G21 - G22 - G23 - G25	
Gas pressure at max. output ⁽²⁾ - Gas: G20/G25		mbar	37.6/56.1	45.5/81.2
Operation			Intermittent	
Standard applications			Boilers: water, steam, diathermic oil	
Ambient temperature		°C	0 - 40	
Combustion air temperature		°C max	60	
Burner weight		Kg	250	300
Noise levels ⁽³⁾	Sound pressure	dB(A)	88	88,1
	Sound power		99	99,1

Tab. D

- (1) Reference conditions: Ambient temperature 20°C - Gas temperature 15°C - Barometric pressure 1013 mbar - Altitude 0 m a.s.l.
 (2) Pressure at the test point of the pressure switch (20)(Fig. 4) with zero pressure in the combustion chamber and at maximum rated output.
 (3) Sound pressure measured in manufacturer's combustion laboratory, with burner operating on test boiler and at maximum rated output. The sound power is evaluated, in line with the regulations, on a spherical surface centred on the burner and with a radius of 1 metre.

4.5 Electrical data

Model		RS 300/M BLU	RS 400/M BLU	RS 500/M BLU	RS 650/M BLU	RS 800/M BLU
Type		859T	860T	856T	1123T	887T
Main electrical supply		3N ~ 400 / 230V +/-10% 50 Hz				
Fan motor IE2	rpm	2900	2900	2920	2935	2935
	V	230/400	400/690	400/690	400/690	400/690
	kW	4.5	7.5	9.2	18.5	22
	A	15/8.7	13.8/8	16.9/9.7	33.3/19.2	38.6/22.3
Ignition transformer	V1 - V2 I1 - I2	230 V - 1 x 8 kV 1 A - 20 mA				
Absorbed electrical power	kW max	5	8	10	19	23
Protection level		IP 54				

Tab. E

Model		RS 500/M BLU		RS 800/M BLU	
Type		856T80		887T80	
Main electrical supply		3N ~ 380 / 220V +/-10% 60 Hz			
Fan motor IE2	rpm	3510		3550	
	V	380/660		380/660	
	kW	9.2		22	
	A	18.3/10.6		42.5/24.5	
Ignition transformer	V1 - V2 I1 - I2	230 V - 1 x 8 kV 1 A - 20 mA			
Absorbed electrical power	kW max	10		23	
Protection level		IP 54			

Tab. F

Model		RS 400/M BLU	RS 500/M BLU	RS 650/M BLU	RS 800/M BLU
Type		860T	856T	1123T	887T
Main electrical supply		3N ~ 400 / 230V +/-10% 50 Hz			
Fan motor IE3	rpm	2920	2880	2880	2880
	V	400/690	400/690	400/690	400/690
	kW	7.5	9.2	18.5	22
	A	14/8.1	16.8/9.7	32.2/18.6	38.2/22.3
Ignition transformer	V1 - V2 I1 - I2	230 V - 1 x 8 kV 1 A - 20 mA			
Absorbed electrical power	kW max	8.8	10.6	20.5	24
Protection level		IP 54			

Tab. G

4.6 Maximum dimensions

The maximum dimensions of the burner are shown in Fig. 1.
Bear in mind that inspection of the combustion head requires the burner to be opened and the rear part turned on the hinge.

The maximum dimensions of the open burner are indicated by the L and R positions.

The I position is reference for the refractory thickness of the boiler door.

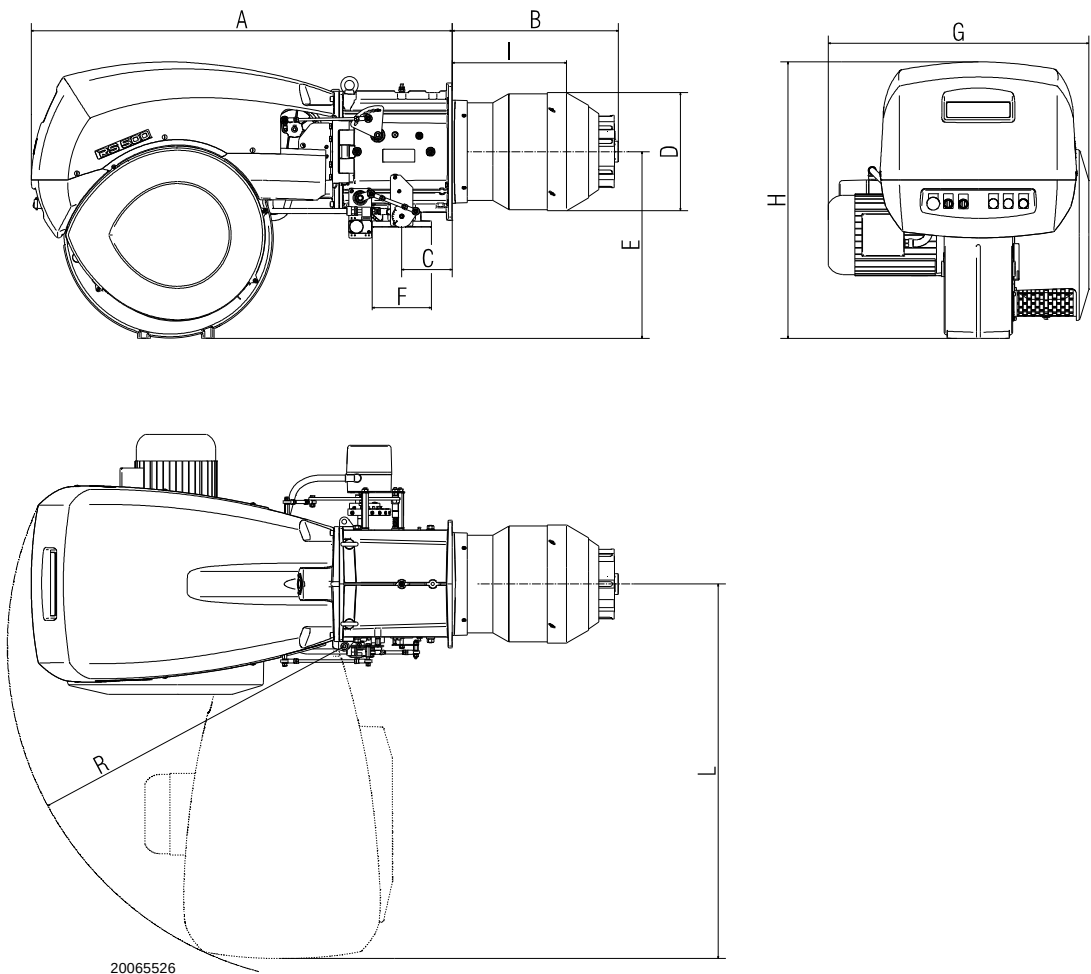


Fig. 1

mm	A	B	C	D	E	F	G	H	I	L	R
RS 300/M BLU	1325	521	164	313	588	DN65	720	867	373	1175	1055
RS 400/M BLU	1325	521	164	313	588	DN65	775	867	373	1175	1055
RS 500/M BLU	1325	521	164	370	588	DN65	775	867	357	1175	1055
RS 650/M BLU	1325	549	164	363	588	DN80	940	867	397	1175	1055
RS 800/M BLU	1325	582	164	363	588	DN80	940	867	418	1175	1055

Tab. H

4.7 Firing rates

The **MAXIMUM OUTPUT** is chosen from within the diagram area (Fig. 2).

The **MINIMUM OUTPUT** must not be lower than the minimum limit of the diagram:



The firing rate value (Fig. 2) has been obtained considering an ambient temperature of 20°C, an atmospheric pressure of 1013 mbar (approx. 0 m a.s.l.), and with the combustion head adjusted as shown on page 20.

Model	kW
RS 300/M BLU	500
RS 400/M BLU	950
RS 500/M BLU	1000
RS 650/M BLU	1400
RS 800/M BLU	1200

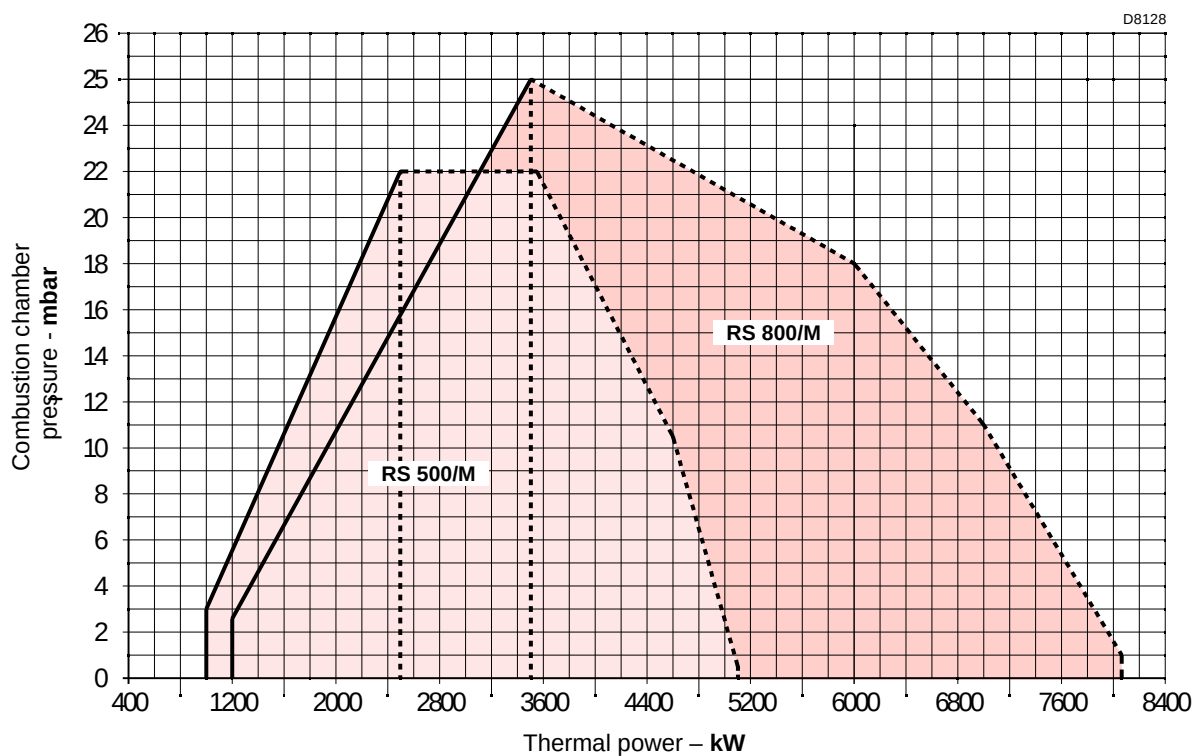
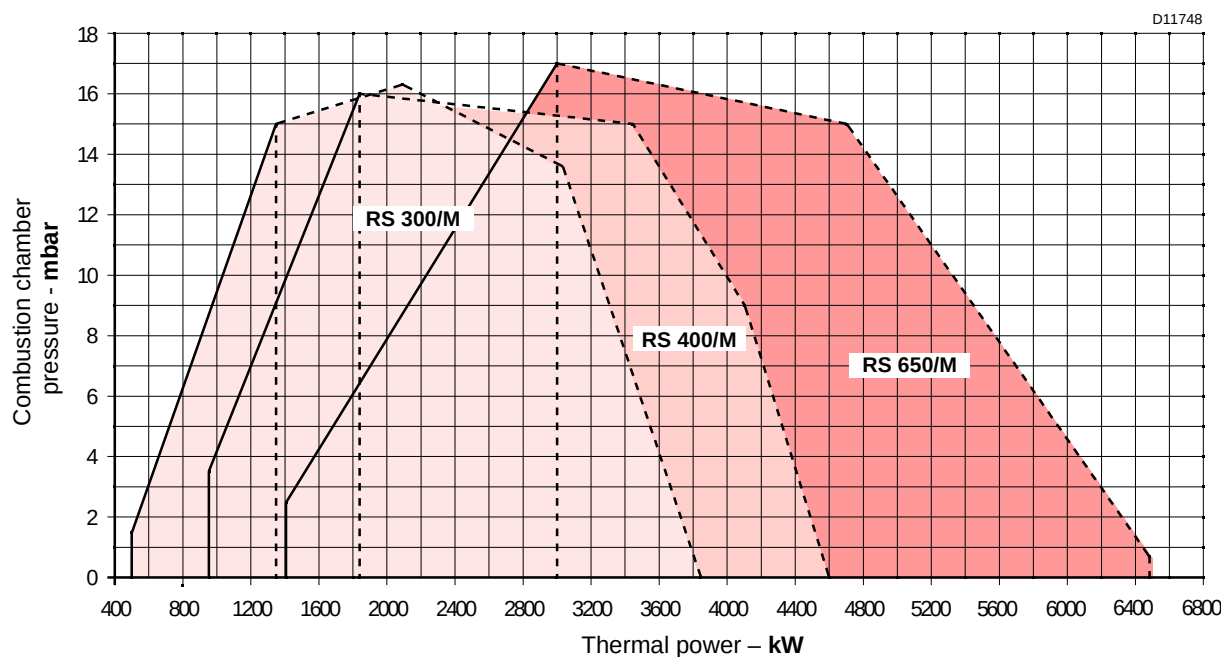


Fig. 2

4.8 Test boiler

The burner/boiler combination does not pose any problems if the boiler is EC approved and its combustion chamber dimensions are similar to those indicated in the diagram (Fig. 3).
If the burner must be combined with a boiler that has not been EC approved and/or its combustion chamber dimensions are clearly smaller than those indicated in the diagram, consult the manufacturer.

The firing rates were obtained in special test boilers, according to EN 676 regulations.
In Fig. 3 you can see the diameter and length of the test combustion chamber.
Example: RS 800/M BLU
Output 7000 kW - diameter 120 cm - length 6 m.

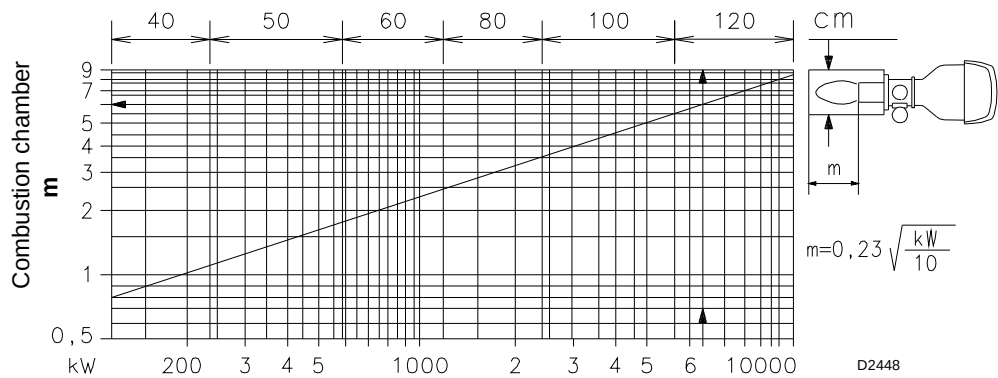


Fig. 3

4.9 Burner equipment

- Gasket for gas train adaptor. No. 1
- M16 x 70 Screws to fix the gas train adaptor. No. 8
- Thermal insulation screen No. 1
- M 18 x 60 screws to secure the burner flange to the boiler No. 4
- Cable grommets kit for optional electrical wiring input. . . . No. 1
- M16 x 67 stud bolts to fix the gas elbow to the pipe coupling (for RS 650-800/M BLU only). No. 8
- M16 nuts to fix the gas elbow to the pipe coupling (for RS 650-800/M BLU only). No. 8
- Instructions. No. 1
- Spare parts list. No. 1

