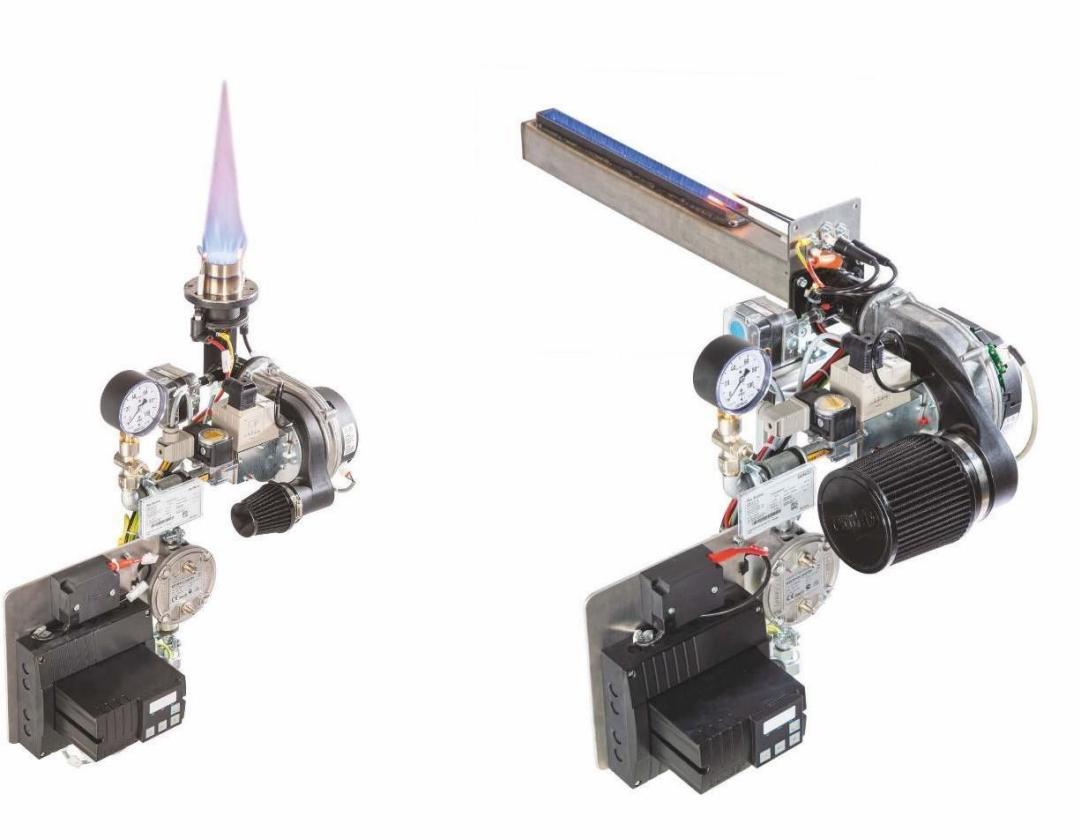
DUNGS®
Combustion Controls

Extended installation instructions:

DUNGS HeatEngine®



Designation:	DUNGS HeatEngine® HEPM-Pxx (HeatEngine PreMix Point-style) HEPM-Lxx (HeatEngine PreMix Line-style)
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Identification of the machine:	see drawing (appendix)

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List of illustrations

1 Introduction and purpose of these operating instructions

The DUNGS HeatEngine burner system is an incomplete machine within the meaning of the Machinery Directive for installation in a thermoprocessing system as a higher-level machine. This document is the assembly instructions in accordance with Annex VI of the Machinery Directive and contains a general description as well as the necessary information for installation and integration into the control system of the higher-level machine (thermoprocessing system). It also contains instructions for use and maintenance.

If the information contained in these operating instructions is not sufficient, please get in touch with your contact at Karl Dungs GmbH & Co. KG, the DUNGS Support Centre (+49 7181 804-804, supportcenter@dungs.com) or DUNGS Global Service (+49 7181 804-0, servicecenter@dungs.com). Contact our American colleagues for US-applications (+1-763-582-1700, info@karldungsusa.com).
You can also find more information about your product at www.dungs.com.

Name and address of the manufacturer:

Karl Dungs GmbH & Co KG

Karl-Dungs-Platz 1

73660 Urbach Germany

Current version of this document: https://www.dungs.com/en/product/dungsheatengine

2 General safety instructions

	The basic prerequisite for safe handling and trouble-free operation of the HeatEngine is knowledge of the basic safety instructions and safety regulations. These operating instructions and the descriptions of the devices installed in the HeatEngine contain the most important instructions for operating the HeatEngine safely. These operating instructions, in particular the safety instructions, must be observed by all persons who operate, run and maintain the HeatEngine. In addition, the rules and regulations for accident prevention applicable to the respective place of use must be observed.
	Note
	Before initial commissioning and before working on the HeatEngine, the instructions in this operating manual and the operating and installation instructions for the devices and components installed in the HeatEngine must be observed. Maintenance and operating personnel must be trained accordingly.
	Warning
	Before commissioning this DUNGS HeatEngine, the procedure must be agreed with the system operator and/or the installer. Improper adjustment, modification, operation and maintenance can lead to property damage and personal injury, possibly resulting in death.
	Danger
	All work on the HeatEngine (e.g. maintenance and repair work) may only be carried out by qualified, expert personnel. DUNGS service personnel and our authorised specialist dealers fulfil this requirement.
	Danger
	The HeatEngine is a burner system in which gas and air are mixed and burnt in a controlled manner as a premix. Incorrect and/or improper use, installation, control and maintenance can lead to fire or explosion.
	Note
	The system is intended for installation in a higher-level machine that provides the necessary protection against accidental contact and protection against foreign bodies and water. Operating the system without appropriate protection is considered improper use.

	Danger
	The product and the associated electrical equipment must be de-energised before maintenance/repair. Before starting work, check that the system is de-energised. Work and troubleshooting on the electrical part of the HeatEngine may only be carried out by trained specialists. The accident prevention regulations and relevant standards must be observed.
	Warning
	The surfaces of the burner housing can become very hot during operation. Beware of unintentional contact with hot surfaces. The HeatEngine must be completely cooled down before maintenance/maintenance work can be carried out. To ensure sufficient cooling, the HeatEngine must be installed in a well-ventilated location.
	Warning
	Regular maintenance of the HeatEngine is necessary. Safety devices must be checked for proper functioning after 10,000 operating hours at the latest and repaired or replaced if necessary.
	Danger
	Sufficient forced or cross ventilation must be provided at the installation site of the HeatEngine to prevent the formation of an explosive atmosphere in the event of a fault.
	Hint
	If extraordinary noise exposure should occur during commissioning and maintenance work, it is advisable to wear personal protective equipment (hearing protection).
	Danger
	When working on the gas-carrying pipe system of the HeatEngine and the components installed in it, the gas supply must be safely shut off before starting work.
	Danger
	The system includes a fan with rotating parts. When working on the system/machine, wait until all parts have come to a standstill. Wear appropriate clothing or keep your distance during operation

3 System overview

3.1 Functional description

The HeatEngine is a premix surface burner system for generating heat in machines for thermal processes. The system has a modular design and fulfils the requirements of the relevant standards for thermal process plants (ISO 13577-2, EN 746-2).
For NFPA 86:2023 some smaller changes are needed. The NFPA version of the P&ID diagram is shown in *Appendix 2*.

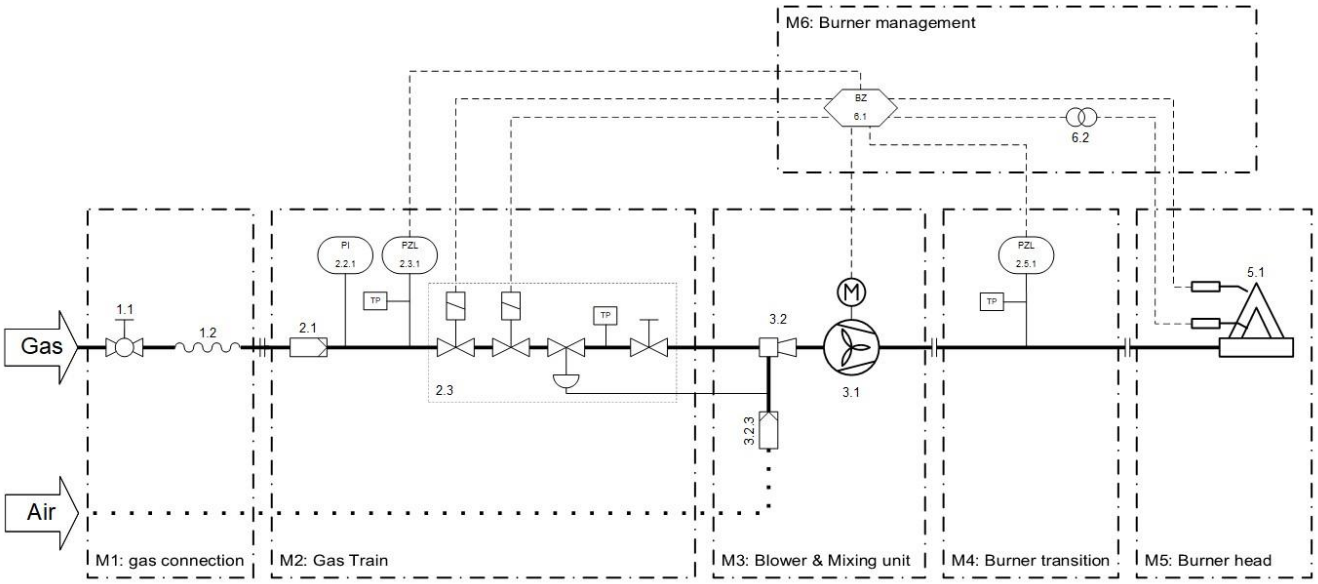


Figure 1: P&ID diagram of the HeatEngine

Figure 1 shows the P&ID diagram of the HeatEngine (see *Appendix 2*) and illustrates the individual modules of the HeatEngine and their functions. The main modules are

- **M1** Gas connection with ball valve (1.1) as main shut-off valve and connection hose (1.2) if necessary
- **M2** Gas train with filter (2.1), pressure gauge (2.2.1), minimum gas pressure switch (2.3.1) and GasMultiBloc MBC (2.3) as a control and safety combination. The MBC compact fitting (2.3) combines the function of two automatic shut-off valves and a proportional/zero pressure regulator for mixture control.
  Module 2 is different for NFPA 86:2023 versions. E.g. test ports, a maximum gas pressure switch and a second ball valve are added (see NFPA 86 P&ID diagram in *Appendix 2*). Following limitations and changes are required as well:
  - Above 44 kW / 150 kBTU/H visual indicators are needed. The use of a MBC is not possible, instead a DMV with FRNG (including visual indicator) is used.
  - From 117 kW / 400 kBTU/H besides the visual indicator one proof of closure is needed. The use of a MBC is not possible, instead a DMV with FRNG (including Proof of closure) is used.

- **M3** Combustion air fan (radial fan, 3.1) with intake housing and WhirlWind gas/air mixer (3.2) for zero pressure operation. An air filter (3.2.3) is fitted to the intake opening and the negative pressure in the intake housing is connected to the MBC controller (2.3) as a pulse to compensate for the power-dependent pressure losses
- **M4** Connector with pressure switch (2.5.1) for monitoring the air/gas mixture pressure
- **M5** Surface burner head (5.1) in point-style or line-style geometry
- **M6** Burner control unit MPA with parameterization and ignition transformer
- **M7** Electrical wiring and assembly

The burner system is supplied pre-assembled. Depending on the order, however, the M6 module (burner control unit and ignition transformer) can be supplied separately to support integration into the higher-level machine on site. The modular design enables customization to the individual higher-level machine without fundamentally changing the function. The burner head geometry and burner output must be selected according to the requirements. The modules and their possible combinations are illustrated graphically in the appendix using the poster (see *Appendix 1*).

Available standard versions of the DUNGS HeatEngine are:

Type	Designation	Item no.	Burner head geometry	Burner output[1)]	Gas connection
HEPM-P025	HEPM-P025/NG-EU-S-IO-1W-E	294440	Point Ø 40 mm OBJ Point Ø 1.5”	5 - 25 kW 15 / 85 kBTU/H	Rp ½ ½” NPT
HEPM-P040	HEPM-P040/NG-EU-S-IO-1W-E	294441	Point Ø 60 mm Point Ø 2.4”	7 - 40 kW 25 / 140 kBTU/H	Rp ½ ½” NPT
HEPM-P060	HEPM-P065/NG-EU-S-IO-1W-E	294442	Point Ø 70 mm Point Ø 2.75”	8 - 65 kW 30 / 225 kBTU/H	Rp ½ ½” NPT
HEPM-P090	HEPM-P090/NG-EU-S-IO-1W-E	294443	Point Ø 98 mm Point Ø 4”	11 - 90 kW 50 / 315 kBTU/H	Rp ¾ ¾” NPT
HEPM-P140	HEPM-P140/NG-EU-S-IO-1W-E	294444	Point Ø 130 mm Point Ø 5.1”	14 - 140 kW 60 / 500 kBTU/H	Rp ¾ ¾” NPT
HEPM-L025	HEPM-L025/NG-EU-S-IO-1W-E	294445	Line 200 mm Line 8”	5 - 25 kW 15 / 85 kBTU/H	Rp ½ ½” NPT
HEPM-L065	HEPM-L065/NG-EU-S-IO-1W-E	294446	Line 440 mm OBJ Line 17.3”	8 - 65 kW 30 / 225 kBTU/H	Rp ½ ½” NPT
HEPM-L140	HEPM-L140/NG-EU-S-IO-1W-E	coming soon	Line 880 mm Line 34.6”	14 - 140 kW 60 / 500 kBTU/H	Rp ¾ ¾” NPT

Table 1: Standard versions of the HeatEngine

Details of the equipment and burner head geometry as well as any technical data deviating from the standard can be found in the order-specific drawing and parts list (see appendix) for the system. The precise execution of the system varies dependending on used standards and needs for the application. The detailed design can be read from the drawing using the type code. The type code is explained under 3.3 Technical data.

We reserve the right to make modifications in the course of technical development.

[1] Burner output in relation to lower calorific value and at neutral back pressure

3.2 Intended use and misuse

The HeatEngine is designed for installation in industrial thermoprocessing systems in accordance with EN 746-2 or ISO 13577-2. The product may only be operated in the oven intended for this purpose. For the installation and operation of the HeatEngine in a higher-level machine, the relevant application standards and guidelines must be observed, e.g. EN 746-2, ISO 13577-2 or NFPA 86:2023. Outdoor operation in a production environment is only permitted with suitable protective measures. The product is intended for use in closed, dry rooms in an industrial environment.

The HeatEngine is a burner system that provides the adequate mixture of gas and air for the subsequent process. It is designed for natural gas (H/L) and LPG/propane (<5% butane).

Any use of the HeatEngine other than that described here is not permitted.

The following risks are possible in the event of misuse:

- The HeatEngine is only safe to operate if it is used as intended
- Failure to observe the instructions may result in personal injury or property damage, financial loss or environmental damage
- In the event of incorrect operation or misuse, there is a risk to life and limb of the operator as well as to the HeatEngine and other property

Warranty and liability

Warranty and liability claims for personal injury and damage to property are excluded if they are attributable to one or more of the following causes:

- improper use of the HeatEngine
- Improper transport, commissioning, operation and maintenance
- Failure to observe the instructions in the operating instructions regarding transport, commissioning, operation, maintenance and repair
- Operating the HeatEngine with defective or non-functional safety and protective devices
- Unauthorized structural changes to the HeatEngine
- Unauthorized changes, e.g. to the control pressure
- Non-compliance with the required maintenance cycles
- Use of unauthorised spare and wear parts

Only use original spare and wear parts. In the case of externally sourced parts, there is no guarantee that they are designed and manufactured to withstand the stress and ensure safety. An exception to this is if no other spare parts are available and the alternative has been previously accepted by DUNGS.

3.3 Technical data

Variants based on the type code

The exact design of the existing DUNGS HeatEngine can be found in the type code (*Figure 2*). This indicates whether it is a point- or line-style burner head, the output of the burner system, the medium with which the system is operated and the region for which it was designed. It also includes the control unit, flame monitoring, wiring, voltage and, if required, a customized abbreviation with a sequential number.