4.10 Burner description

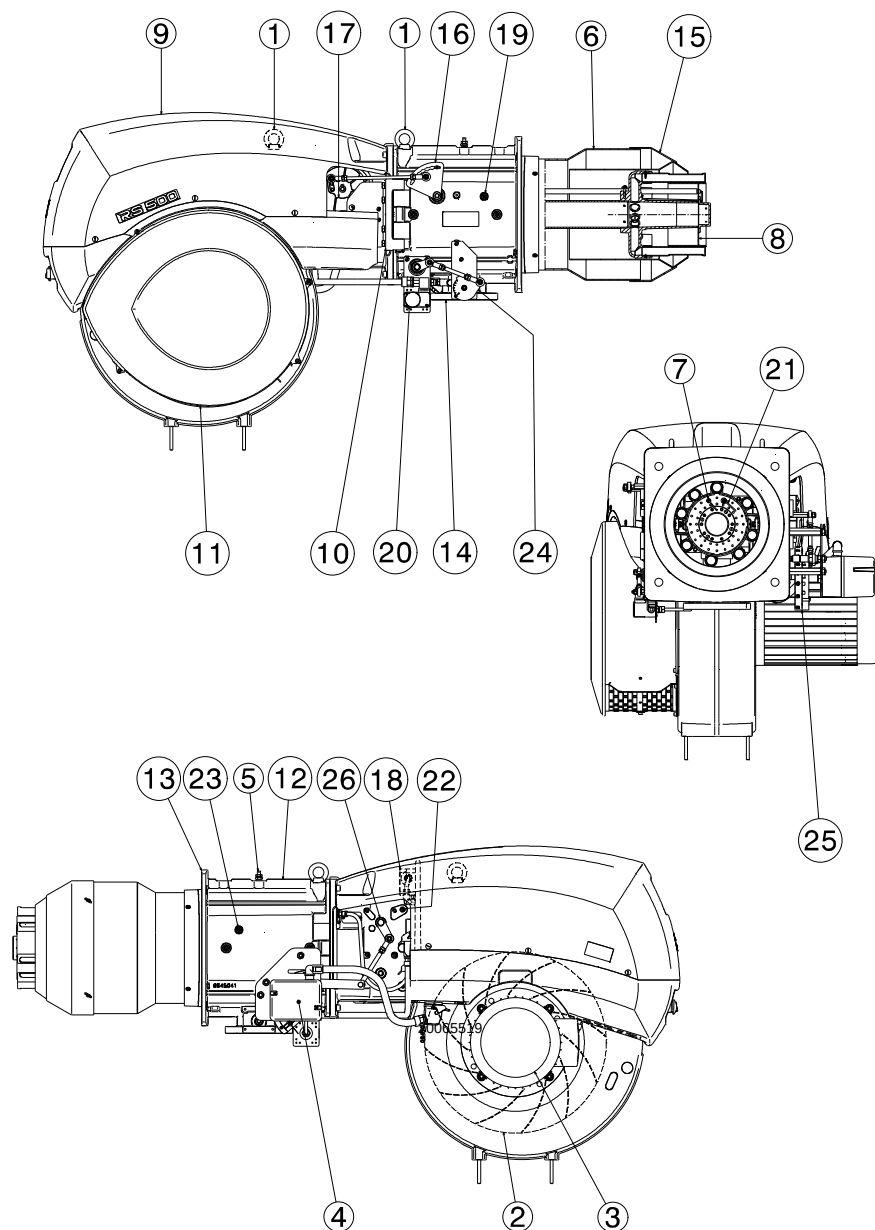


Fig. 4

- 1 Lifting rings
- 2 Fan
- 3 Fan motor
- 4 Air damper servomotor
- 5 Combustion head gas pressure test point
- 6 Combustion head
- 7 Ignition electrode
- 8 Flame stability disc
- 9 Electrical panel casing
- 10 Hinge for opening the burner
- 11 Fan air inlet
- 12 Pipe coupling
- 13 Gasket for boiler fixing
- 14 Gas inlet flange
- 15 Shutter
- 16 Combustion head movement lever
- 17 Air damper movement gears
- 18 Air pressure switch
- 19 Combustion head air pressure test point
- 20 Maximum gas pressure switch with pressure test point
- 21 Flame sensor probe
- 22 Pressure test point for air pressure switch “+”

- 23 Pressure test point for air pressure switch “-”
(for RS 300-400-500/M BLU only)
- 24 Gas butterfly valve control lever
- 25 Adjustable profile cam
- 26 Air damper control lever



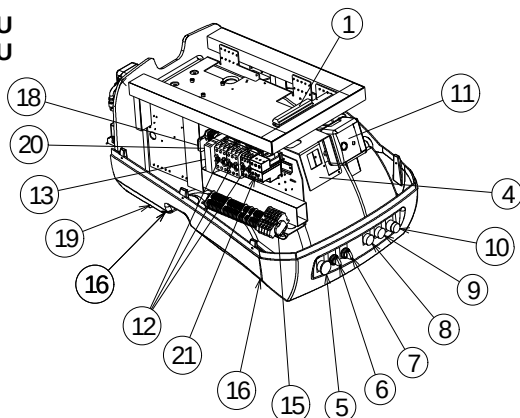
CAUTION

The burner can be opened to the right or to the left without links to the fuel supply side.

When the burner is closed, the hinge can be refitted on the opposite side.

4.11 Electrical panel description

RS 650/M BLU
RS 800/M BLU



RS 300/M BLU
RS 400/M BLU
RS 500/M BLU

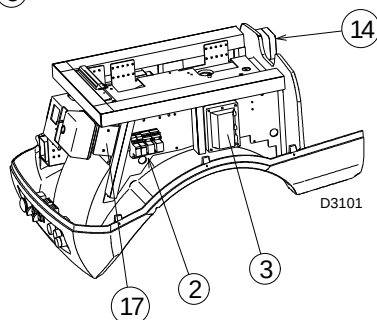
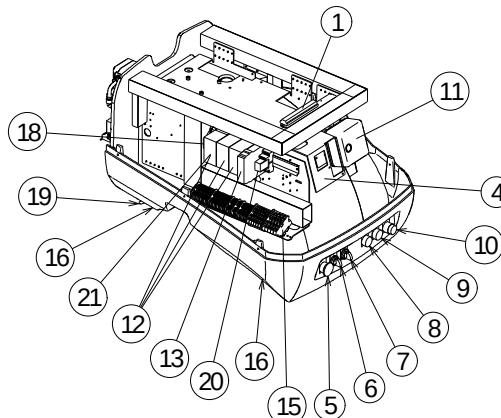


Fig. 5

- 1 Terminal board for kits
- 2 Clean contacts output relay
- 3 Ignition transformer
- 4 Bracket for application of output power regulator kit RWF40
- 5 Stop push-button
- 6 OFF-automatic-manual selector
- 7 Power increase - power reduction selector
- 8 Light signalling start-up enabling
- 9 Light signalling of motor thermal relay operation
- 10 Light signalling of burner lockout and reset switch
- 11 Electrical control box
- 12 Star-triangle starter (except for RS 300/M BLU)
- 13 Timer (except for RS 300/M BLU)
- 14 Air pressure switch
- 15 Main terminal supply board
- 16 Supply cables and external connections passage
- 17 Bracket for application of UV sensor kit
- 18 Auxiliary circuits fuse
- 19 Plug/socket servomotor
- 20 Relay
- 21 Thermal relay

4.11.1 Fan motor rotation

Place in front of the cooling fan of the fan motor and check that it turns anticlockwise.

NOTE

Two types of burner lockout may occur:

- **Control box lockout:** if the control box button (**red led**) 11) Fig. 5) and the backlit button 10) light up, it indicates that the burner is in lockout.
Release by pressing the pushbutton 10).
- **Motor lockout:** release by pressing the button on thermal relay.

4.12 RMG88.62C2 control box

Warnings



To avoid accidents, material or environmental damage, observe the following instructions!

The RMG88.62C2 control box is a safety device! Avoid opening or modifying it, or forcing its operation. Riello S.p.A. cannot assume any responsibility for damage resulting from unauthorised interventions!

- All interventions (assembly and installation operations, assistance, etc.) must be carried out by qualified personnel.
- Before modifying the wiring in the control box connection area, fully disconnect the system from the power supply (omnipolar separation). Check the system is not powered and cannot be accidentally reconnected. Failure to do this will lead to the risk of electrocution.
- Protection against electrocution from the control box and all connected electric components is obtained with the correct assembly.
- Before any intervention (assembly and installation operations, assistance, etc.), ensure the wiring is in order and that the parameters are correctly set, then make the safety checks.
- Falls and collisions can negatively affect the safety functions.
In this case, the control box must not be operated, even if it displays no evident damage.
- Press the reset button of the burner lockout command or the reset button (by applying a force of not more than 10 N), without the aid of tools or sharp objects.

For the safety and reliability of the control box, comply with the following instructions:

- avoid conditions that can favour the development of condensate and humidity. Otherwise, before switching on again, make sure that the entire control box is perfectly dry!
- Static charges must be avoided since they can damage the control box's electronic components when touched.

Installation notes

- Check the electric wiring inside the boiler complies with the national and local safety regulations.
- Ensure that spliced wires cannot get into contact with neighbouring terminals. Use adequate ferrules.
- The actuator execution times must correspond to the burner control program. An additional safety control of the burner with the actuators is needed.
- Make sure the cable grommets of the connected cables comply with the relevant standards.
- Arrange the H.V. ignition cables separately, as far as possible from the control box and the other cables.
- Phase and neutral must not be swapped over (danger of fire, operating defects, loss of protection against electric shock, etc.).



S8906

Fig. 6

Technical data

Mains voltage	AC 110...120 V +10 % / -15 %
Mains frequency	50 / 60 Hz ±6 %
Power absorption	20 VA
Protection level	IP20
Safety class	I
Weight	approx. 260 g
Cable length	
Thermostat cable	Max. 20 m at 100 pF/m
Air pressure switch	Max. 1 m at 100 pF/m
Gas pressure switch	Max. 20 m at 100 pF/m
Remote reset	Max. 20 m at 100 pF/m
CPI	Max. 1 m at 100 pF/m
Environmental conditions:	
Operation	DIN EN 60721-3-3
Climatic conditions	Class 3K3
Mechanical conditions	Class 3M3
Temperature range	-20...+60°C
Humidity	< 95 % r.h.

Tab. I

Mechanical structure

The control box is made of plastic to resist knocks, heat and flame propagation.

The control box contains the following components:

- a microprocessor that controls the program sequence, and a relay for controlling the load
- an electronic flame signal amplifier
- a built-in reset button with 3 signalling colours (LED) for status and error messages

4.13 LKS 310-35 servomotor
Warnings


To avoid accidents, material or environmental damage, observe the following instructions!

Avoid opening, modifying or forcing the actuators.

- All interventions (assembly and installation operations, assistance, etc.) must be carried out by qualified personnel.
- Falls and collisions can negatively affect the safety functions. In this case, the servomotor must not be operated, even if it displays no evident damage.
- Fully disconnect the servomotor from the mains when working near terminals and connections.
- Condensation and exposure to water are not allowed.

Assembly notes

- Check the relevant national safety standards are respected.
- For safety reasons, the servomotor must be checked after long periods of non-use.

Installation notes

- To avoid the risk of electrocution, fix the cover and all electrical wiring correctly.
- Check the wiring is in order.
- Arrange the H.V. ignition cables separately, as far as possible from the control box and the other cables.
- Electromagnetic emissions must be checked on an application-specific basis



S8421

Fig. 7
Technical data

Mains voltage	230 V -15% +10%
Mains frequency	50 / 60 Hz
Power absorption	7 ... 15 VA
Motor	Reversible synchronous
Clutch	Red lever, separates gears from motor
Drive angle	90°
Protection level	IP54, with appropriate cable entry
Cable entry	2 x PG11
Cable connection	terminal board for 0.5mm ² (min.) and 2.5mm ² (max.)
Rotation direction	Clockwise
Rated torque (max.)	15 Nm
Holding torque	10 Nm
Operation time	30 s.
Weight	approx. 1.8 kg
Environmental conditions:	
Operation	0...+60° C
Transport and storage	-20...+60°C

Tab. J

5 Installation

5.1 Notes on safety for the installation

After carefully cleaning all around the area where the burner will be installed, and arranging the correct lighting of the environment, proceed with the installation operations.



All the installation, maintenance and disassembly operations must be carried out with the electricity supply disconnected.



The installation of the burner must be carried out by qualified personnel, as indicated in this manual and in compliance with the standards and regulations of the laws in force.



Combustion air inside the boiler must be free from hazardous mixes (e.g.: chloride, fluoride, halogen); if present, it is highly recommended to carry out cleaning and maintenance more frequently.

5.2 Handling

The packaging of the burner includes a wooden platform, so it is possible to move the burner (still packaged) with a transpallet truck or fork lift truck.



The handling operations for the burner can be highly dangerous if not carried out with the greatest attention: keep any unauthorised people at a distance; check the integrity and suitability of the available means of handling. Check also that the area in which you are working is empty and that there is an adequate escape area (i.e. a free, safe area to which you can quickly move if the burner should fall). When handling, keep the load at not more than 20-25 cm from the ground.



After positioning the burner near the installation point, correctly dispose of all residual packaging, separating the various types of material.



Before proceeding with the installation operations, carefully clean all around the area where the burner will be installed.

5.3 Preliminary checks

Checking the consignment



After removing all the packaging, check the integrity of the contents. In the event of doubt, do not use the burner; contact the supplier.



The packaging elements (wooden cage or cardboard box, nails, clips, plastic bags, etc.) must not be abandoned as they are potential sources of danger and pollution; they should be collected and disposed of in the appropriate places.

RBL	A	B	C
D	E	F	
GAS: KAASU GAZ: AERIO	☒ G G	H H	
I			RIELLO spa 1-37045 Legnano (VA)
			CE

D10411

Fig. 8

Checking the characteristics of the burner

Check the identification label of the burner, showing:

- the model (A) (Fig. 8) and type of burner (B);
 - the year of manufacture, in cryptographic form (C);
 - the serial number (D);
 - the data for electrical supply and the protection level (E);
 - the absorbed electrical power (F);
 - the types of gas used and the relative supply pressures (G);
 - the data of the burner's minimum and maximum output possibilities (H) (see Firing rate)
- Warning.** The burner output must be within the boiler's firing rate;
- the category of the appliance/countries of destination (I).



A burner label, or any other component, that has been tampered with, removed or is missing, prevents the definite identification of the burner and makes any installation or maintenance work difficult.

5.4 Operating position



WARNING

- The burner is designed to operate only in positions 1, 2, 3 and 4 (Fig. 9).
- Installation 1 is preferable, as it is the only one that allows the maintenance operations as described in this manual.
- Installations 2, 3 and 4 permit operation but make maintenance and inspection of the combustion head more difficult.



DANGER

- Any other position could compromise the correct operation of the appliance.
- Installation 5 is prohibited for safety reasons.

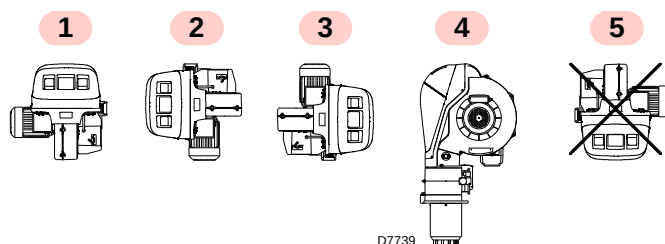


Fig. 9

5.5 Removal of the locking screws from the shutter



WARNING

Remove the screws and the nuts 1)-2)(Fig. 10), before installing the burner on the boiler.

Replace them with the screws 3) M12 X 25 supplied with the burner.

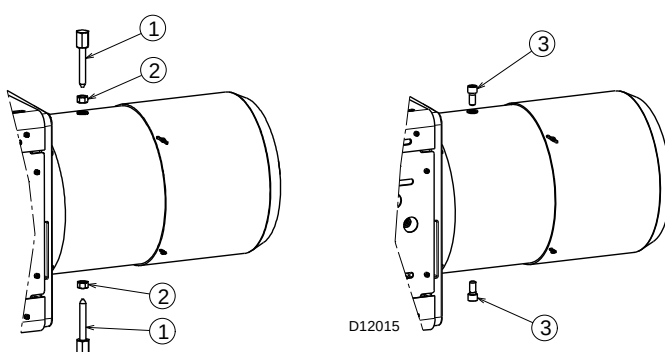


Fig. 10

5.6 Preparing the boiler

5.6.1 Boring the boiler plate

Pierce the closing plate of the combustion chamber, as in Fig. 11. The position of the threaded holes can be marked using the thermal insulation screen supplied with the burner.

5.6.2 Blast tube length

The length of the blast tube must be selected according to the indications provided by the manufacturer of the boiler, and in any case it must be greater than the thickness of the boiler door complete with its refractory.

For boilers with front flue passes 1) (Fig. 12) or flame inversion chamber, a protection in refractory material 5) must be inserted between the boiler fettling 2) and the flame funnel 4).

This protection must not compromise the extraction of the blast tube.

For boilers with a water-cooled frontpiece, a refractory lining 2)-5) (Fig. 12) is not necessary, unless expressly requested by the boiler manufacturer.

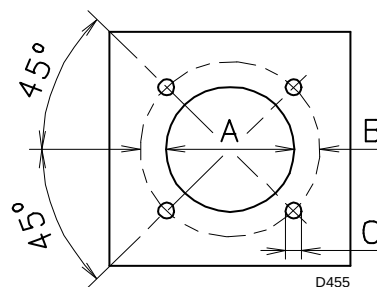


Fig. 11

mm	A	B	C
RS 300/M BLU	350	452	M18
RS 400/M BLU	350	452	M18
RS 500/M BLU	390	452	M18
RS 650/M BLU	400	495	M18
RS 800/M BLU	400	495	M18

Tab. K

5.7 Securing the burner to the boiler



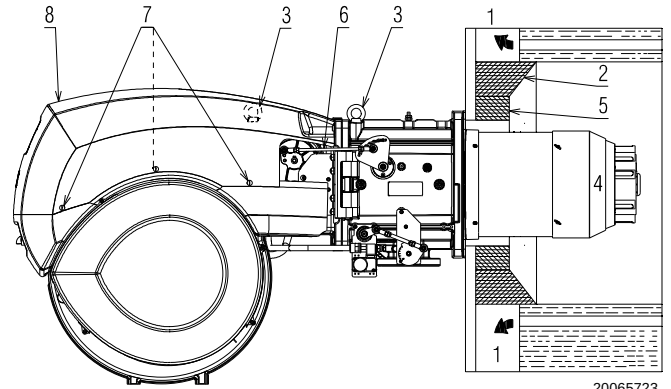
Prepare a suitable lifting system using rings 3)(Fig. 12).

- Fit the heat insulation supplied onto the blast tube (4) (Fig. 12).
- Fit the entire burner onto the boiler hole prepared previously (Fig. 11), and fasten with the screws supplied.



WARNING

The seal between burner and boiler must be airtight.

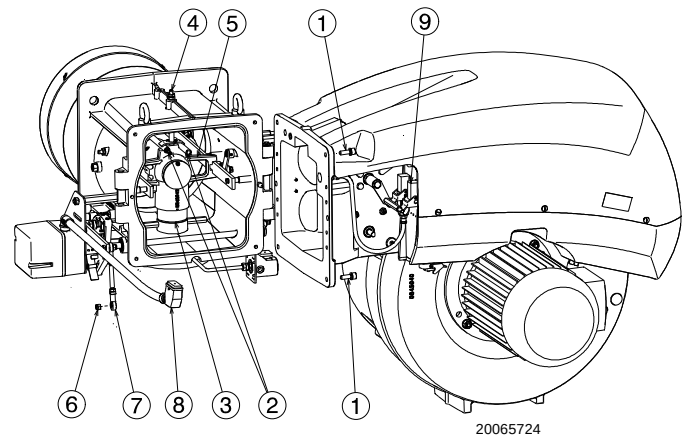


20065723

Fig. 12

5.8 Access to head internal part

- Unhook the tie-rod 6)(Fig. 12) of the head movement lever, removing the nut.
- Undo the self-locking nut 6)(Fig. 13) and unhook the tie-rod 7).
- Disconnect the socket 8) of the servomotor.
- Disconnect the socket 9) of the gas pressure switch.
- Remove the 4 fixing screws 1).
- Open the burner on the hinge as in Fig. 13.
- Unhook the probe cables and electrode 2).
- Turn the underneath part of the elbow 3) anticlockwise up to release it from its housing.
- Undo the screw 4) with pressure test point.
- Remove the internal part of the head 5).



20065724

Fig. 13

5.9 Probe-electrode position



WARNING

Check that the probe and the electrode are placed as in Fig. 14, according to the dimensions indicated.

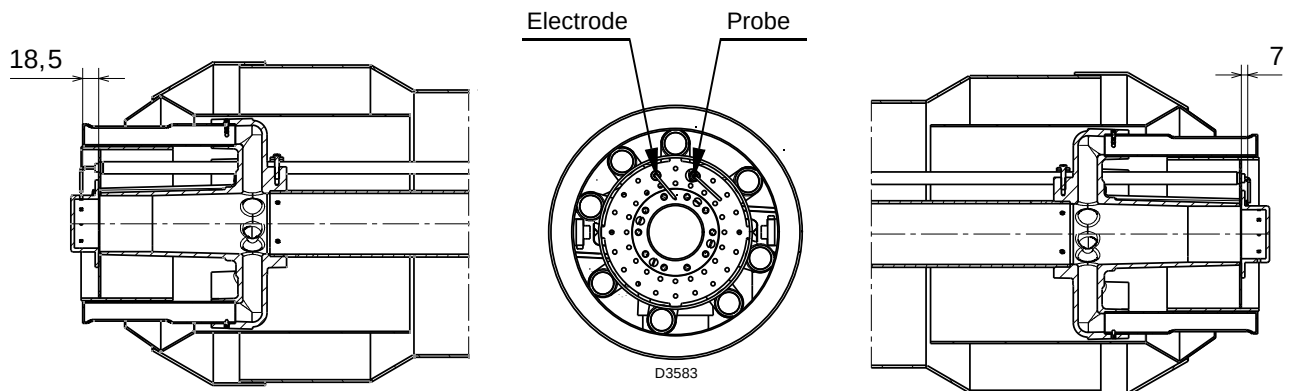


Fig. 14

5.10 Combustion head adjustment

The air damper servomotor 4)(Fig. 4 on page 13), beyond varying the air output according to the output demand, through a leverage varies the combustion head adjustment.

This system allows an optimum adjustment also at minimum firing rate.

Similarly to servomotor rotation, it is possible to vary the opening of the combustion head moving the tie-rod on the holes (1-2-3), (Fig. 15).

The selection of the hole (1-2-3) to be used is determined according to the maximum output requested (Tab. L).

In the factory, the hole is adjusted for the maximum stroke (hole 3).

In case in which, with boilers with high back pressure, also with damper completely open, the air output is not enough, it is possible to carry out a calibration different to the one indicated by the Tab. L, moving the tie-rod on the following higher hole, increasing the opening of the combustion head and the air output.

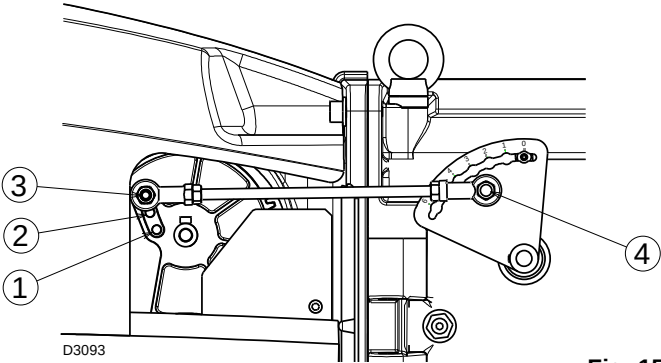


Fig. 15

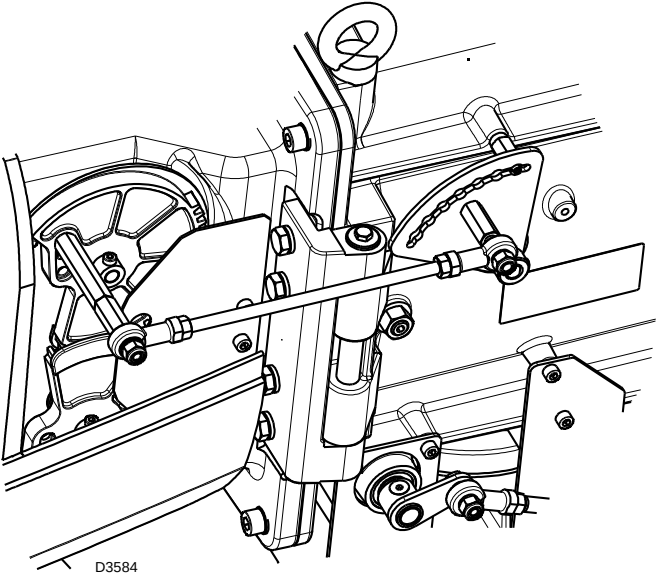


Fig. 16

Output (kW)		No. Hole
RS 300/M	1200	1
	2200	2
	2800	3
	3200	3
RS 400/M	1800	1
	3400	2
	4000	3
	4500	3
RS 500/M	1000	1
	2500	2
	3500	3
	5200	3
RS 650/M	1400	2
	4700	3
	6500	3
RS 800/M	1800	1
	4000	2
	6000	3
	8100	3

Tab. L



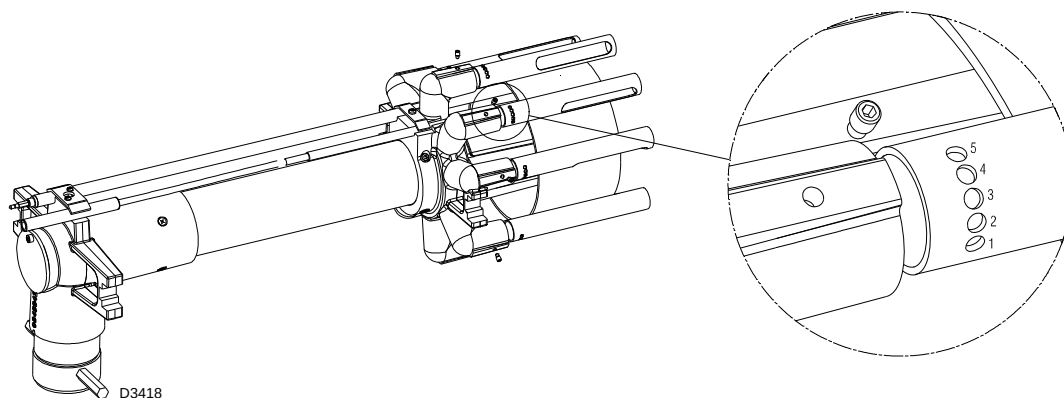
WARNING

For RS 300-400-500/M BLU only

In order to work correctly in flame inversion boilers, the gas tubes must be adjusted in the hole in position 4, see Fig. 17.



Pay attention to moving parts.
Danger of crushing of limbs!



D3418

Fig. 17

5.11 Gas feeding



Explosion danger due to fuel leaks in the presence of a flammable source.

Precautions: avoid knocking, attrition, sparks and heat.

Make sure that the fuel interception tap is closed before performing any operation on the burner.



WARNING

The fuel supply line must be installed by qualified personnel, in compliance with current standards and laws.

5.11.1 Gas feeding line

Key (Fig. 18 - Fig. 19 - Fig. 20 - Fig. 21)

- 1 Gas input pipe
- 2 Manual valve
- 3 Vibration damping joint
- 4 Pressure gauge with pushbutton cock
- 5 Filter
- 6A Includes:
 - filter
 - working valve
 - safety valve
 - pressure adjuster
- 6B Includes
 - working valve
 - safety valve
 - pressure adjuster
- 6C Includes
 - safety valve
 - working valve
- 6D Includes:
 - safety valve
 - working valve
- 7 Minimum gas pressure switch
- 8 Leak detection control, provided as an accessory or integrated, based on the gas train code. In compliance with the EN 676 standard, the leak detection control is compulsory for burners with maximum outputs over 1200 kW.
- 9 Gasket, for “flanged” versions only
- 10 Pressure adjuster
- P2 Upline pressure of valves/adjuster
- P3 Upstream pressure of the filter
- L Gas train, supplied separately
- L1 The responsibility of the installer

MBC “threaded”

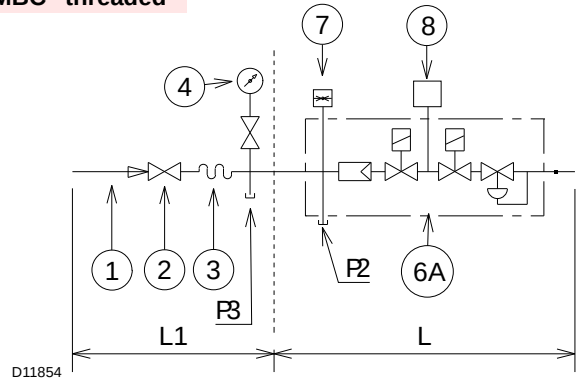


Fig. 18

MBC “flanged”

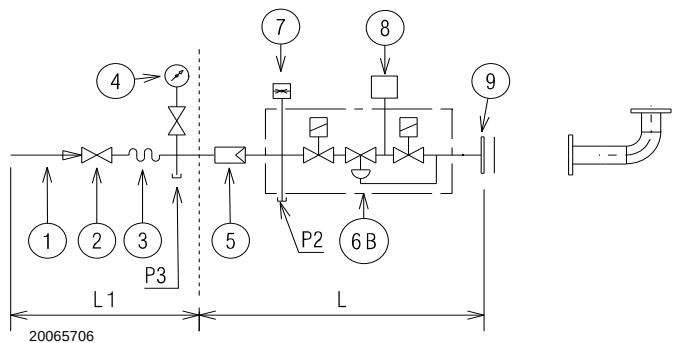


Fig. 19

DMV “flanged or threaded”

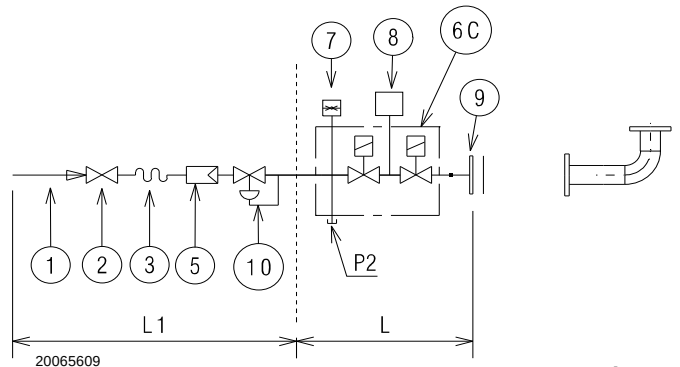


Fig. 20

CB “flanged or threaded”

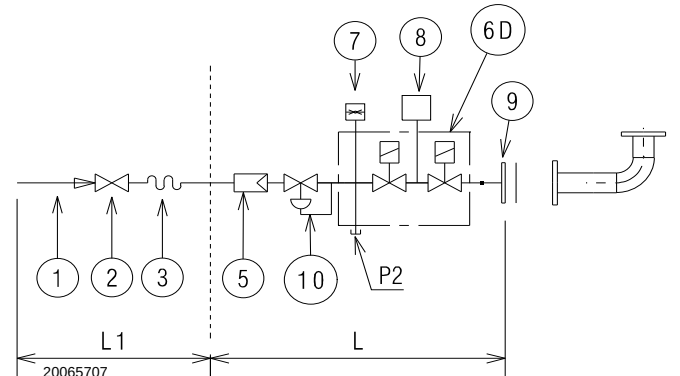


Fig. 21

5.11.2 Gas train

Approved according to standard EN 676 and provided separately from the burner.

To select the correct gas train model, refer to the supplied "Burner-gas train combination" manual.



Beware of train movements: danger of crushing of limbs.



Make sure that the gas train is properly installed by checking for any fuel leaks.

5.11.3 Gas train installation



Disconnect the electrical power using the main system switch.



Check that there are no gas leaks.



The operator must use appropriate tools for installation.

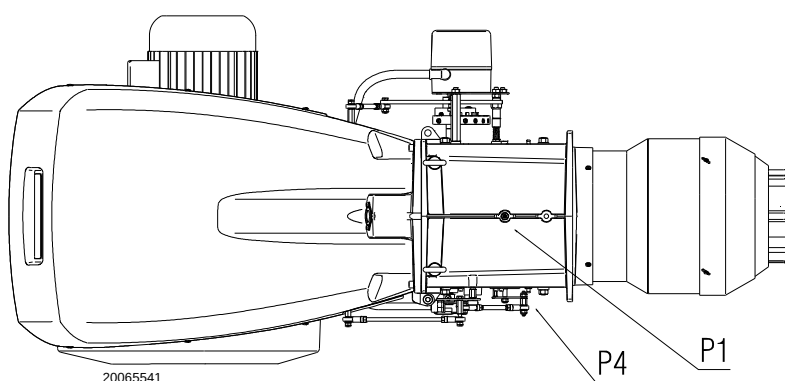


Fig. 22

5.11.4 Gas pressure

Tab. M indicates the minimum pressure drops along the gas supply line, depending on the maximum burner output.

The values shown in Tab. M refer to:

- Natural gas G 20 NCV 9.45 kWh/Sm³ (8.2 Mcal/Sm³)
- Natural gas G 25 NCV 8.13 kWh/Sm³ (7.0 Mcal/Sm³)

Column 1

Pressure drop on combustion head.

Gas pressure measured at the test point P1) (Fig. 22), with:

- Combustion chamber at 0 mbar;
- Burner working at maximum output;
- Combustion head adjusted as in page 20.

Column 2

Pressure loss at gas butterfly valve 10) (Fig. 20) with maximum opening: 90°.

Calculate the approximate maximum output of the burner in this way:

- subtract the combustion chamber pressure from the gas pressure measured at test point P1) (Fig. 22).
- Find, in the table Tab. M related to the burner concerned, the pressure value closest to the result of the subtraction.
- read the corresponding output on the left.

Example for RS 650/M BLU with G20 natural gas:

Maximum output operation

Gas pressure at test point P1)(Fig. 22) = 25.6 mbar

Pressure in combustion chamber = 2 mbar

25.6 - 2 = 23.6 mbar

A pressure of 23.6 mbar, column 1, corresponds in the table Tab. M to an output of 4,500 kW.

This value serves as a rough guide; the effective output must be measured at the gas meter.

To calculate the required gas pressure at test point P1) (Fig. 22), set the MAX output required from the burner operation:

- find the nearest output value in the table Tab. M for the burner in question.
- read, on the right (column 1), the pressure at the test point P1)(Fig. 22).
- Add this value to the estimated pressure in the combustion chamber.