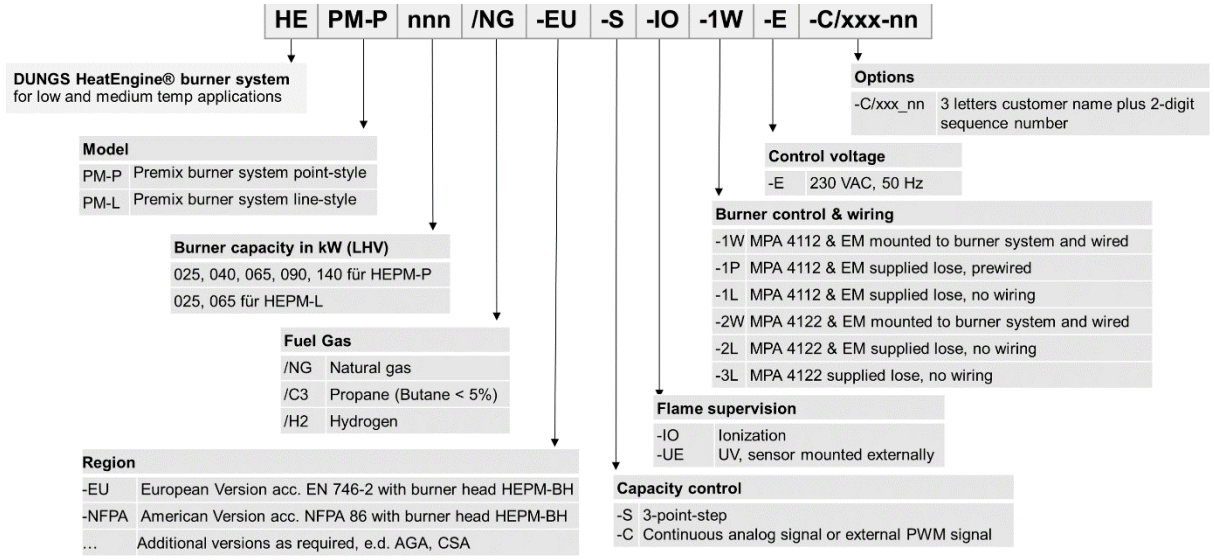


Figure 2: Type code of the HeatEngine

Mechanics

Note: for order-specific deviations, see drawing (see appendix)

Medium:	Natural gas (L/H)
	LPG[2]/propane (<5% butane)
Gas pressure inlet ball valve:	min. 30 mbar
	0.5 Psig min
Pressure in the process chamber:	min.-5 mbar, max. 3 mbar
	-2” WC / +1.5” WC
Process air speed:	max. 5 m/s
	15 ft/s max
Installation:	Coordination of the installation with DUNGS is recommended
	(horizontal, vertical upwards, vertical downwards (increase low load if necessary))
Dimensions:	according to drawing (see appendix)
Flame length[2]:	see *table 1*

[2] Liquified Petroleum Gas

Execution	Rated power [kW] / [kBTU/H]	Flame length max. load [cm] / ["][2]	Flame length min. load [cm] / ["]
HEPM-P025	25 / 85	40 / 16	10 / 4
HEPM-P040	40 / 140	50 / 20	12 / 5
HEPM-P065	65 / 225	60 / 24	14 / 5.5
HEPM-P090	90 / 315	80 / 32	17 / 7
HEPM-P140	140 / 500	100 / 40	20 / 8
HEPM-L025	25 / 85	35 / 14	8 / 3
HEPM-L065	65 / 225	40 / 16	8 / 3

Table 2: Flame length of the standard versions

Control/ electrical engineering

Mains frequency:	230 VAC / 120 VAC
Mains frequency:	50 / 60 Hz
Control:	3-point step control
	Analog control on request
Protection class:	IP 00 (like the blower)
Ambient temperature:	min. -15°C, max. 60°C
Oven flange temperature:	max. 150°C
Process temperature:	max. 450°C downstream of the burner max. 300°C upstream of the burner (incoming process air)

Important parameters of the automatic burner control MPA V2 and their standard setting:

Parameter-No.	Parameter description	Possible values	Presetting
239	Extension module	0, 1 (= EM installed)	1
General			
10	Release parameter settings***	0 = No, 1 = Yes	0
11	Fieldbus address configuration	0…254 (255 = off)	255
12	Number of restart attempts	0, 1, 2, 3, 4, 5	5
13	Number of restart attempts when flame is missing	0, 1, 2, 3, 4, 5	0
14	Number of restart attempts after flame lift-off	0, 1, 2, 3, 4, 5	0
15	Locking with open safety chain	0 = Restart attempt 1 = Immediate malfunction lockout	1
16	Operating mode for LDW 1	0, 1, 2, …, 15	13
17	Temperature controller: Operating mode	0, 1, 2, 3, 4	0
18	Input X17	0, 1, 2, 3, …15	3
19	Configuration of output for operation	0, 1, 2, 3, … 11	3

[2] Visible flame length when operating with natural gas in free range 0...100 [%]

20	Safety chain open duration	0…65534 [1/ 16 s] (65535 = infinite)	65535
21	Shutter test for flame detector device	0, 1, 2, 3	0
22	FM mode	0, 1	1
23	POC tolerance time	16…48 (in 1/16 s)	16
26	Input X16	see parameter 18	2
27	Input X18	see parameter 18	9
28	Input X19	see parameter 18	10
29	Input X20	see parameter 18	11
60	Network adress 3	0…255	192
61	Network adress 2	0…255	168
65	Behaviour when waiting for air purge / cooling	0, 1	0
Start-up			
30	Pre-aeration duration	0…32767 [1/16 s]	32767
31	Duration of pre-ignition time	2…65534 [1/16 s]	0
32	Safety time for start-up / first safety time	16…960 [1/16 s]	48
33	Active flame detector device(s) for safety time for start-up	1, 2, 3, 4	1
34	Stabilization time A	0…65534 [1/16 s]	48
35	Second saftey time during start-up	16…480 [1/16 s]	16
36	Active flame detector device(s) for phase 2	1, 2, 3, 4	1
37	Stabilization time B	0…65534 [s]	0
38	Operating mode V1 V2	0, 1, 2, … 5	1
39	Maximum waiting time for start release	0…65534 [1/16 s] (65535 = infinite)	2400
48	Ionization threshold	12…60 [0,1 µA]	12
49	Operating release control	0, 1 (= active)	1
Operation			
40	Duration of normal operation	1…65534 [min] (65535 = infinite)	65535
41	Safety time operation FLW 1	12…48 [1/16 s]	16
42	Safety time operation FLW 2	3…48 [1/16 s]	16
43	Duration for new start of pilot burner	8…960 [1/16 s]	16
Shutdown			
50	Follow-up time	16…65534 [1/16 s]	16
51	Post-purge time	16…65534 [1/16 s]	96
52	Restart protection	16…65534 [1/16 s]	0
Extension module			
25	Maximum waiting time until motor position is reached	0…1920 [1/16 s]	480

240	Pre-aeration position	0…100 [%]	100
241	Ignition position	0…100 [%]	30
242	Stabilization	0…100 [%]	30
243	Post-aeration	0…100 [%]	100
244	Start value	0…100 [%]	25
245	Minimum speed	0…100 [%]	19
246	Maximum speed	0…100 [%]	100
247	Schrittweite Drehzahländerung	0…100 [%]	1
248	Increment for speed changes	0…4095,875 [s]	5
249	Bit functionns	PWM / Analog	PWM

Table 3: Default setting of important MPA parameters

Note: The default setting may differ from customized settings. Please pay attention, in the case of customer-specific parameterization, to the parameter setting supplied.

3.4 Function of the control unit

The burner system is controlled via the MPA burner control unit as an interface to the control unit of the higher-level machine. Details can be found in the circuit diagram (see appendix). A 3-point step control is used as standard. Analog control with 0-10V or 4-20mA is also possible, but must be detailed for the specific project on request.

The following signal inputs and outputs are provided:

- Safety chain okay (emergency stop, overtemperature, machine-related safety limits)
- Heat request = switch on burner
- Increase performance.
- Reduce power.
- Interference suppression
- Operating message = Burner in operation
- Fault message

The combustion air fan and the automatic shut-off valves are controlled by the MPA burner control unit in accordance with the specified sequence. The speed of the fan for pre-purge and ignition as well as the maximum and minimum output are determined by the MPA parameters.

When heat is requested by the control system of the higher-level machine, the combustion air fan is started by the burner control system. The burner and the on-site combustion chamber are first pre-purged; the duration and fan output correspond to the MPA parameterization. Following the pre-purge, the blower output is reduced to the ignition output. To start the burner, the MPA opens the gas shut-off valves and activates the ignition transformer to ignite the gas-air mixture generated in the WhirlWind. The formation of the flame is detected by the ionization electrode and the MPA burner control unit sends the operating signal to the control unit of the higher-level machine, which then takes over the power control.

During operation, the power is determined by the fan speed. The blower output is specified via a PWM signal. The air flow generates a negative pressure in the WhirlWind gas/air mixer, which sucks in the fuel gas through the Venturi effect (zero pressure control).

The gas volume is set to the desired mixture on the MBC at the integrated main volume throttle A and via the offset (adjusting screw B). The procedure for setting the main volume throttle on the MBC is described in *5.4 Commissioning* and *6 Manufacturer settings*. Further information can be

found in the MBC documentation.