Example for RS 650/M BLU with G20 natural gas:

Required burner maximum output operation: 4,500 kW

Gas pressure at an output of 4,500 kW = 23.6 mbar

Pressure in combustion chamber = 2 mbar

23.6 + 2 = 25.6 mbar

Pressure required at test point P1)(Fig. 22).

	kW	1 Δp (mbar)		2 Δp (mbar)	
		G 20	G 25	G 20	G 25
RS 300/M BLU	1,245	7.8	11.6	1.3	2.0
	1,500	9.4	13.9	1.9	2.8
	1,750	10.9	16.2	2.6	3.9
	2,000	12.4	18.5	3.4	5.0
	2,250	13.0	19.5	4.3	6.4
	2,500	13.7	20.4	5.3	7.9
	2,750	14.3	21.4	6.4	9.5
	3,000	15.0	22.4	7.6	11.3
	3,250	17.6	26.2	8.9	13.3
	3,500	20.2	30.1	10.3	15.4
RS 400/M BLU	3,800	23.3	34.8	12.2	18.2
	1,800	6.3	9.3	2.9	4.3
	2,000	7.9	11.7	3.5	5.3
	2,250	9.9	14.7	4.5	6.7
	2,500	11.9	17.7	5.5	8.2
	2,750	13.9	20.7	6.7	10.0
	3,000	15.9	23.7	8.0	11.9
	3,250	17.9	26.7	9.3	13.9
	3,500	19.7	29.4	10.8	16.2
	3,750	21.1	31.4	12.4	18.6
RS 500/M BLU	4,000	22.4	33.5	14.2	21.1
	4,250	27.4	40.8	16.0	23.8
	4,500	32.5	48.4	17.9	26.7
	2,500	11.5	17.2	0.6	0.8
	2,600	12.3	18.4	0.6	0.9
	2,800	13.9	20.8	0.7	1.0
	3,000	15.5	23.2	0.8	1.2
	3,200	17.1	25.5	0.9	1.4
	3,400	18.7	27.9	1.0	1.5
	3,600	20.5	30.6	1.2	1.7
RS 650/M BLU	3,800	22.5	33.6	1.3	1.9
	4,000	24.5	36.6	1.4	2.1
	4,200	26.5	39.5	1.6	2.3
	4,400	28.5	42.5	1.7	2.6
	4,600	30.5	45.5	1.9	2.8
	4,800	33.0	49.2	2.0	3.1
	5,000	35.5	53.0	2.2	3.3
	5,200	38.0	56.7	2.4	3.6
	3,000	11.0	13.7	1.0	1.5
	3,250	13.1	16.7	1.1	1.7
RS 800/M BLU	3,500	15.2	19.8	1.3	2.0
	3,750	17.3	22.8	1.5	2.3
	4,000	19.4	25.8	1.7	2.6
	4,250	21.5	28.9	1.9	2.9
	4,500	23.6	31.9	2.1	3.3
	4,750	25.7	35.1	2.4	3.7
	5,000	28.4	39.3	2.6	4.0
	5,250	31.2	43.5	2.9	4.5
	5,500	33.9	47.7	3.2	4.9
	5,750	36.6	51.9	3.5	5.4
	6,000	39.3	56.0	3.8	5.8
	6,250	42.1	60.2	4.1	6.3
	6,500	44.8	64.4	4.5	6.8
	3,500	9.4	12.8	0.6	0.7
	4,000	12.8	17.7	0.7	0.9
	4,500	16.2	22.5	0.9	1.1
	5,000	19.6	27.3	1.2	1.4
	5,500	23.0	32.1	1.4	1.7
	6,000	26.4	37.0	1.7	2.0
	6,500	30.9	44.7	2.0	2.3
	7,000	35.5	52.4	2.3	2.7
	7,500	40.9	59.8	2.6	3.1
	8,000	46.3	67.1	3.0	3.5
	8,060	47.0	68.0	3.0	3.5

Tab. M

5.12 Electrical wiring

Notes on safety for the electrical wiring



DANGER

- The electrical wiring must be carried out with the electrical supply disconnected.
- Electrical wiring must be made in accordance with the regulations currently in force in the country of destination and by qualified personnel. Refer to the wiring diagrams.
- The manufacturer declines all responsibility for modifications or connections different from those shown in the wiring diagrams
- Check that the electrical supply of the burner corresponds to that shown on the identification label and in this manual.
- The burner has been type-approved for continuous use.
This means they should compulsorily be stopped at least once every 72 hours to enable the control box to perform checks of its own start-up efficiency. Normally, burner stopping is guaranteed by the boiler's thermostat/pressure switch.
- If this is not the case, a time switch should be fitted in series to TL to stop the burner at least once every 72 hours. Refer to the wiring diagrams.
- The electrical safety of the device is obtained only when it is correctly connected to an efficient earthing system, made according to current standards. It is necessary to check this fundamental safety requirement. In the event of doubt, have the electrical system checked by qualified personnel. Do not use the gas tubes as an earthing system for electrical devices.
- The electrical system must be suitable for the maximum power absorption of the device, as indicated on the label and in the manual, checking in particular that the section of the cables is suitable for that level of power absorption.
- For the main power supply of the device from the electricity mains:
 - do not use adapters, multiple sockets or extensions;
 - use a multiple pole switch with at least a 3 mm gap between the contacts (overvoltage category III), as envisaged by the present safety standards.
- Do not touch the device with wet or damp body parts and/or in bare feet.
- Do not pull the electric cables.

Before carrying out any maintenance, cleaning or checking operations:



DANGER

Disconnect the electrical supply from the burner by means of the main system switch.



DANGER

Close the fuel interception tap.



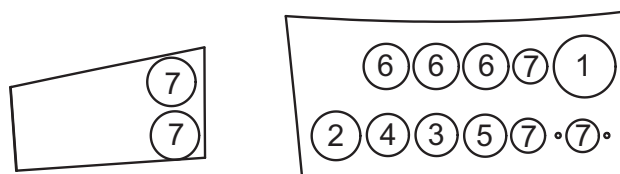
DANGER

Avoid condensate, ice and water leaks from forming.

If the hood is still present, remove it and proceed with the electrical wiring according to the wiring diagrams.

Use flexible cables in compliance with the EN 60 335-1 standard.

RS 300-400-500/M BLU



RS 650-800/M BLU

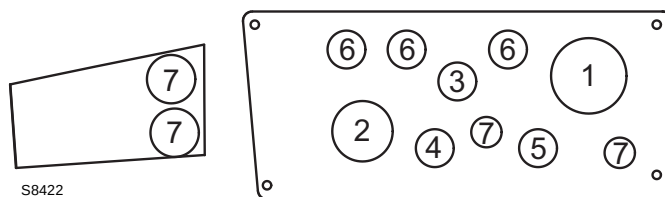


Fig. 23

5.12.1 Supply cables and external connections passage

All the cables to be connected to the burner must be threaded through cable grommets. The use of the cable grommets can take various forms. By way of example see Fig. 23.

Key (Fig. 23)

- 1 Electrical supply
- 2 Fan motor
- 3 minimum gas pressure switch
- 4 VPS gas valve leak detection control device
- 5 Gas train
- 6 Consents/Safety
- 7 available



Perform all maintenance, cleaning or inspection operations and mount the casing again.

6 Start-up, calibration and operation of the burner

6.1 Notes on safety for the first start-up



The first start-up of the burner must be carried out by qualified personnel, as indicated in this manual and in compliance with the standards and regulations of the laws in force.



Check the correct working of the adjustment, command and safety devices.

6.2 Adjustments prior to ignition

Combustion head adjustment is already described on page 20.

In addition, the following adjustments must also be made:

- Open manual valves upline from the gas train.
- Adjust the minimum gas pressure switch to the start of the scale.
- Adjust the maximum gas pressure switch to the end of the scale.
- Adjust the air pressure switch to the start of the scale.
- Purge the air from the gas line.
We recommend using a plastic tube routed outside the building and to purge air until gas is smelt.
- Fit a U-type pressure gauge or a differential pressure gauge (Fig. 24), with socket (+) on the gas pressure of the pipe coupling and (-) in the combustion chamber.
The manometer readings are used to calculate MAX burner output using the Tab. M.
- Connect two lamps or testers to the two gas line solenoids to check the exact moment in which voltage is supplied. This operation is unnecessary if each of the two solenoids is equipped with a pilot light that signals voltage passing through.



Before starting up the burner, it is good practice to adjust the gas train so that ignition takes place in conditions of maximum safety, i.e. with gas delivery at the minimum.

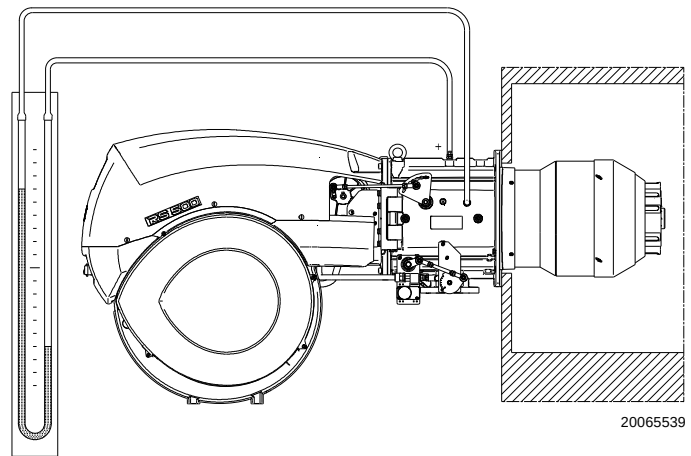


Fig. 24

6.3 Burner start-up

Turn off the thermostats/pressure switches and check the light signal 8) comes on (Fig. 5 on page 14).

Put the selector 1)(Fig. 25) in position "MAN".



Make sure that the lights or testers connected to the solenoids, or the pilot lights on the solenoids themselves, indicate that no voltage is present. If voltage is present, stop the burner **immediately** and check the electrical wiring.

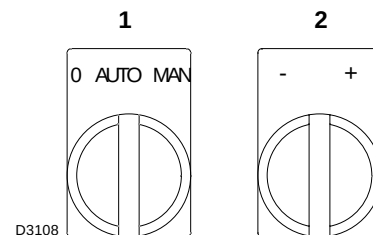


Fig. 25

6.4 Burner ignition

The burner should light after having performed the above steps.

If the motor starts up, but the flame does not appear and the control box goes into lockout, reset it and wait for a new ignition attempt.

If ignition does not occur, it may be that gas is not reaching the combustion head within the safety time period of 3 seconds. In this case, increase gas ignition delivery.

The arrival of gas at the pipe coupling is indicated by the U-type pressure gauge (Fig. 24).

Once the burner has ignited, proceed with the global adjustment of the burner.

6.5 Servomotor adjustment

The servomotor (Fig. 26) provides simultaneous adjustment for the air damper, by means of the adjustable profile cam and the gas butterfly valve.

Performs a rotation of 130° in 43 s.



WARNING

Do not alter the factory setting for the 4 cams; simply check that they are set as indicated below:

- Cam 1 (blue) : 0°**
Limits rotation toward minimum position.
When the burner is shut down, the air damper and gas butterfly valve must be closed: 0°.
- Cam 2 (orange) : 35°**
Adjusts the ignition position and the MIN output.
- Cam 3 (red) : 125°**
Limits rotation toward maximum position.
- Cam 4 (black) : not used**

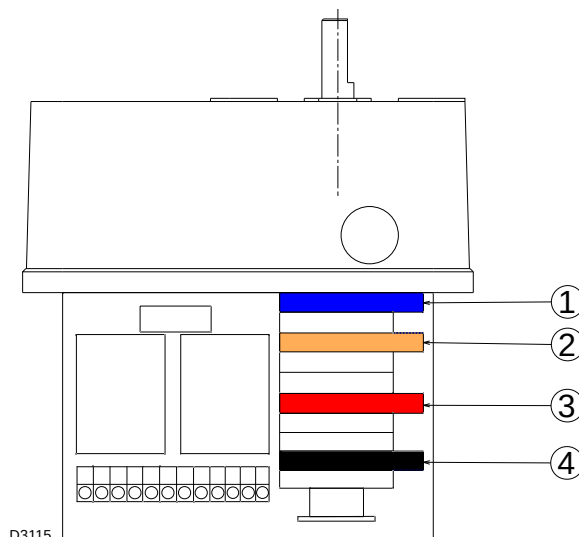


Fig. 26

6.6 Air / fuel adjustment

The air/fuel synchronisation is carried out by means of a servomotor 1)(Fig. 27) that, connected to a variable profile cam 2), operates on the delivery air dampers and, through proper leverage, on the combustion head and on the gas butterfly valve.



WARNING!
MOVING PARTS



DANGER: CRUSHING OF LIMBS

It is advisable, to reduce the loss and for a wide calibration field, to adjust the servomotor to the maximum of the output used, the nearest possible to the maximum opening (125°).

On the gas butterfly valve, fuel step according to the burner output required, with servomotor completely open, is carried out by the pressure stabiliser placed on the train.

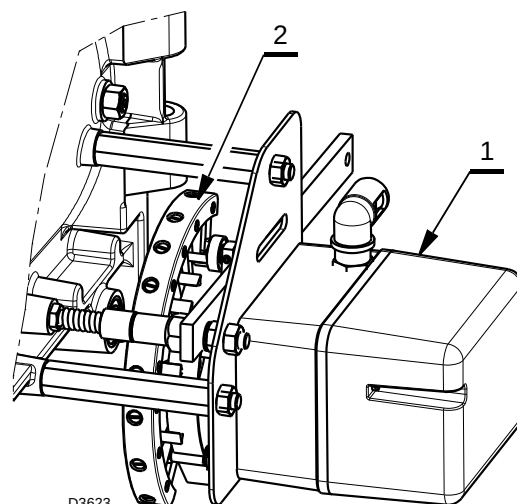


Fig. 27

6.6.1 Maximum output adjustment

Excluding model RS 800/M BLU

Air adjustment

Adjust the servomotor to the maximum opening so that the air dampers are completely open. To reduce the output, loosen the screw 2)(Fig. 28) placed under the burner suction line and close progressively the grid 1) up to obtain the output required.

Steps in suction line are not necessary only in case in which the burner is working at maximum of the firing rate on page 11.



WARNING

It is advisable to take to the maximum output required manually and, just after defining the steps in suction line, the gas pressure and the combustion head adjustment, carry out complete calibration.

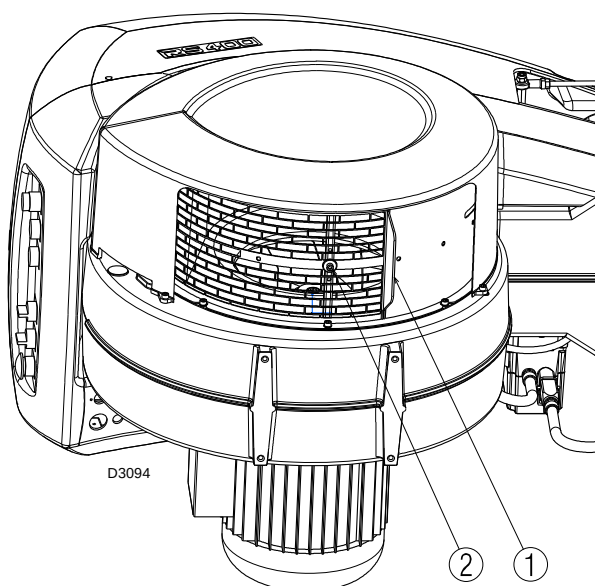


Fig. 28

6.6.2 Minimum output adjustment

The MIN output must be set within the firing rate indicated on page 11.

Turn the selector 2)(Fig. 25) "output reduction", and keep it turned to "-" until the servomotor has closed the air damper and the gas butterfly valve at 35 (adjustment made in the factory).

Gas adjustment

Measure the gas delivery on the gas meter.

- If it is necessary to reduce it, reduce slightly the angle of cam 2) (Fig. 26) with small, regular movements, i.e. bring it from an angle of 35° to 33° - 31°....
- If you need to increase it, rotate the "power increase" selector 2)(Fig. 25) (open the gas butterfly valve by 10-15), and increase the cam angle 2)(Fig. 26) with a series of small movements - i.e. move from angle 35° to 37° - 39°....
- Now press the "power reduction" button until the servomotor returns to the minimum opening position, and measure the gas delivery.

Air adjustment

Progressively adjust the end profile of cam 1) (Fig. 29) by turning the cam adjustment screws 2).

It is preferable not to turn the first screw since this is used to set the air damper to its fully closed position.

6.6.3 Intermediate output adjustment

After adjusting the maximum and minimum output of the burner, carry out air adjustment on higher intermediate positions of the servomotor.

The passage from one position to the next one is obtained by pressing the selector 2)(Fig. 25) on the symbol (+) or (-).

For better adjustment repeatability, take care to stop the rotation of the cam unit when the upper bearing that slides on the profile 4)(Fig. 29) is aligned with one of the adjustment screws 2).

Screw or unscrew the preset screw 2) to increase or decrease the air output so as to adjust it to the corresponding gas output.



CAUTION

After output adjustment (maximum, minimum and intermediate), it is important to lock all the air adjustment screws 2) by the locking screws 3) so as to avoid possible movements from the position of air - gas calibration.

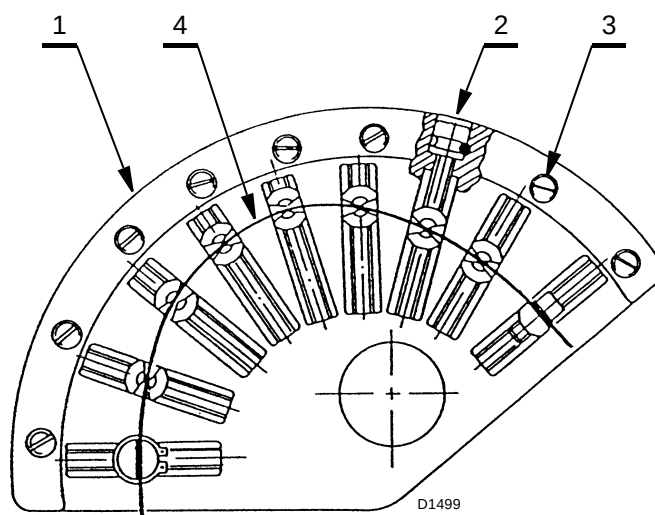


Fig. 29

Key (Fig. 29)

- 1 Cam
- 2 Adjustment screws
- 3 Locking screws
- 4 Adjustable profile

6.7 Pressure switch adjustment

6.7.1 Air pressure switch - check CO

Adjust the air pressure switch (Fig. 30) after performing all other burner adjustments with the air pressure switch set to the start of the scale.

With the burner operating at MIN output, increase adjustment pressure by slowly turning the relative knob clockwise until the burner locks out.

Then turn the knob anticlockwise by about 20% of the set point and repeat burner start-up to ensure it is correct.

If the burner locks out again, turn the knob anticlockwise a little bit more.



WARNING

In conformity with the standard, the air pressure switch must prevent the air pressure falling below 80% of the adjusted value and the CO in the flue gases exceeding 1% (10,000 ppm).

To check this, insert a combustion analyser into the chimney, slowly close the fan suction inlet (for example with cardboard) and check that the burner locks out, before the CO in the fumes exceeds 1%.

On RS 300-400-500/M BLU burners the air pressure switch is fitted in a "differential" mode, that is, with two pipes connected to the specific pressure test points "+" and "-" 22)-23) (Fig. 4 on page 13).

On RS 650-800/M BLU burners the air pressure switch is fitted in an "absolute" mode, that is, connected only to the pressure test point "+" 22) (Fig. 4 on page 13).