When the *heat request* signal is switched off, the burner is switched off. The burner control unit de-energizes the automatic shut-off valves of the MBC and the valves close. The burner is then purged to remove the ignitable gas-air mixture from the burner and the on-site combustion chamber. The duration and blower output correspond to the MPA parameterization.

The presetting of the MBC and the standard parameters of the MPA allow quick and easy commissioning after installation and integration into the control system of the higher-level machine. A converter is required for analog control.
This is necessary as the fan can only interpret signals in the form of pulse width modulation. The converter is fed by the MPA and modulates a PWM signal using the analog input signal.

The structure of a 3-point step control and the analog control are shown as block diagrams (see *Appendix 3*). However, this diagram is only a general representation. For effective analog control, this must be detailed on a project-specific basis.

4 Transport and storage

Take care when storing and transporting the HeatEngine to the site. Handle the components with care. This also includes vibration-free transport.
Do not throw or drop the product. Observe the relevant regulations, e.g. accident prevention regulations. Only store the product in a dry and clean working environment. Only store the product within the permitted temperature range. Correct operation of the HeatEngine is only guaranteed if it is transported and stored correctly.

5 Installation and commissioning

5.1 Scope of delivery

The scope of delivery of the HeatEngine depends on the selection regarding *module 7 - Wiring*. Ideally, a pre-assembled version should be ordered. In this case, the HeatEngine is delivered assembled and wired. The associated automatic burner control unit is also preset. The HeatEngine can be regarded as a plug & play system.

Alternatively, however, the HeatEngine can also be supplied with pre-wired loose individual parts or completely without cabling. In principle, every HeatEngine system - regardless of the choice of cabling - is supplied with the corresponding plugs and seals. When ordering a non-wired HeatEngine, the following electrical components are supplied:

- Connectors for blowers, electrodes, MBC and pressure switches
- Ignition cable (length e.g. 550 mm, 1000 mm or 1500 mm)
- Ionization cable (length e.g. 550 mm, 1000 mm or 1500 mm)
- Power supply cable for transformer

5.2 Integration into the machine

	Note
	Ensure a firm, stable substructure during installation. Reinforce if necessary!

	Note
	Pay attention to external EMC interference signals on site during installation! EMC interference signals can occur, for example, from motors with speed control via frequency converters.

The burner system is attached to the burner head via the mounting flange using six mounting screws. The mounting flange has two seals, which are shown in *Figure 3*. Information on the flange dimensions and the positions of the screw openings can be found in the drawing of the burner system.

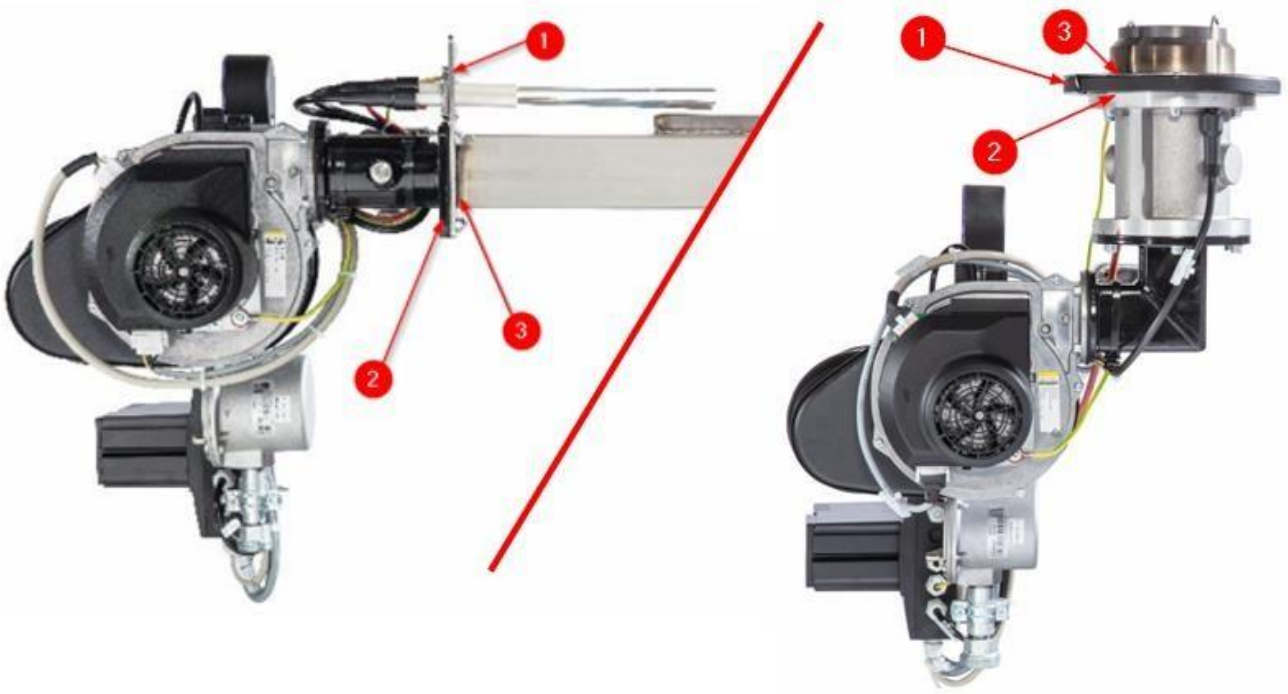


Figure 3: Mounting flange and seals of the HeatEngine (left: line-style burner, right: point-style burner)

The burner head is mounted on the housing of the process chamber using the mounting flange, position 1 in *Figure 3.* One seal, position 2 in *Figure 3, is* located on the transition piece between the burner head and blower and on the mounting flange. The second seal, position 3 in *Figure 3*, is placed between the mounting flange of the HeatEngine and the outer wall of the process chamber during installation. The external components such as cables and gas line must be protected from heat. The installation is suitable for applications up to 200°C / 400F without additional insulation. An outer lining, as shown in *Figure 4* on the left, only minimally increases the temperature resistance. With this variant, it is important that the mounting flange and screws are not insulated. An inner lining, as shown in *Figure 4* on the right, increases the temperature resistance to 450°C / 840F.

The outer wall of the process chamber is represented by position 2 in *Figure 4.* Position 3 shows the outer insulation and position 4 the inner insulation. Regardless of the type of insulation, a sight glass must be provided in accordance with ISO 13577-2 and NFPA 86:2023. This is used for visual inspection of the flame pattern and for burner adjustment. In *Figure 4,* position 1 corresponds to the sight glass.

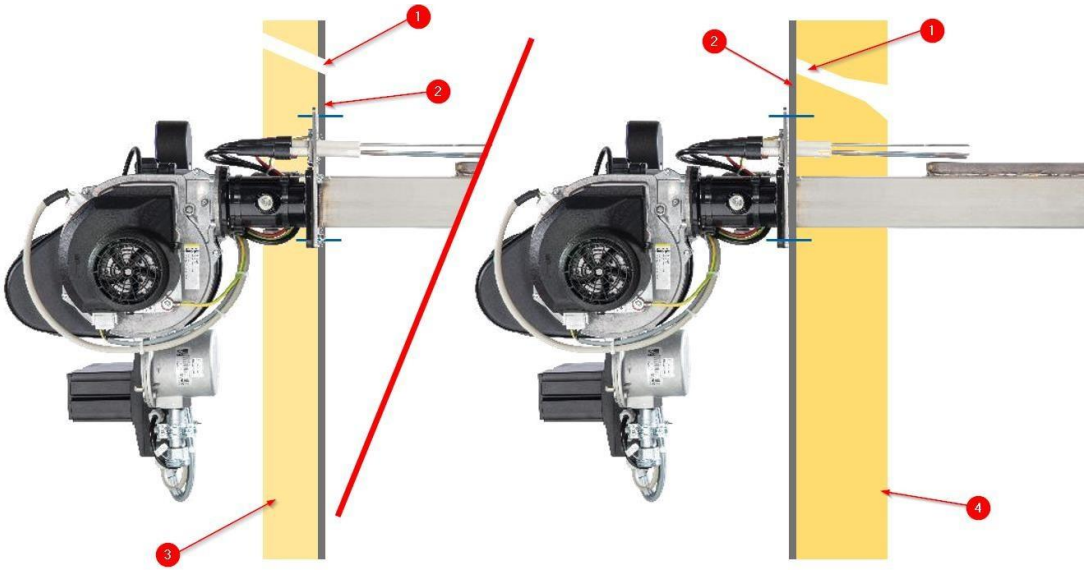


Figure 4: HeatEngine in process chamber with outer and inner lining/insulation (line-style burner system)

Installation via the mounting flange is equivalent for point-style and line-style burner heads. The difference based on the burner type lies in the positioning of the sight glass. The sight glass, which is required for visual inspection of the flame pattern, must always be aligned so that it is in line of sight with the pad. For line-style burner heads, it is sufficient to place a sight glass above the HeatEngine system, as shown in *Figure 4.* This is because the mounting wall is automatically perpendicular to the focal surface. With point-style burner heads, on the other hand, a wall adjacent to the mounting wall must be used. A sight glass placed perpendicular to the focal surface of a point-style burner head is shown in *Figure 5*.

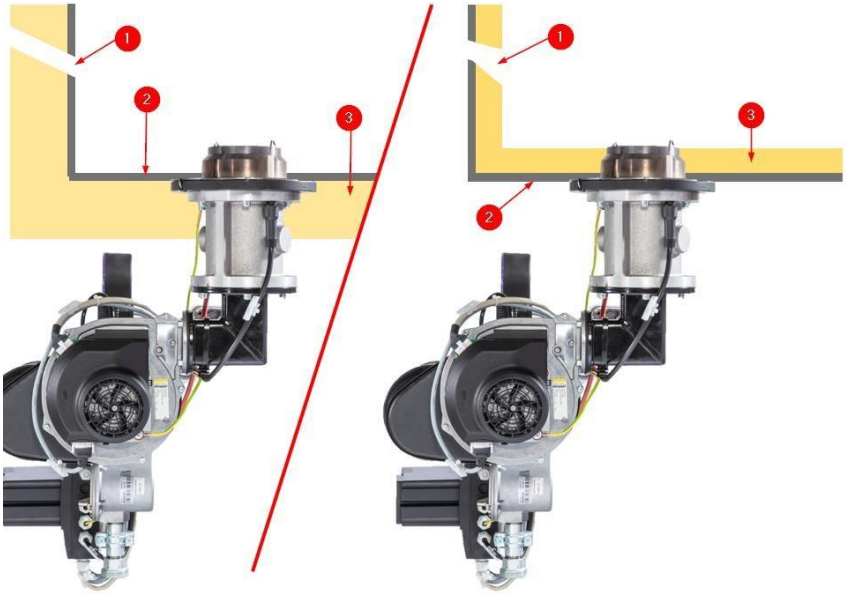


Figure 5: HeatEngine in process chamber with outer and inner lining/insulation (point-style burner system)

In addition to installation via the burner head flange, the gas control line must be supported! This must be realized on site according to the possibilities of the higher-level machine.

When determining the installation position, ensure that the burner system is accessible for inspection and maintenance work. In accordance with EN 746-2, ISO 13577-2 and NFPA 86:2023 it must be possible to visually inspect the flame (see flame pattern catalogue, *Appendix 4*).

When determining the installation situation, it must be ensured that the combustion air fan can draw in sufficient clean, dust-free air and that the exhaust gases produced during combustion are safely discharged. Sufficient openings must be provided in the higher-level machine for the air supply, through which clean ambient air can be drawn in.

	Warning
	Insufficient air supply represents a safety risk and must be ruled out.

After installing the burner system, establish a gas connection and check that the gas supply line is adequately dimensioned. The ball valve must be installed as a manually operated main shut-off valve in accordance with EN 746-2, ISO 13577-2 or NFPA 86:2023 and must be easily accessible. The connection hose, if present, must be installed so that it is protected from damage.

	Warning
	Ensure that the gas pressure is secured on site. Excessive gas pressure (greater than the specified maximum inlet pressure) can lead to damage.

After the mechanical installation of the burner system in the higher-level machine, establish electrical connections and, if necessary, intermediate cabling in accordance with the circuit diagram (see appendix). Check the on-site electrical fuse protection.

After installation and before commissioning the DUNGS HeatEngine

a) Check power supply.
b) Carry out an electrical function test.
c) Check the gas system for leaks.
d) Check the ventilation of the installation room.

Depending on the installation location of the higher-level machine, obtain the necessary authorizations in accordance with regional regulations before commissioning.

5.3 Checking the installation

The installation and commissioning of the HeatEngine must be carried out by qualified, expert personnel. The relevant standards and regulations must be observed during installation and commissioning. Commissioning must be prepared as follows:

1. Check whether the higher-level machine is ready to start the burner system, e.g.
   - Burner not blocked
   - No flammable objects in front of the burner head
   - Heat dissipation given
   - Exhaust gas removal ensured
   - All required interlocks in order and integrated into the safety chain
2. Check the position of the electrodes in the burner head, see HEPM-BH burner head documentation
3. Establish/check voltage and gas supply
4. Check the parameterization of the burner control unit MPA and adjust if necessary
   - Parameter 30 *Duration of pre-ventilation is* preset to a maximum value of approx. 1 hour as standard and can be shortened according to the machine configuration.
     Note: In accordance with EN 746-2 and ISO 13577-2, 5 complete air changes are required. In accordance with NFPA 86:2023, 4 complete air changes are required.
   - Parameter 51 *Post-purge time* is preset to 6 seconds as standard to purge the burner itself and may need to be extended according to the machine configuration in order to also purge the combustion chamber and exhaust gas system.
   - Parameters 240 to 248 determine the blower control. They are preset with default values and can be adjusted to optimize the process.

5.4 Commissioning

	Warning
⚠	The system must be properly purged during initial commissioning or after work on the gas system.

1. Open the gas ball valve and check the gas pressure on the pressure gauge
2. Check the setting of the gas pressure switch (item 2.3.1, Fig. 1) or set to
   - 25 mbar / 10”WC (approx. 80% of the minimum required inlet pressure of 30 mbar / 0.5 Psig)
3. Check setting of mixture pressure switch (item 2.5.1, Fig. 1) or set to 0.5 mbar / 0.2”WC
4. Switch on burner system (*heat request* signal)
   The burner starts with a regular starting process with pre-purge, approaching the ignition position, ignition spark and flame formation. The fan output during pre-purge and ignition as well as the flame stabilization time is determined by MPA parameters 240 to 242.

	Note
🕮	Before the system was delivered, the MBC was preset so that the burner should ignite. During initial commissioning or after work on the gas system, several start attempts may be necessary to fill the system with fuel.

5. Run the burner to MAX (high load) and check the flame pattern visually using the flame pattern catalogue (see *Appendix 4*). If necessary, adjust the gas quantity at the main volume throttle **A** of the MBC. The blower output is set by the MPA parameter 246 *Maximum speed* determined. The gas quantity can be determined by a gas meter, a gas counter or a measuring orifice in the gas supply line.

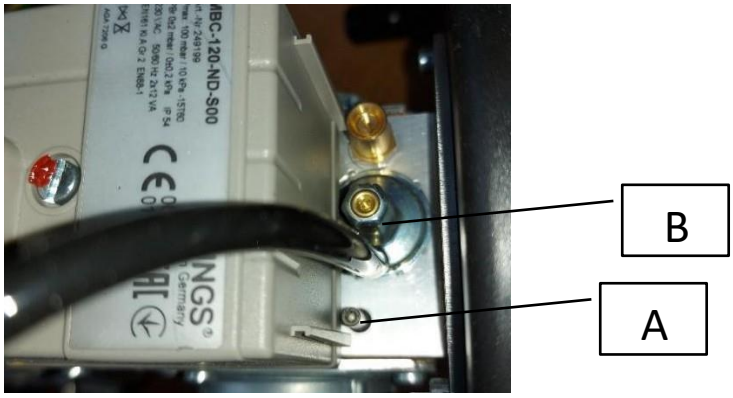


Fig: Photo MBC with labelling of main volume throttle and offset screw

6. Set the burner to MIN (low load) and visually check the flame pattern (see flame pattern catalogue, *Appendix 4*). If necessary, adjust the gas quantity at offset screw **B** of the MBC. The blower output is determined by the MPA parameter 245 *Minimum speed.* The gas quantity can be determined by a gas meter, a gas counter or a measuring orifice in the gas supply line.

	Note
	Only change the offset in very small steps of e.g. ¼ turn and make a note of this.

7. Switch back and forth several times between high load and low load, repeating steps 5 and 6. Finally, document the settings of the pressure switches, MPA parameters, position (length) of the main volume throttle, any changes made to the offset, controller outlet pressure (**measuring point 3**) at MAX and MIN and, if possible, gas volume flows MAX and MIN

	Note
	The pad of the burner head should not glow during operation in order to avoid excessive wear. If the pad surface glows too much (significantly more than 50% glowing surface), this can lead to thermal overload of the pad surface.