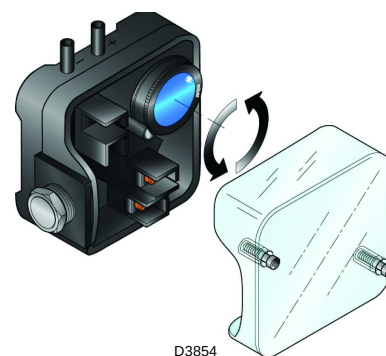


Fig. 30

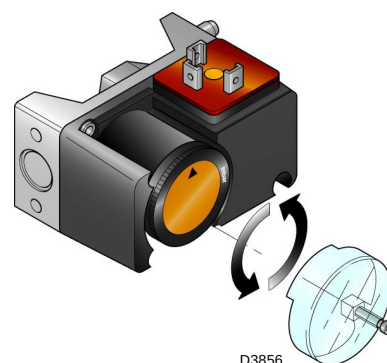


Fig. 31

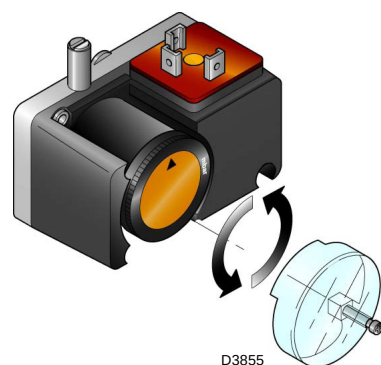


Fig. 32

6.7.2 Maximum gas pressure switch

Adjust the maximum gas pressure switch (Fig. 31) after performing all other burner adjustments with the maximum gas pressure switch set to the end of the scale.

With the burner operating at maximum output, lower adjustment pressure by slowly turning the relative knob anticlockwise until the burner locks out.

Turn the knob clockwise by 2 mbar and repeat the start-up of the burner.

If the burner locks out again, turn the knob clockwise again by 1 mbar.

6.7.3 Minimum gas pressure switch

Adjust the minimum gas pressure switch (Fig. 32) after performing all the other burner adjustments with the pressure switch set to the start of the scale.

With the burner operating at maximum output, increase adjustment pressure by slowly turning the relative knob clockwise until the burner locks out.

Then turn the knob anticlockwise by 2 mbar and repeat burner start-up to ensure it is uniform.

If the burner locks out again, turn the knob anticlockwise again by 1 mbar.

6.8 Operation sequence of the burner

6.8.1 Burner start-up

- 0s: TL thermostat/pressure switch closes.
- 2s: Start of electrical control box programme.
Fan motor starts up, servomotor starts up, the pre-purging phase starts. The servomotor rotates to the right by 125, i.e. until the contact intervenes on the cam 3)(Fig. 26 on page 27).
- 42s: The air damper arrives to the MAX. output position.
- 63s: The servomotor rotates towards the left until the angle set on the cam 3)(Fig. 26 on page 27).
- 96s: The air damper arrives on the MIN power position or ignition position.
- 97s: Ignition electrode strikes a spark. The safety valve VS opens, along with the adjustment valve VR. The flame is ignited at a low output level, point A.
Delivery is then progressively increased, with the valve VR opening slowly up to MIN. output, point B.
- 99s: The spark goes out.
- 106s: The control value box starting cycle ends.

6.8.2 Operation

Burner without the output power regulator RWF40

Once the start-up cycle is completed, the servomotor command moves on to the TR thermostat/pressure switch that controls the pressure or the temperature in the boiler, point C. (The electrical control box continues to check the presence of the flame and the correct position of the air and gas maximum pressure switches).

- If the temperature or the pressure is low so the thermostat/pressure switch TR is closed, the burner progressively increases the output up to the MAX value (section C-D).
- If subsequently the temperature or pressure increases until TR opens, the burner progressively decreases its output to the MIN value (section E-F). The sequence repeats endlessly.
- The burner locks out when the heat request is less than the heat supplied by the burner at MIN output, (section G-H). The TL thermostat/pressure switch opens, and the servomotor returns to angle 0 limited by the contact of the cam 2)(Fig. 26 on page 27).
The air damper closes completely to reduce heat losses to a minimum.

For every change of output, the servomotor will automatically change the gas output (butterfly valve), the air output (fan damper) and the air pressure (2 shutters in the combustion head).

Burner with the output power regulator RWF40

See manual enclosed with the adjuster.

6.8.3 Ignition failure

If the burner does not fire, it goes into lockout within 3 sec. after the gas valve opens and 98 seconds after the control device TL closes.

6.8.4 Burner flame goes out during operation

If the flame should go out during operation, the burner will lockout within 1s.

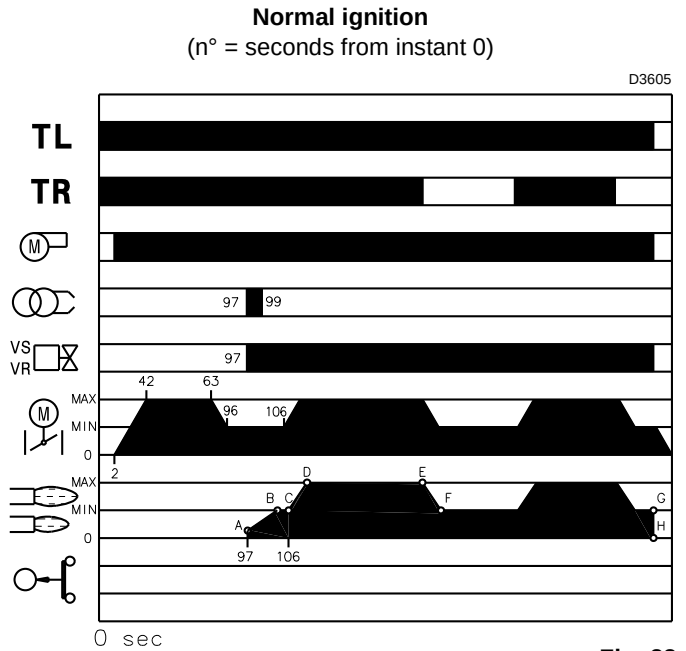


Fig. 33

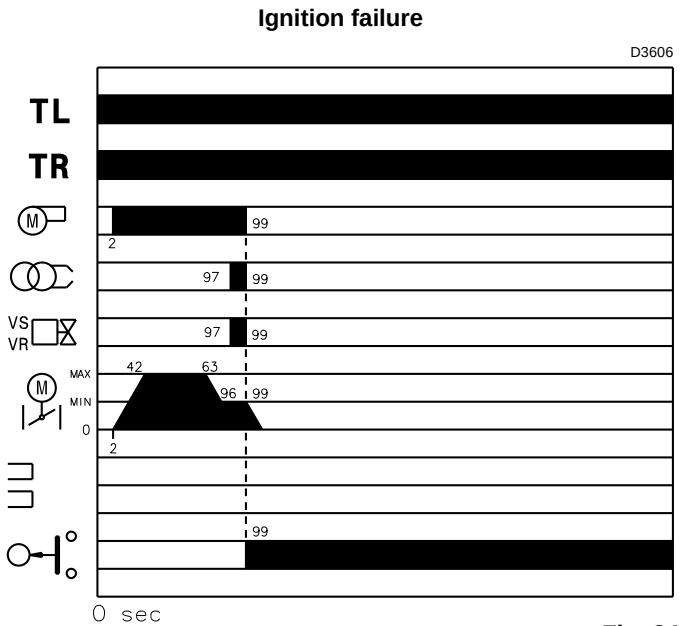


Fig. 34

6.9 Burner start-up cycle diagnostics

During start-up, indication is according to the colour code table (Tab. N).

Sequences	Colour code
Pre-purging	● ● ● ● ● ● ● ● ● ●
Ignition phase	● ○ ● ○ ● ○ ● ○ ●
Operation, flame OK	□ □ □ □ □ □ □ □ □ □
Operation with weak flame signal	□ ○ □ ○ □ ○ □ ○ □
Electrical supply below ~ 170V	● ▲ ● ▲ ● ▲ ● ▲ ●
Lockout	▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲
Extraneous light	▲ □ ▲ □ ▲ □ ▲ □ ▲

Tab. N

Key (Tab. N):

○ Off ● Yellow □ Green ▲ Red

RED LED lit wait for at least 10s	Lockout	Press reset for > 3s	Pulses	3s interval	Pulses
■	■	■	● ● ● ●	■	● ● ● ●

Tab. O

The methods that can be used to reset the control box and use diagnostics are given below.

6.9.2 Control box reset

To carry out the control box reset, proceed as follows:

- Hold the button down for between 1 and 3 seconds.
The burner restarts after a 2-second pause once the button is released.
If the burner does not restart, you must make sure the limit thermostat is closed.

6.9.3 Visual diagnostics

Indicates the type of burner malfunction causing lockout. To visualise the diagnostics proceed as follows:

- Hold the button down for more than 3 seconds once the red LED (burner lockout) remains steadily lit.
A yellow light blink to tell you the operation is done.
- Release the button once the light has blinked. The number of blinks indicates the reason for the malfunctioning (refer to the coding in Tab. T on page 36).

6.9.1 Resetting of control box and diagnostics use

The control box features a diagnostics function through which any causes of malfunctioning are easily identified (indicator: **RED LED**).

To use this function, you must wait at least 10 seconds once it has entered the safety condition (**lockout**), and then press the reset button.

The control box generates a sequence of pulses (1 second apart), which is repeated at constant 3-second intervals.

Once you have seen how many times the light blinks and identified the possible cause, the system must be reset by holding the button down for 1 - 3 seconds.

6.9.4 Software diagnostics

Gives an analysis of the life of the burner, through optical connections with a PC showing the working hours, number and types of lockout, control box serial number etc.

To view diagnostics, proceed as follows:

- Hold the button down for more than 3 seconds once the red LED (burner lockout) remains steadily lit.
A yellow light blink to tell you the operation is done.
- Release the button for 1 second and then press again for over 3 seconds until the yellow light blinks again.
- Once the button is released, the red LED will flash intermittently with a higher frequency: only now can the optical link be activated.

Once the operations are done, the control box's initial status must be restored using the resetting procedure described above.

PRESSURE ON THE BUTTON	STATE OF CONTROL BOX
From 1 to 3 seconds	Reset of the control box without visualisation of the visual diagnostics.
More than 3 seconds	Visual diagnostics of the lockout condition: (LED blinks at 1-second intervals).
More than 3 seconds starting from the condition of visual diagnostics	Software diagnostics, with the help of optical interface and PC (possibility to visualise the working hours, irregularities, etc.)

Tab. P

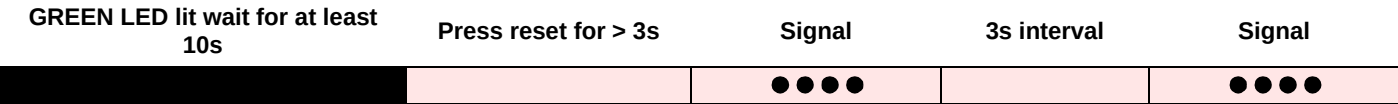
The sequence of led pulses issued by the control box identifies the possible types of malfunction, which are listed in the table Tab. T on page 36.

6.10 Normal operation / flame detection time

The control box has a further function to guarantee the correct burner operation (signal: **GREEN LED** permanently on).

To use this function, wait at least ten seconds from the burner ignition and then press the control box button for a minimum of 3 seconds.

After releasing the button, the GREEN LED starts flashing as shown in: Tab. Q



Tab. Q

The pulses of the LED constitute a signal spaced by approximately 3 seconds.

The number of pulses will measure the probe detection time since the opening of gas valves, according to: Tab. R

Signal	Flame detection time
1 blink ●	0.4 s
2 blinks ● ●	0.8 s
6 blinks ● ● ● ● ● ●	2.8 s

Tab. R

This is updated in every burner start-up.

Once read, the burner repeats the start-up cycle by briefly pressing the control box button.



If the result is > 2 s, ignition will be retarded. Check the adjustment of the hydraulic brake of the gas valve, the air damper and the combustion head adjustment.

7 Maintenance

7.1 Notes on safety for the maintenance

The periodic maintenance is essential for the good operation, safety, yield and duration of the burner.

It allows you to reduce consumption and polluting emissions and to keep the product in a reliable state over time.



DANGER

The maintenance interventions and the calibration of the burner must only be carried out by qualified, authorised personnel, in accordance with the contents of this manual and in compliance with the standards and regulations of current laws.

Before carrying out any maintenance, cleaning or checking operations:



DANGER

Disconnect the electrical supply from the burner by means of the main system switch.



DANGER

Close the fuel interception tap.



Wait for the components in contact with heat sources to cool down completely.

7.2 Maintenance programme

7.2.1 Maintenance frequency



The gas combustion system should be checked at least once a year by a representative of the manufacturer or another specialised technician.

7.2.2 Checking and cleaning



The operator must use the required equipment during maintenance.

Combustion

Carry out an analysis of the combustion discharge gases. Significant differences with respect to the previous check indicate the points where more care should be exercised during maintenance.

Combustion head

Open the burner and make sure that all components of the combustion head are in good condition, not deformed by the high temperatures, free of impurities from the surroundings and correctly positioned.

Burner

Check that there are not excess wear or loosen screws. Clean the outside of the burner.

Fan

Check to make sure that no dust has accumulated inside the fan or on its blades, as this condition will cause a reduction in the air flow rate and provoke polluting combustion.

Boiler

Clean the boiler as indicated in its accompanying instructions in order to maintain all the original combustion characteristics intact, especially the flue gas temperature and combustion chamber pressure.

Flame presence check

The burner is fitted with an ionisation system to check that a flame is present. The minimum current for control box operation is 6 μA (Fig. 35).

The burner provides a much higher current, so controls are not normally required.

However, if it is necessary to measure the ionisation current, disconnect the plug-socket on the ionisation probe cable and insert a direct current microammeter with a base scale of 100 μA .

Carefully check the polarities!

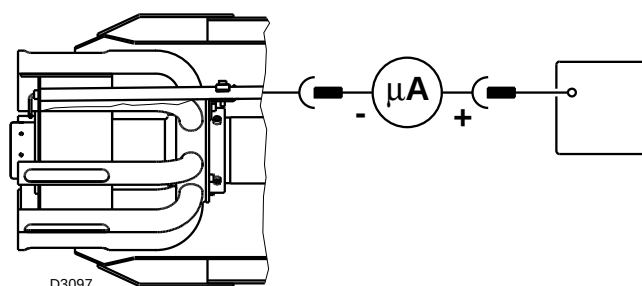


Fig. 35

Gas leaks

Make sure that there are no gas leaks on the pipes between the gas meter and the burner.

Gas filter

Replace the gas filter when it is dirty.

Combustion

If the combustion values measured before starting maintenance do not comply with applicable legislation or do not indicate efficient combustion, consult the Tab. S or contact our Technical Support Service to implement the necessary adjustments. It is advisable to set the burner according to the type of gas used and following the indications in Tab. S.

EN 676		Air excess			
		Max. output $\lambda \leq 1.2$		Min. output $\lambda \leq 1.3$	
		CO ₂ % Calibration		CO	NO _x
GAS	CO ₂ theoretical max. 0% O ₂	$\lambda = 1.2$	$\lambda = 1.3$	mg/kWh	mg/kWh
G 20	11.7	9.7	9.0	≤ 100	≤ 170
G 25	11.5	9.5	8.8	≤ 100	≤ 170
G 30	14.0	11.6	10.7	≤ 100	≤ 230
G 31	13.7	11.4	10.5	≤ 100	≤ 230

Tab. S

7.3 Opening the burner



Disconnect the electrical supply from the burner by means of the main system switch.



Close the fuel interception tap.



Wait for the components in contact with heat sources to cool down completely.

- Remove the tie-rod 1)(Fig. 36) of the head movement lever, undoing the nut 2).
- Disconnect the socket 3) of the servomotor.
- Disconnect the socket 4) of the gas pressure switch.
- Remove the self-locking nut 5).
- Remove the screws 6).

At this point, it is possible to open the burner on the hinge.

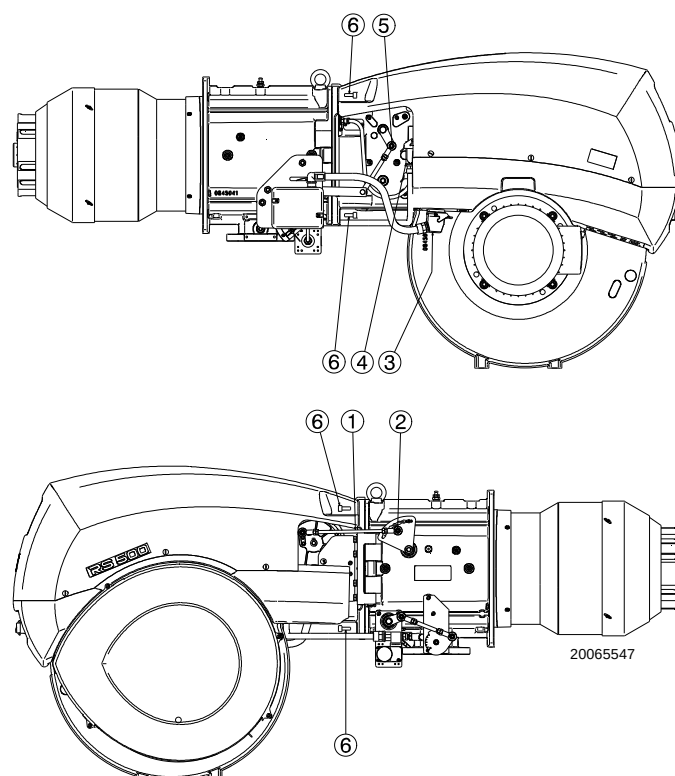


Fig. 36

7.4 Closing the burner

Refit following the steps described but in reverse order; refit all burner components as they were originally assembled.