At the end of commissioning, check the connections and closures for leaks using a foaming agent and retighten if necessary.

6 Manufacturer settings

The HeatEngine flame pattern catalogue contains images for the correct setting of a point- and line-style burner system based on the flame pattern. The appearance of the flame varies depending on the combustion medium*appendix 4*).

The setting values of the MBC and the pressure monitor can also be used as an aid. The min. pressure monitor on the MBC is set to 25 mbar / 10”WC as standard and the mixture pressure monitor on the burner connection piece is set to 0.5 mbar / 0.2”WC. The setting values for the main volume throttle, on the other hand, are not generally valid values, but merely reference points for the setting. This is because each system is different due to various tolerances.

As already described under *5.4 Commissioning*, there are two possible setting values for the MBC. Offset B should not be adjusted if possible, or only minimally if absolutely necessary and with documentation of the changes made.

The main volume throttle A, on the other hand, can and should be used to adjust the gas volume at the MBC. This changes the ratio of the air/gas mixture. The position and direction of rotation of the main volume throttle is shown in *Figure 6.*

Figure 6: Diagram for setting the main volume throttle

Guide values for the setting of the main volume throttle have been taken from various laboratory tests. It should be emphasized once again that these are not explicit values. In addition to the product's own tolerances, the setting values depend on the capacity, fuel and gas pressure, among other things. Therefore, these values are given in the following table (*Table 4) in* addition to the design of the HeatEngine and the setting value of the main volume throttle.

Execution	Rated power [kW] / [kBTU/H][3]	Fuel	Throttle position [mm]
HEPM-P025	25 / 85	Natural gas (H)	15,3
		Propane	14,5
HEPM-P040	40 / 140	Natural gas (H)	16,3
		Propane	14,6
HEPM-P065	65 / 225	Natural gas (H)	16,7
		Propane	15,1
HEPM-P090	90 / 315	Natural gas (H)	14
		Propane	12,9
HEPM-P140	140 / 500	Natural gas (H)	19,1
		Propane	13,2
HEPM-L025	25 / 85	Natural gas (H)	15,5
		Propane	14,3
HEPM-L065	65 / 225	Natural gas (H)	16,2
		Propane	14,9

Table 4: Standard values for setting the main volume throttle

7 Operation

The burner system is designed for fully automatic operation without supervision. The higher-level machine monitors the safety-related interlocks, switches the burner on and off according to the process requirements and controls the output by activating the corresponding inputs on the MPA burner control unit (see documentation). The MPA burner control unit monitors the gas and mixture pressure, controls the automatic shut-off valves and monitors the formation of the flame.

[3] The output is specified in realtion to the lower heating value (LHV)

8 Product and capacity changes

It is necessary to replace safety-relevant components once they have reached the end of their service life. DUNGS recommends replacement in accordance with *Table 1*:

Safety-relevant Component	Design-related service life		CEN standard
	Number of cycles	Time [years]	
Valve testing systems	250.000	10	EN 1643
Gas pressure switch	50.000	10	EN 1854
Air pressure switch	250.000	10	EN 1854
Low-gas switch	N/A	10	EN 1854
Combustion manager	250.000	10	EN 298 (gas) EN 230 (oil)
UV flame sensor[1]	N/A	10.000 Operating hours	-
Gas pressure regulators[1]	N/A	15	EN 88-1 EN 88-2
Gas valve with valve test systems[2]	After recognised error		EN 1643
Gas valve without valve test systems[2]	50.000-200.000 depending on the nominal diameter	10	EN 161
Gas-air composite systems	N/A	10	EN 88-1 EN 12067-2

[1] Decreasing operating characteristics due to ageing
[2] Gas families II, III
N/A not applicable

Table 5: Service life of the components

9 Maintenance and servicing

All maintenance and servicing work on the HeatEngine may only be carried out by qualified, expert personnel. DUNGS service personnel and our authorized specialist dealers fulfil this requirement.

Carry out regular annual inspections to maintain and ensure functional safety. Observe the instructions for the components used. Replace defective components from the DUNGS delivery program (pressure switch, MBC, etc. see details on the order-specific drawing). If a spare part is required, please contact your responsible sales engineer.

The minimum requirements for maintenance are as follows:

1. General condition check
2. Check condition of gas filter, air filter and wearing parts
3. Visual and functional inspection including the safety and control devices (pressure switch and GasMultiBloc MBC)
4. Checking the safety-relevant components to ensure that they have reached their nominal service life.
5. Check fuel-carrying system components for leaks, corrosion, and signs of ageing.
6. Checking the burner head with ignition and monitoring device, see HEPM-BH documentation.
7. Checking the combustion chamber and heating surface for soiling
8. Checking the supply of the necessary combustion air network
9. Checking the exhaust gas routing for function and safety
10. Final inspection check by measuring and documenting the measurement and test results.

10 Cleaning

If necessary, the burner components, combustion chamber and heating surfaces must be cleaned. Ensure that the burner system is properly switched off before cleaning. The steps to be taken can be found in the maintenance instructions. The relevant cleaning instructions can also be found in the documentation for the individual components.

11 Malfunctions

Various faults and error patterns can occur during operation. Known malfunctions and possible causes are listed below. Furthermore, starting difficulties can be remedied under certain circumstances by increasing the starting power.

Possible causes if **the burner system does not ignite:**

- Ignition transformer defective
- Ignition cable damaged or not properly connected
- Ignition electrode dirty, worn or incorrectly positioned
- No or too little gas, incorrect mixture

possibleB

Possible causes if **the burner system only burns for a short time:**

- Missing flame signal
- Ionization line damaged or not properly connected
- Ionization electrode dirty, worn or incorrectly positioned possible

causes of **flame failure during operation:**

- Unstable flame signal, e.g. due to wear of the ionization electrode
- Burner low load too low, e.g. due to contamination of the air filter
- Heavy load too high, flame lifts off
- Fault in the gas supply to the burner

12 Decommissioning and disposal

To decommission, switch off the gas supply and power supply and close the gas ball valve.

Once the intended service life has been reached or when the higher-level machine is decommissioned, the DUNGS HeatEngine can also be disposed of separately according to the components.

Local guidelines for the disposal of these materials must be observed.

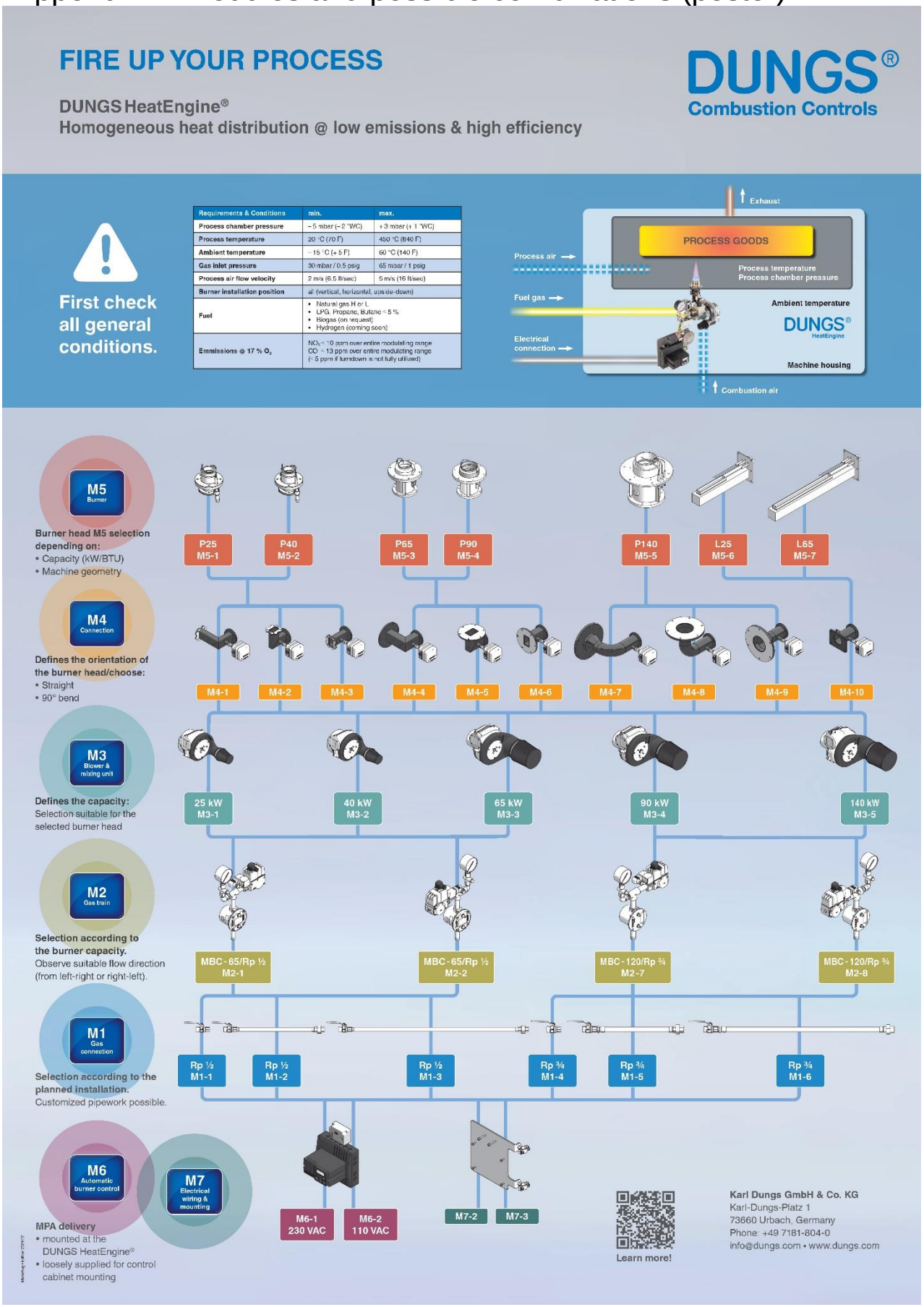
13 Documents and drawings

The extended installation instructions include the appendices listed below.

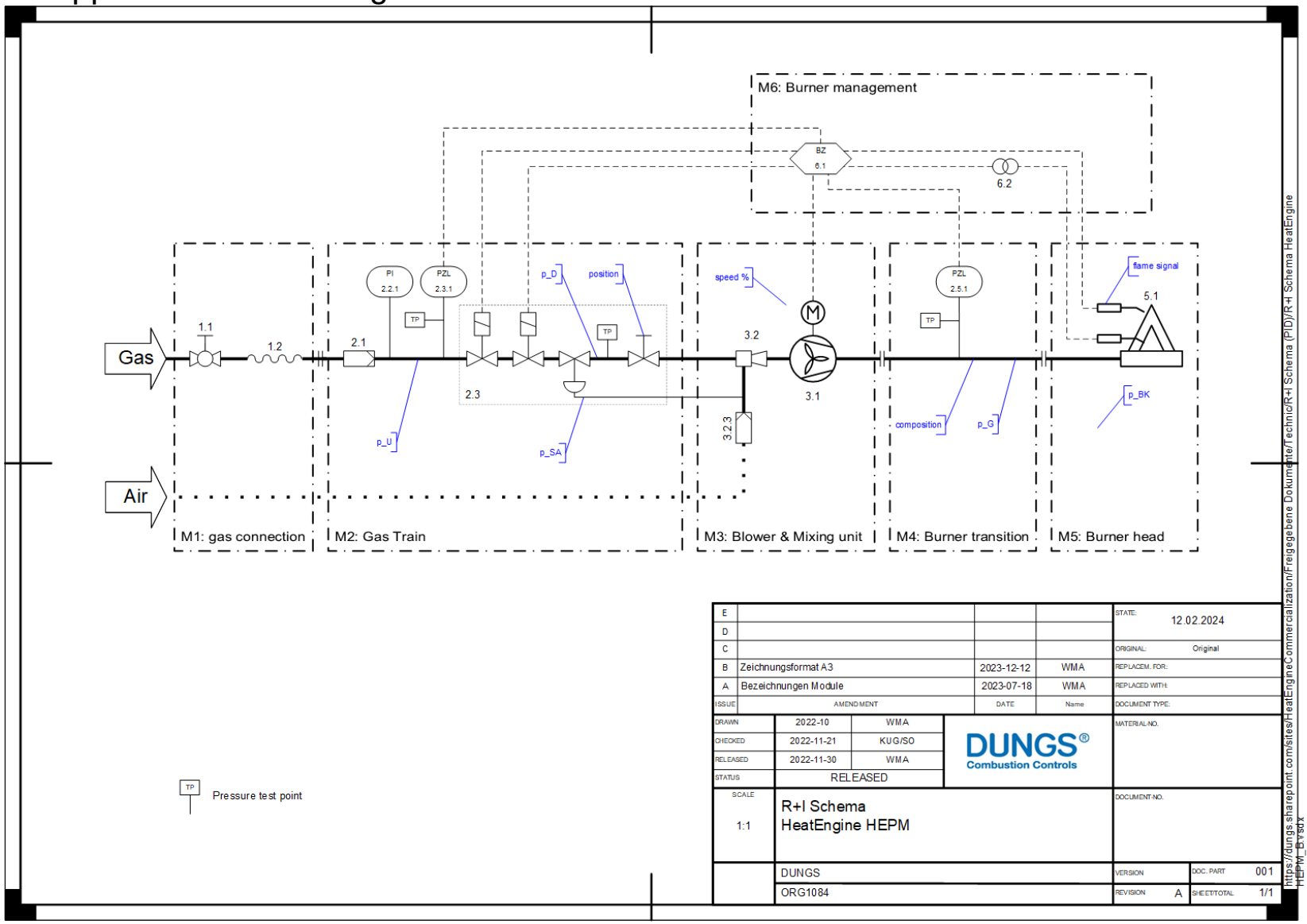
The drawing can be found at the end of the general section of the extended installation instructions in the system documentation, and the corresponding documentation is also enclosed for each component of the burner system.

We reserve the right to make changes in the interest of technical progress.

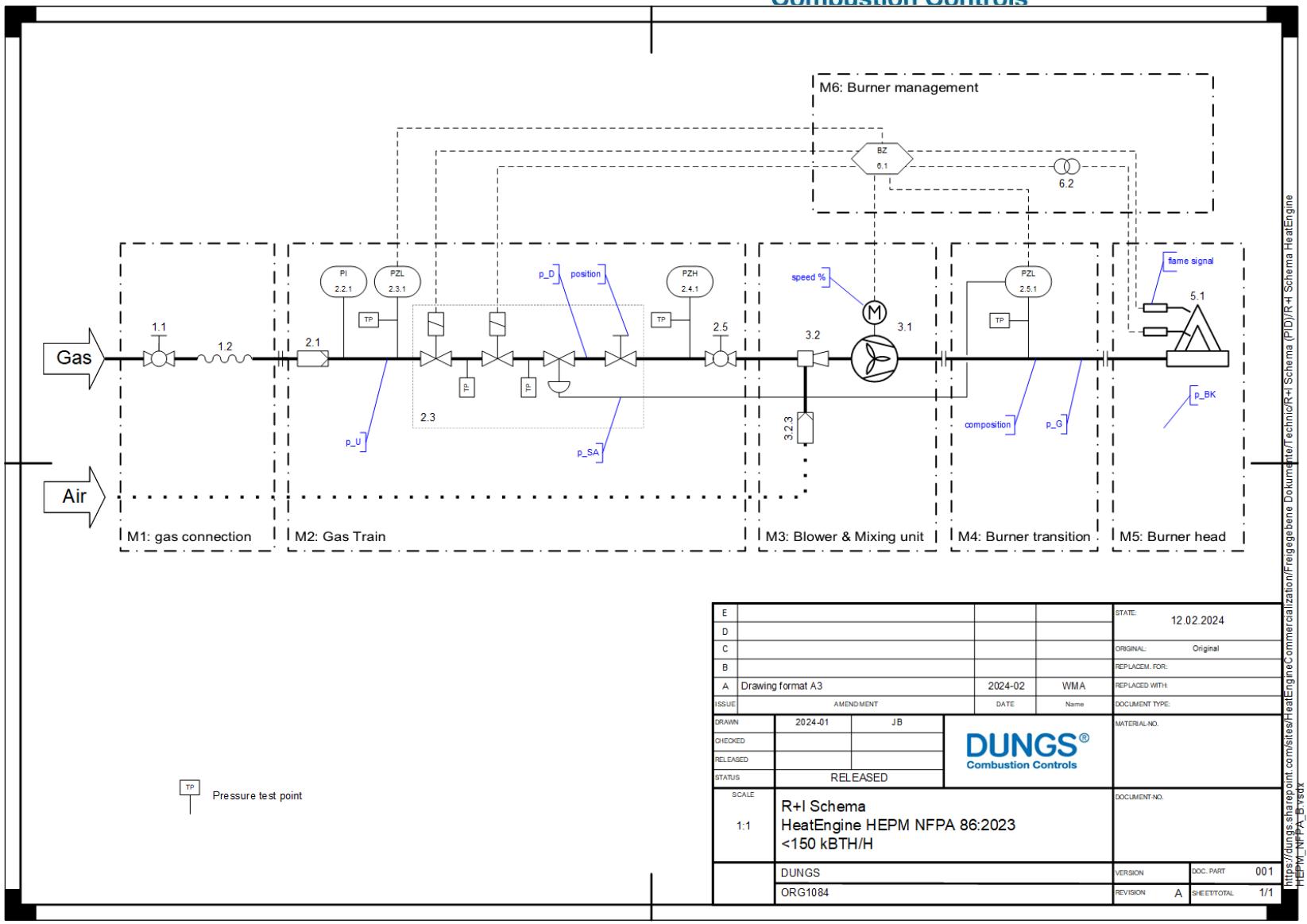
Appendix 1: Modules and possible combinations (poster)