Carry out all maintenance work and mount the casing again.

8 Faults - Probable causes - Solutions



WARNING

In the event of a burner lockout, more than two consecutive burner reset operations could cause damage to the installation. On the third lockout, contact the Aftersales Service.



DANGER

If further lockouts or burner faults occur, interventions must only be made by qualified, authorised personnel (as indicated in this manual, and in compliance with the laws and regulations currently in force).

Signal	Problem	Possible cause	Recommended remedy
2 blinks ● ●	Once the pre-purging phase and safety time have passed, the burner goes into lockout without the appearance of the flame	The operation solenoid lets little gas through	Increase
		One of the two solenoid valves does not open.	Replace
		Gas pressure too low	Increase pressure at governor
		Ignition electrode incorrectly adjusted	Adjust it
		Electrode grounded due to broken insulation	Replace
		High voltage cable defective	Replace
		High voltage cable deformed by high temperature	Replace and protect
		Ignition transformer defective	Replace
		Incorrect valve or transformer electrical wiring	Check
		Defective control box	Replace
		A closed valve upline the gas train	Open
		Air in pipework	Bleed air
		Gas valves unconnected or with interrupted coil	Check connections or replace coil
3 blinks ● ● ●	The burner does not switch on, and the lock-out appears	Air pressure switch in operating position	Adjust or replace
	The burner switches on, but then stops in lockout	Air pressure switch does not switch owing to lack of air pressure.	
		Air pressure switch incorrectly adjusted.	Adjust or replace
		Pressure switch pressure test point pipe blocked	Clean
		Poorly adjusted head	Adjust
		High pressure in the furnace	Connect air pressure switch to fan suction line
	Lockout during pre-purging phase	Defective motor control contactor (only three-phase version)	Replace
		Defective electrical motor	Replace
Motor lockout (defective electrical motor)		Replace	
4 blinks ● ● ● ●	The burner switches on, but then stops in lockout	Flame simulation	Replace the control box
	Lockout when burner stops	Permanent flame in the combustion head or flame simulation	Eliminate persistence of flame or replace control box
6 blinks ● ● ● ● ● ●	The burner switches on, but then stops in lockout	Defective or incorrectly adjusted servomotor	Adjust or replace
7 blinks ● ● ● ● ● ● ●	The burner goes into lockout immediately following the appearance of the flame	The operation solenoid lets little gas through	Increase
		Ionisation probe incorrectly adjusted	Adjust
		Insufficient ionisation (less than 5 A)	Check probe position
		Earth probe	Withdraw or replace cable
		Burner poorly grounded	Check grounding
		Phase and neutral connections inverted	Invert them
		Defective flame detection circuit	Replace the control box
	Burner locks out when shifting from minimum to maximum output and vice versa	Too much air or too little gas	Adjust air and gas
	Burner goes into lock-out during operation	Probe or ionisation cable grounded	Replace worn parts

Signal	Problem	Possible cause	Recommended remedy
10 blinks ●●●●● ●●●●●	The burner does not switch on, and the lock-out appears	Incorrect electrical wiring	Check
	The burner goes into lockout	Defective control box	Replace
		Presence of electromagnetic disturbances in the thermostat lines	Filter or eliminate
		Presence of electromagnetic disturbance	Use the radio disturbance protection kit
No blink	The burner does not start	No electrical power supply	Check connections
		A limiter or safety control device is open	Adjust or replace
		Line fuse blocked	Replace
		Defective control box	Replace
		No gas supply	Open the manual valves between contactor and train
		Mains gas pressure insufficient	Contact your gas company
		Minimum gas pressure switch fails to close	Adjust or replace
		Servomotor fails to move to min. ignition position	Replace
	The burner continues to repeat the start-up cycle, without lockout	The gas pressure in the gas mains lies very close to the value to which the gas pressure switch has been set. The sudden drop in pressure after valve opening causes temporary opening of the pressure switch itself, the valve immediately closes and the burner comes to a halt. Pressure increases again, the pressure switch closes again and the ignition cycle is repeated. And so on	Reduce the minimum gas pressure switch intervention pressure. Replace the gas filter cartridge.
	Ignition with pulsations	Poorly adjusted head	Adjust
		Ignition electrode incorrectly adjusted	Adjust it
		Incorrectly adjusted fan air damper: too much air	Adjust
		Output during ignition phase is too high	Reduce
	Burner does not reach maximum output	Remote control device TR fails to close	Adjust or replace
		Defective control box	Replace
		Defective servomotor	Replace
	Burner stops with air damper open	Defective servomotor	Replace

Tab. T

A Appendix - Accessories**Long head kit**

Burner	Standard head length (mm)	Extended head length (mm)	Code
RS 300-400/M BLU	521 (B) - 373 (I)	621 (B) - 473 (I)	3091427
RS 300-400/M BLU	521 (B) - 373 (I)	671 (B) - 523 (I)	3091919
RS 300-400/M BLU	521 (B) - 373 (I)	721 (B) - 573 (I)	20022815
RS 500/M BLU	521 - 357	671 - 507	20028449

For (B) - (I) positions, refer to paragraph "Maximum dimensions".

Analogue control signal converter kit

Burner	Type	Code
All models	0/2 - 10V 0/4 - 20mA	3010390

Kit for modulating operation

Burner	Output regulator	Code
All models	RWF 40 BASIC	3010356
All models	RWF 40 HIGH	3010357

Burner	Probe	Adjustment field	Code
All models	PT 100 temperature	- 100...+ 500°C	3010110
All models	4 - 20 mA pressure	0...2.5 bar	3010213
All models	4 - 20 mA pressure	0...16 bar	3010214

Potentiometer kit

Burner	Code
All models	3010402

Continuous purging kit

Burner	Code
All models	3010094

UV photocell kit

Burner	Code
All models	3010359

Software interface kit

Burner	Code
All models	3002719

Soundproofing box kit

Burner	Type	dB(A)	Code
All models	C7	10	3010376

GPL kit

Burner	Code
RS 300/M BLU	3010445
RS 400-500/M BLU	20012916
RS 800/M BLU	20007822

Spacer kit

Burner	Code
All models	20008903

Gas trains in compliance with EN 676

Please refer to manual.

B Appendix - Electrical panel layout

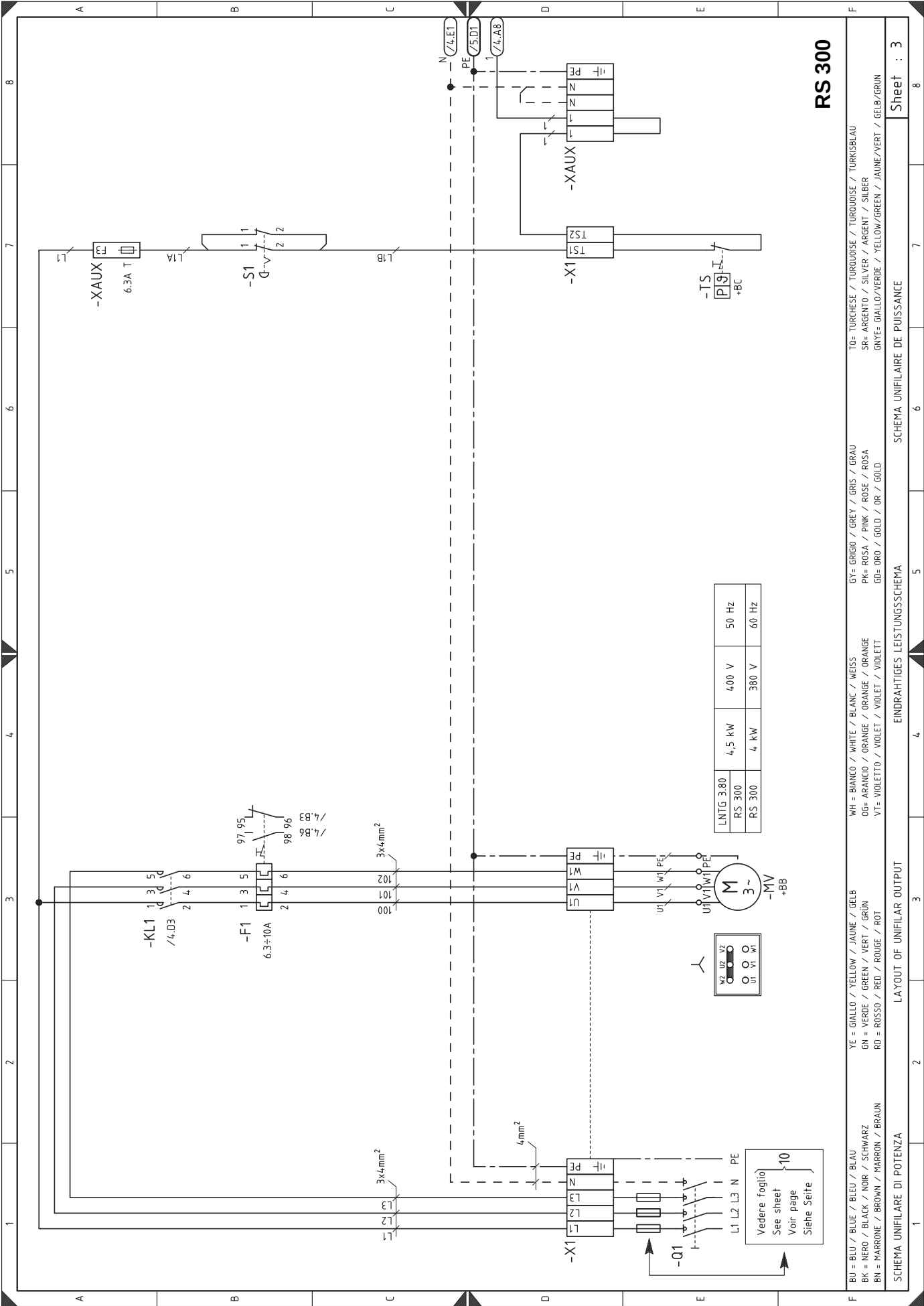
1	Index of layouts
2	Indication of references
3	Single-wire output layout
4	Functional layout (RS 300/M BLU) Star-triangle starter functional layout (RS 400-500-650-800/M BLU)
5	Functional layout RMG/M...
6	Functional layout gas train
7	Functional layout RMG/M...
8	Functional layout RMG/M...
9	RWF40 kit electrical wiring... internal
10	Electrical wiring that the installer is responsible for
11	RWF40 Functional layout ...
12	RWF40 kit electrical wiring... external

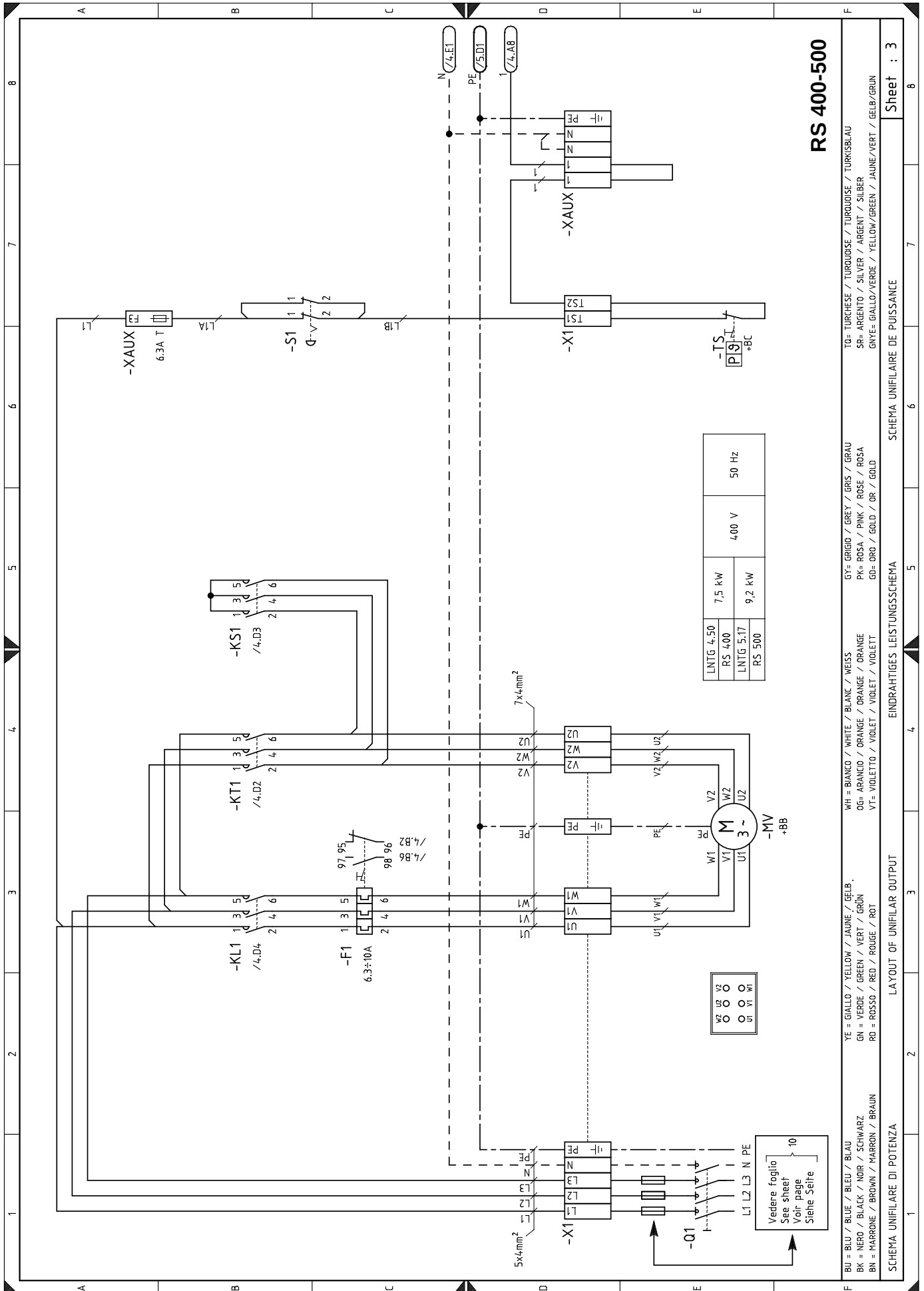
2 Indication of references

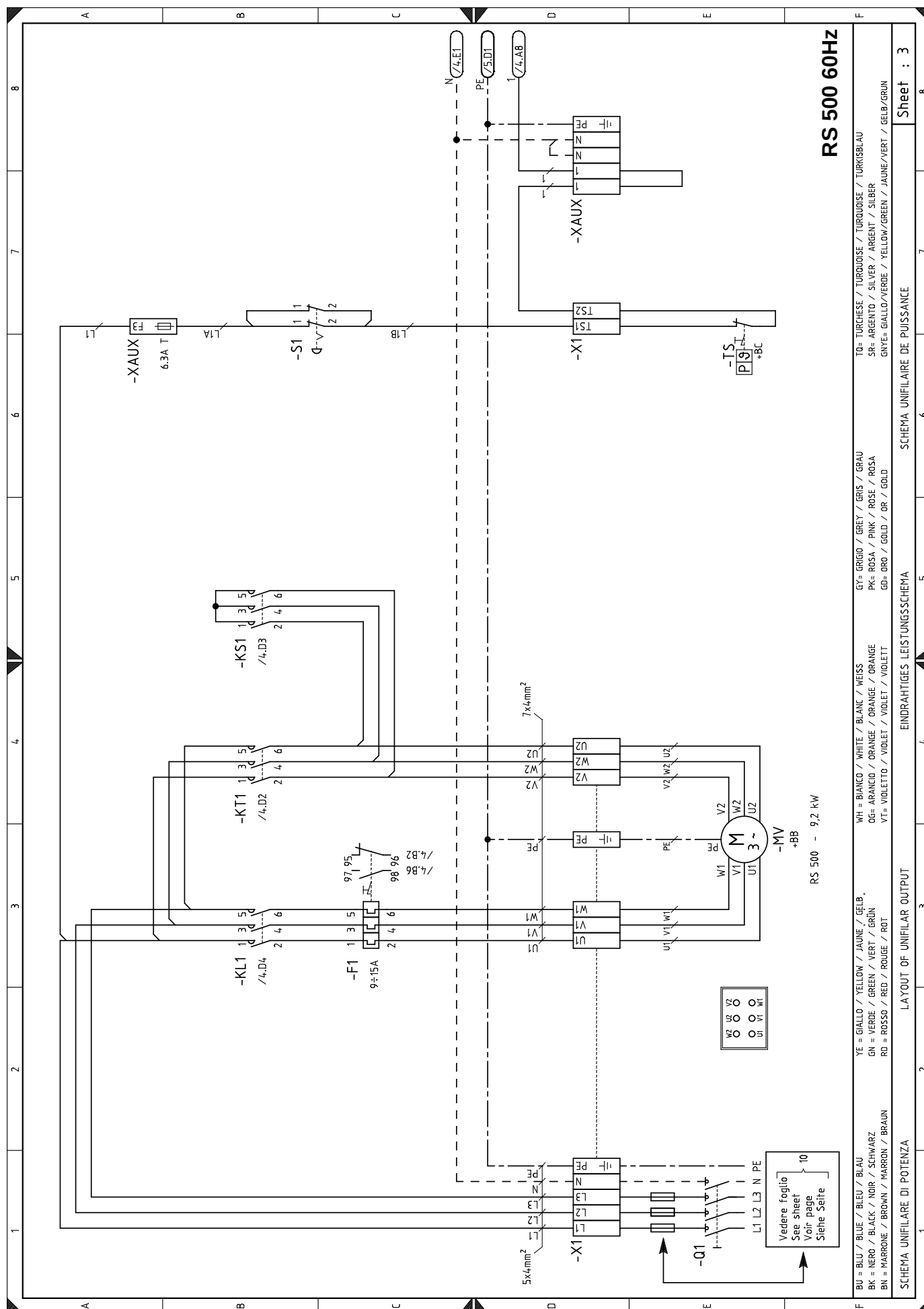
/1.A1

Sheet no.

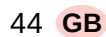
Co-ordinates



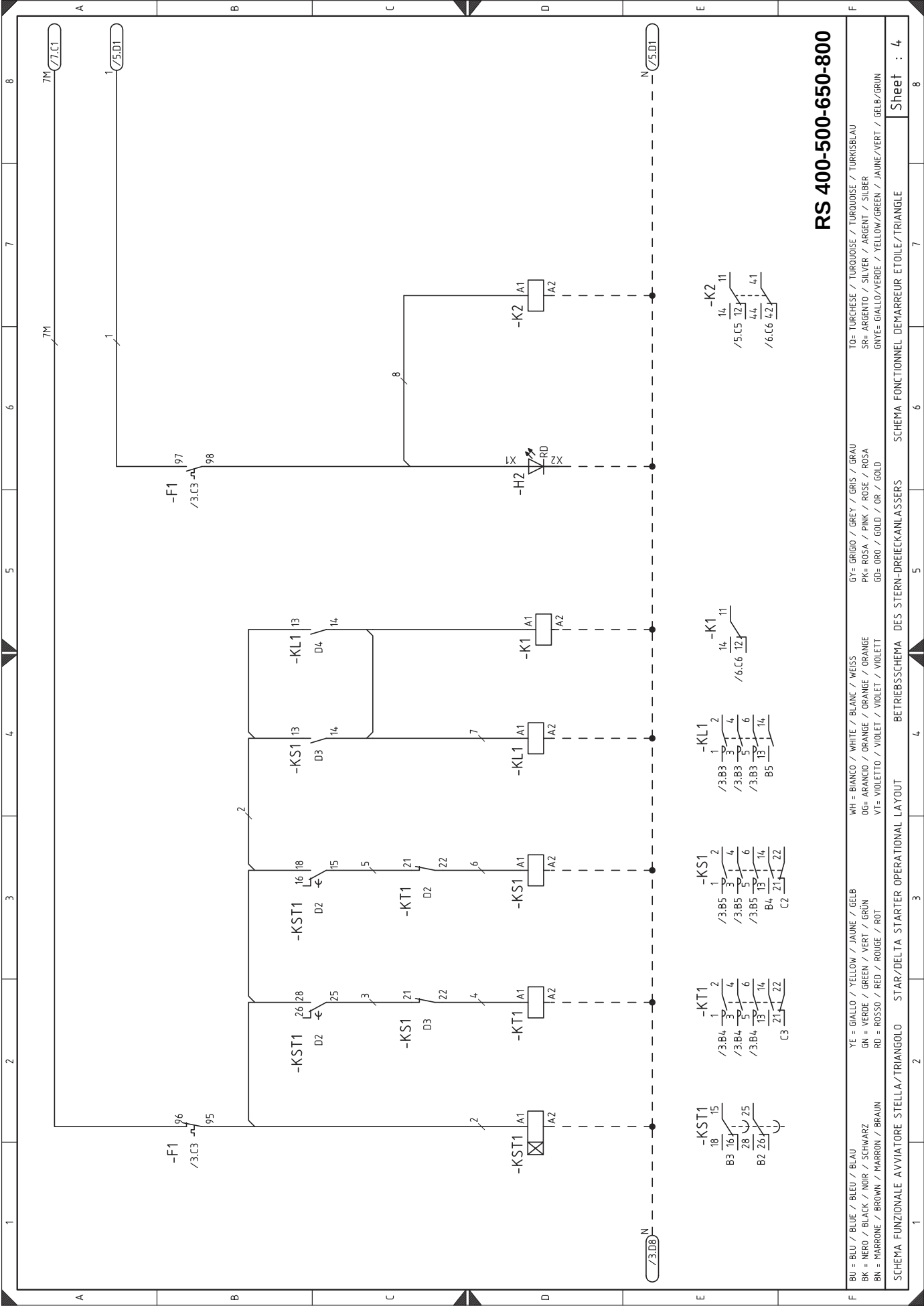


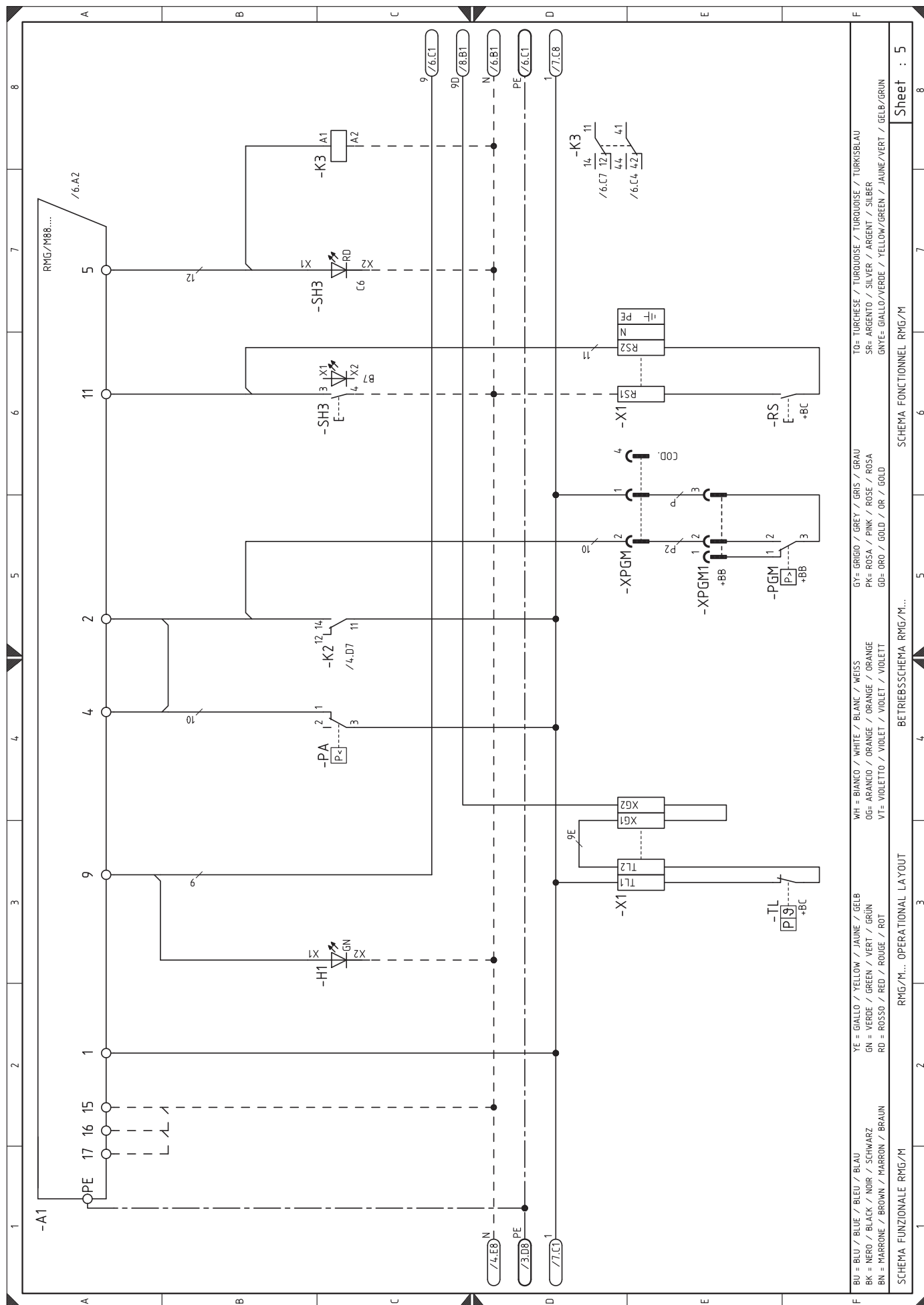


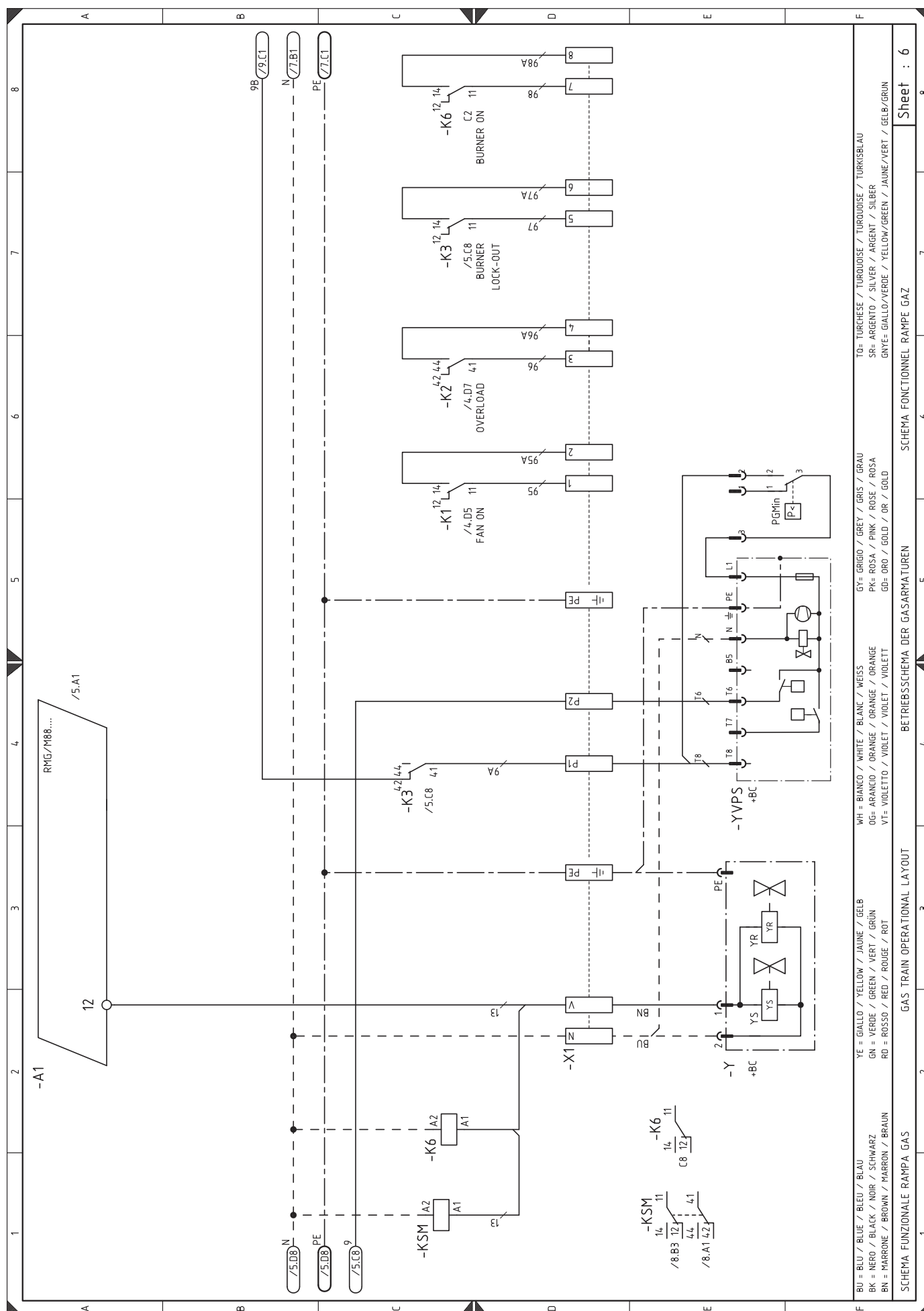




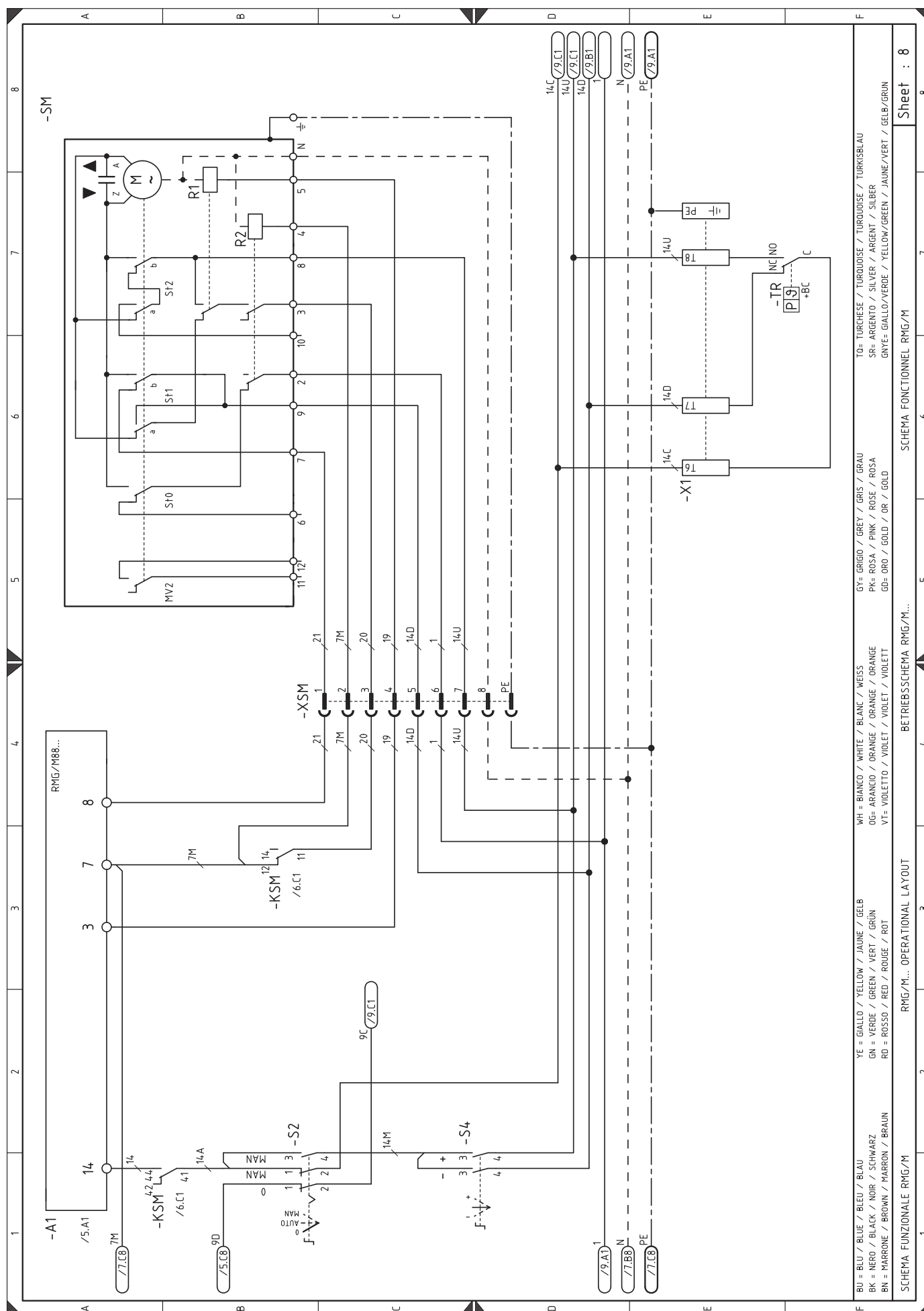


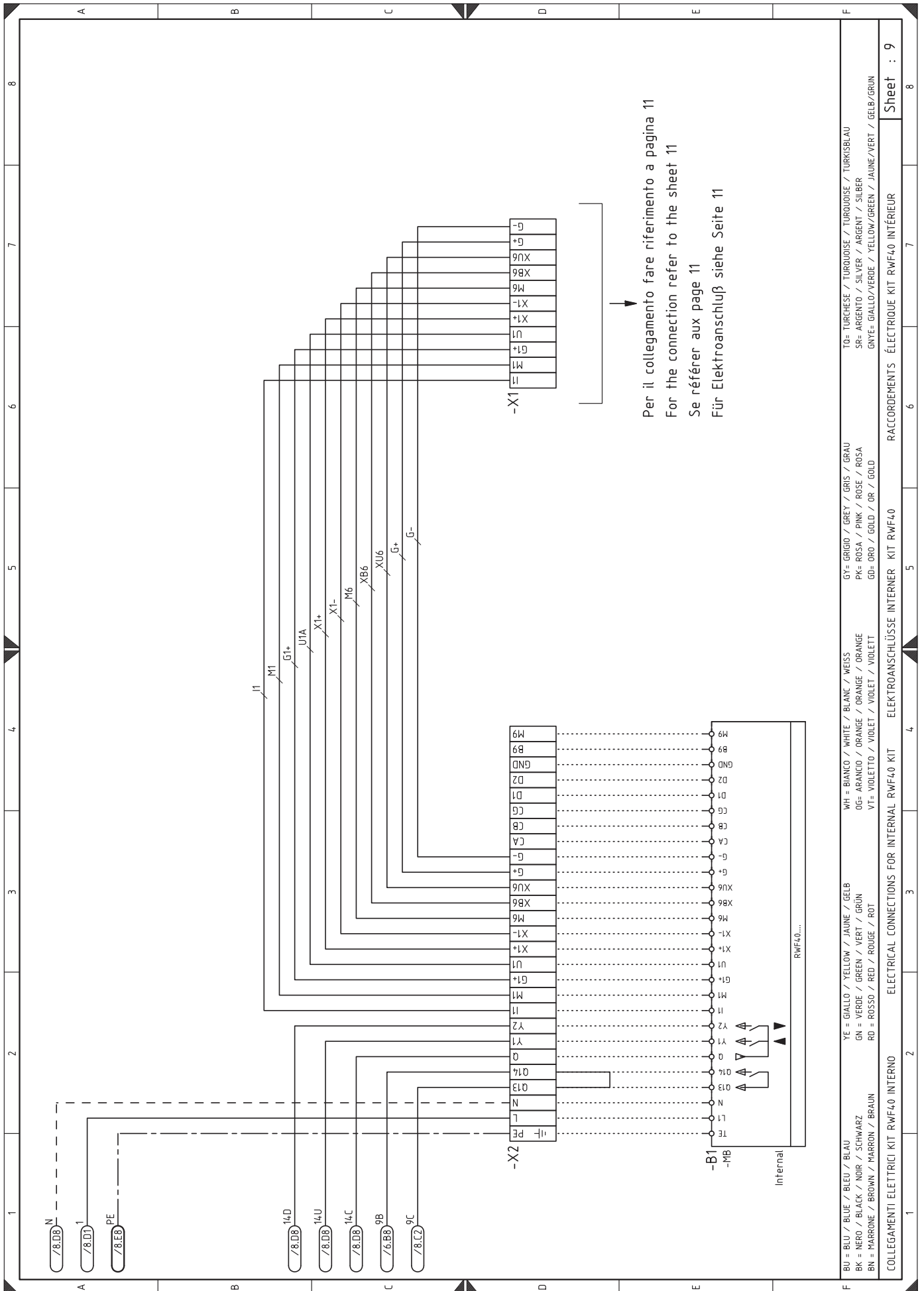


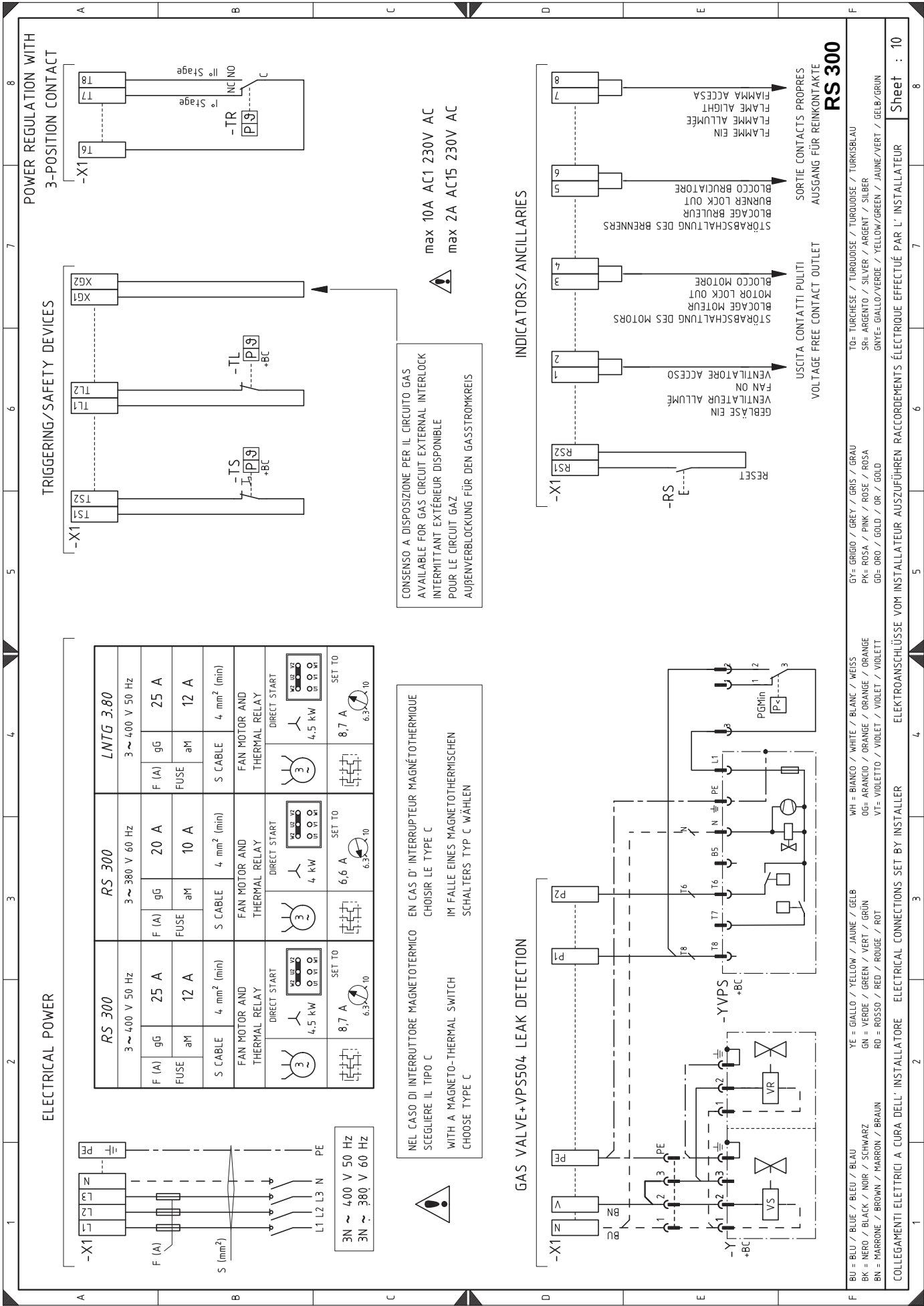




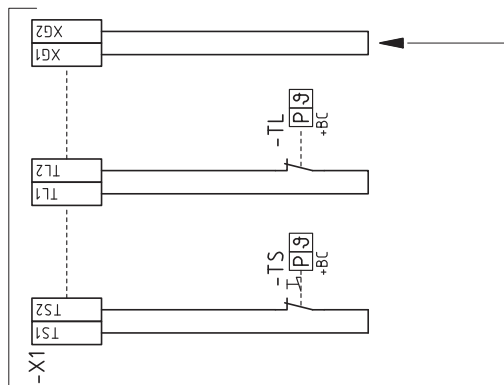








TRIGGERING/SAFETY DEVICES



CONSENSO A DISPOSIZIONE PER IL CIRCUITO GAS
AVAILABLE FOR GAS CIRCUIT EXTERNAL INTERLOCK
INTERMITTANT EXTÉRIEUR DISPONIBLE
POUR LE CIRCUIT GAZ
AÜBENVERBLOCKUNG FÜR DEN GASSTROMKREIS



max 10A AC1 230V AC
max 2A AC15 230V AC

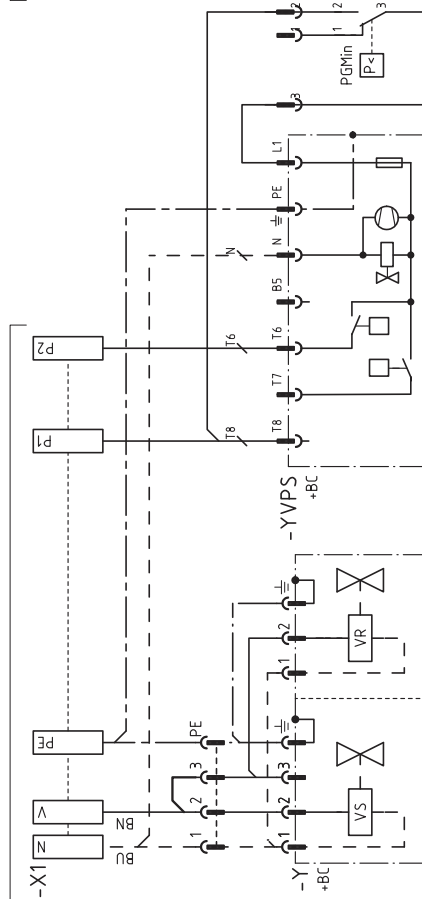
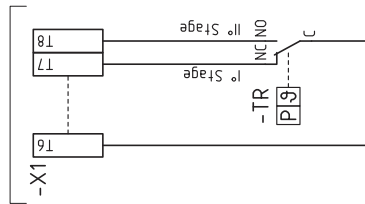
IM CAS D'INTERRUPTEUR MAGNÉTOtherMIQUE
CHOISIR LE TYPE C

IM FALLE EINES MAGNETOTHERMISCHEN
SCHALTERS TYP C WÄHLEN

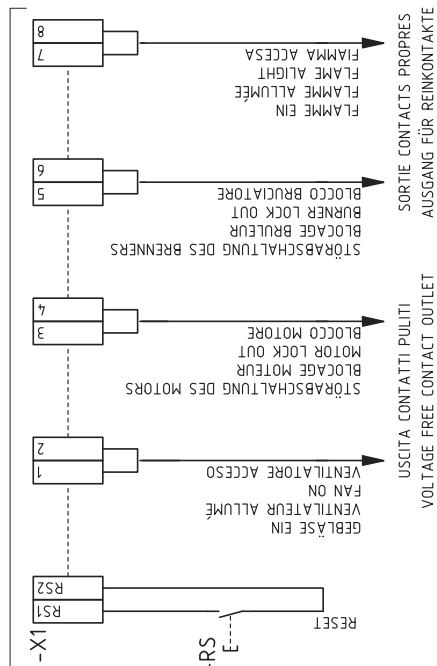
INEL CASO DI INTERRUTTORE MAGNETOTERMICO
SCEGLIERE IL TIPO C

WITH A MAGNETO-THERMAL SWITCH
CHOOSE TYPE C

GAS VALVE+VPS504 LEAK DETECTION

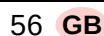
POWER REGULATION WITH
3-POSITION CONTACT

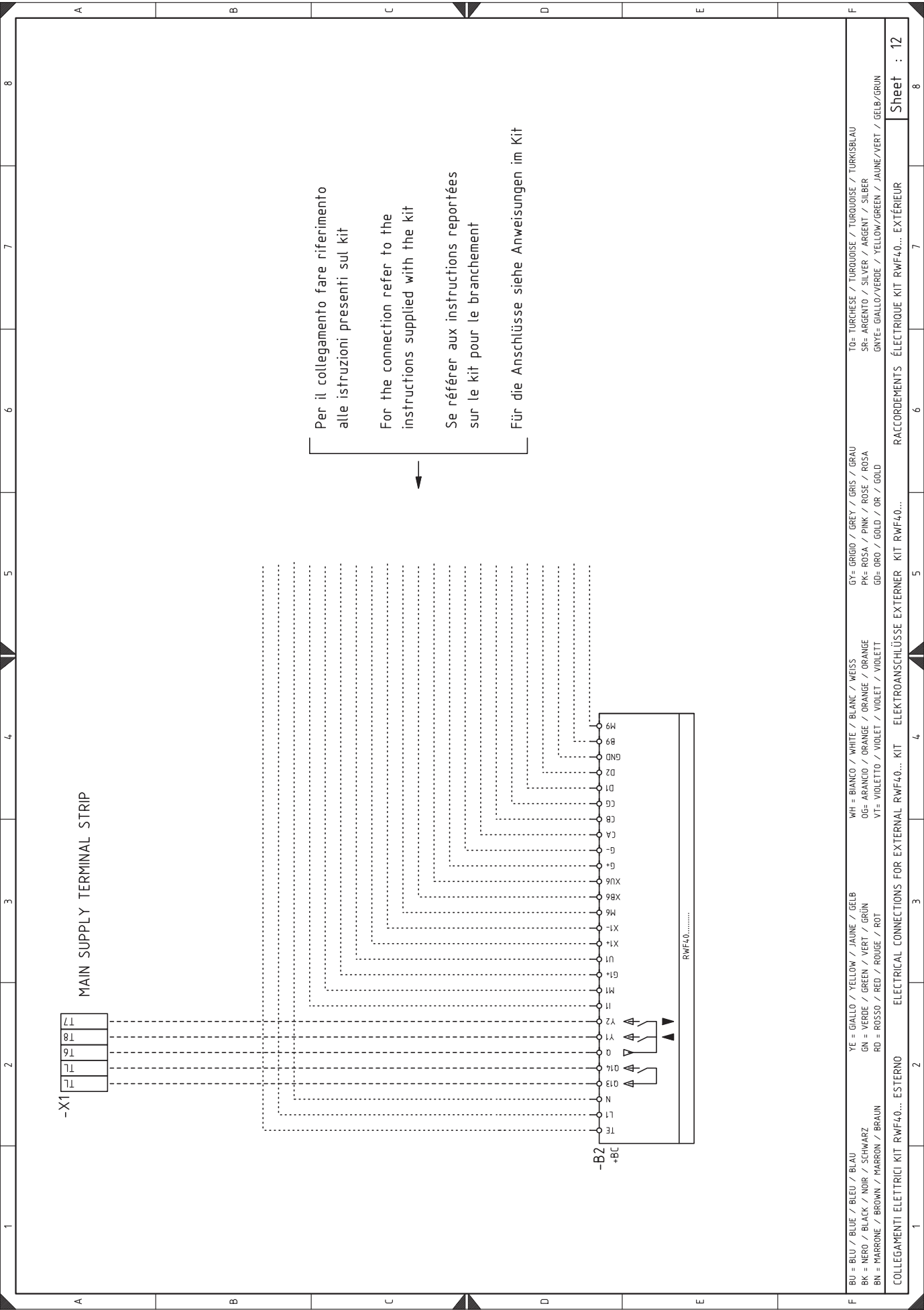
INDICATORS/ANCILLARIES

**RS 400-500**

BU = BLU / BLUE / BLEU / BLAU	YE = GIALLO / YELLOW / JAUNE / GELB	WH = BIANCO / WHITE / BLANC / WEISS	GY = GRIGIO / GREY / GRIS / GRAU	TO= TURCHESE / TURKUISE / TURKISBLAU
BK = NERO / BLACK / NOIR / SCHWARZ	GN = VERDE / GREEN / VERT / GRÜN	OG= ARANCIO / ORANGE / ORANGE / ORANGE	PK= ROSA / PINK / ROSE / ROSA	SR= ARGENTO / SILVER / ARGENT / SILBER
BN = MARRONE / BROWN / MARRON / BRAUN	RD = ROSSO / RED / ROUGE / ROT	VT= VIOLETTO / VIOLET / VIOLET / VIOLETT	GO= ORO / GOLD / OR / GOLD	GNVE= GIALLO/VERDE / YELLOW/GREEN / GELB/GRÜN
COLLEGAMENTI ELETTRICI A CURA DELL' INSTALLATORE			ELEKTROANSCHLÜSSE VOM INSTALLATEUR AUSZUFÜHREN	
ELECTRICAL CONNECTIONS SET BY INSTALLER			ÉLECTRIQUE EFFECTUÉ PAR L' INSTALLATEUR	
Sheet : 10				







Wiring layout key

A1	Electrical control box	YVPS	Valve leak detection device
B1	Output regulator RWF40 internal	X1	Main terminal supply board
B2	Output regulator RWF40 external	X2	Terminal board for RWF40 kit and UV sensor kit
BA	Input in current DC 0...20 mA, 4...20 mA	XAUX	Auxiliary terminal board
BA1	Input in current DC 0...20 mA, 4...20 mA to modify remote setpoint	XPGM	Maximum gas pressure switch connector
BP	Pressure probe	XPGM1	Maximum gas pressure switch connector
BP1	Pressure probe	XRWF	RWF40 Terminal board
BR	Remote setpoint potentiometer	XS	Flame sensors connector
BT1	Thermocouple probe	XSM	Servomotor connector
BT2	Probe Pt100, 2 wires	UV	UV Photocell
BT3	Probe Pt100, 3 wires		
BT4	Probe Pt100, 3 wires		
BTEXT	External probe for climatic compensation of the setpoint		
BV	Input in voltage DC 0...1 V, 0...10 V		
BV1	Input in voltage DC 0...1 V, 0...10 V to modify remote setpoint		
F1	Fan motor thermal relay		
F3	Auxiliary fuse		
G	Signal converter for UV cell		
H1	Light signalling burner on		
H2	Fan motor lock-out warning lamp		
ION	Ionisation probe		
KL1	Direct and line start-up contactor for star/triangle starter (excluding RS 300/M BLU)		
KT1	Triangle contactor for star/triangle starter (excluding RS 300/M BLU)		
KS1	Star contactor for star/triangle starter (excluding RS 300/M BLU)		
KSM	Relay		
KST1	Star/triangle starter timer		
K1	Volt-free fan on contacts output relay		
K2	Clean contacts output relay motor lockout		
K3	Clean contacts output relay burner lockout		
K6	Clean contacts output relay burner switched on		
MV	Fan motor		
PA	Air pressure switch		
PE	Burner earth		
PGMin	Minimum gas pressure switch		
PGM	Maximum gas pressure switch		
RS	Remote reset switch		
S1	Emergency stop button		
S2	Off / automatic / manual selector		
S4	Power increase / power reduction selector		
SH3	Burner reset button and lock-out signal		
SM	Servomotor		
TA	Ignition transformer		
TL	Limit thermostat/pressure switch		
TR	Adjustment thermostat/pressure switch		
TS	Safety thermostat/pressure switch		
Y	Gas adjustment valve + gas safety valve		