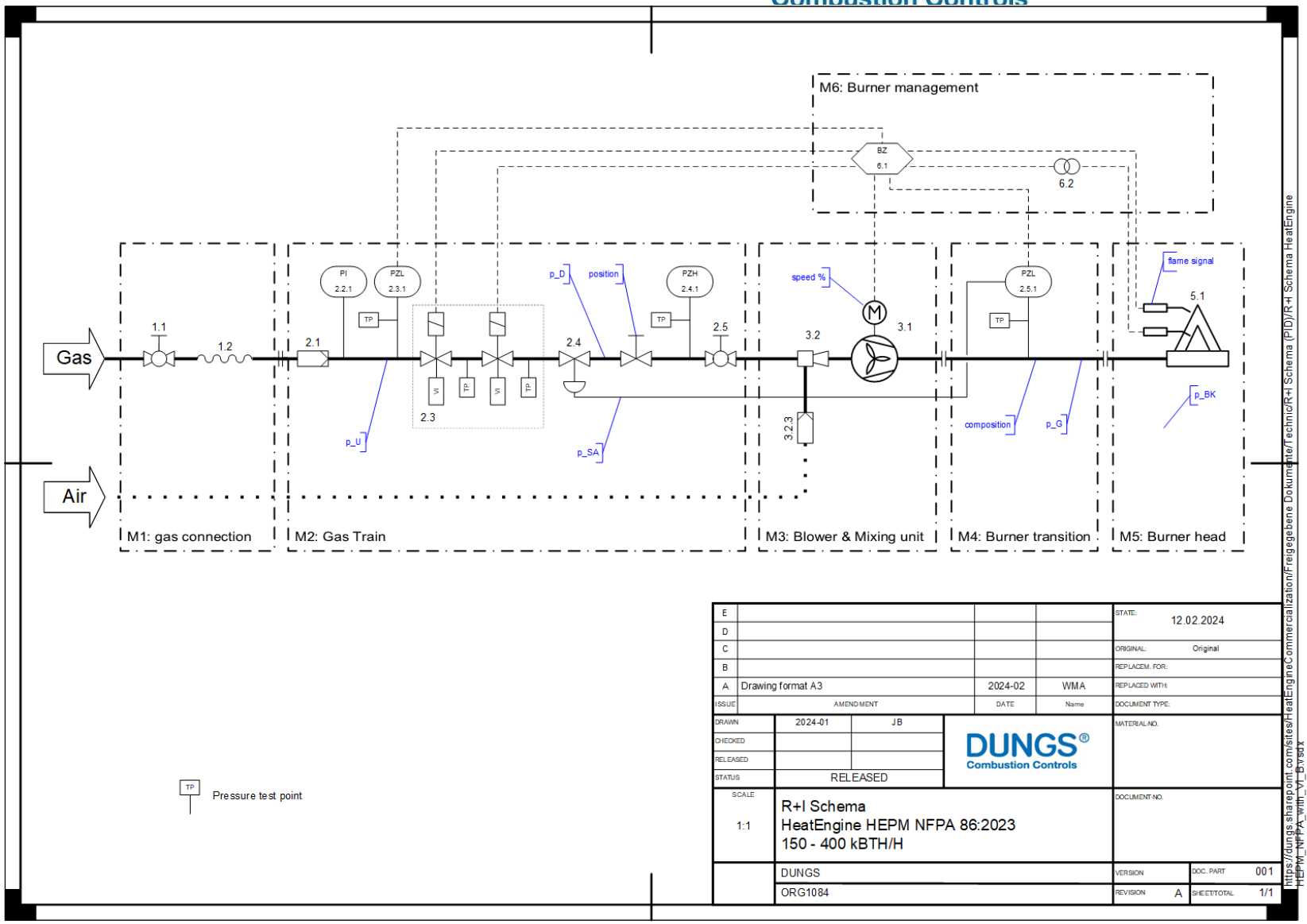
Appendix 2: P&ID diagrams



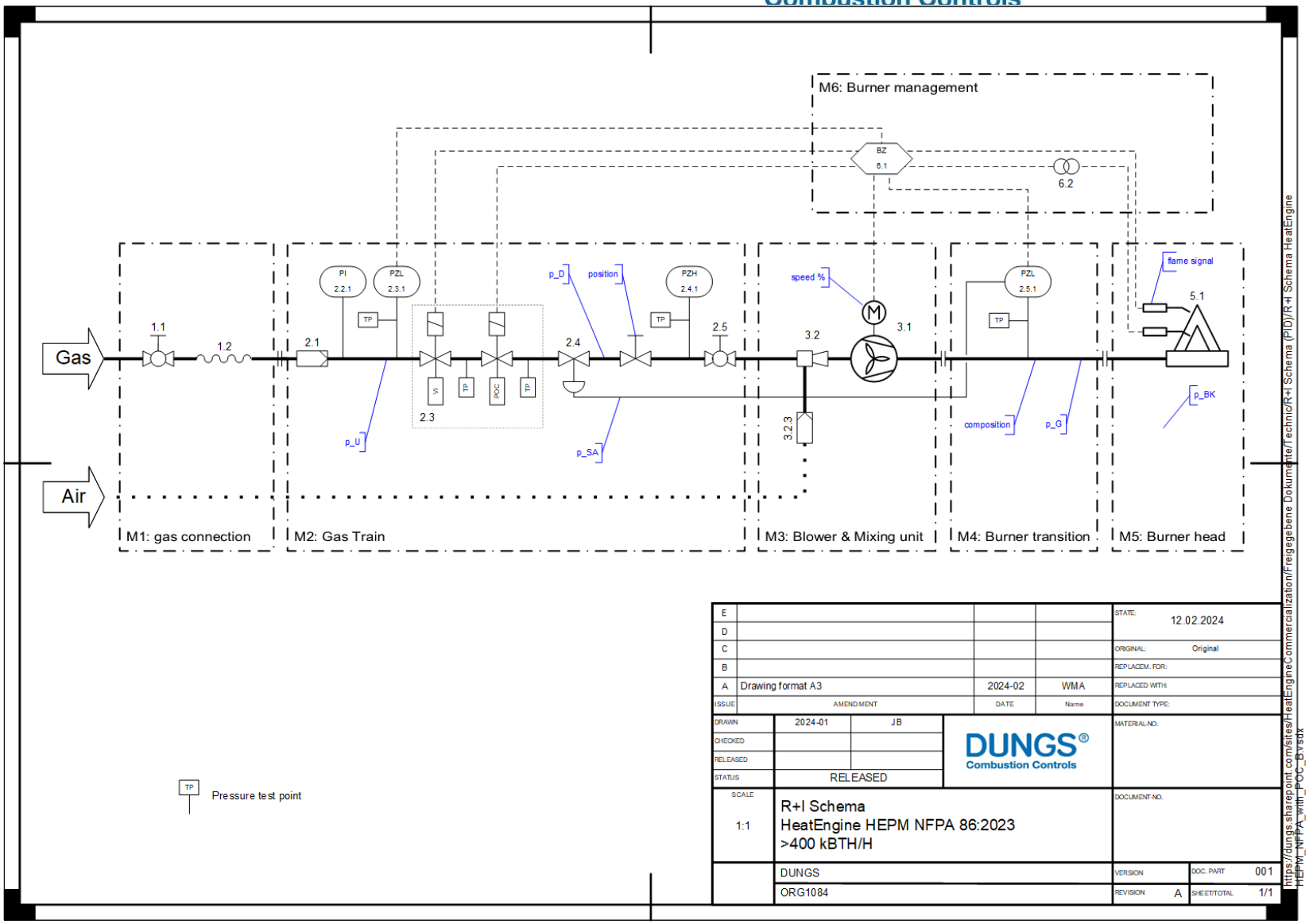
1 Standard P&ID for ISO 13577-2



2 Standard P&ID for NFPA 86:2023 up to 150 kBTU/H (44kW)



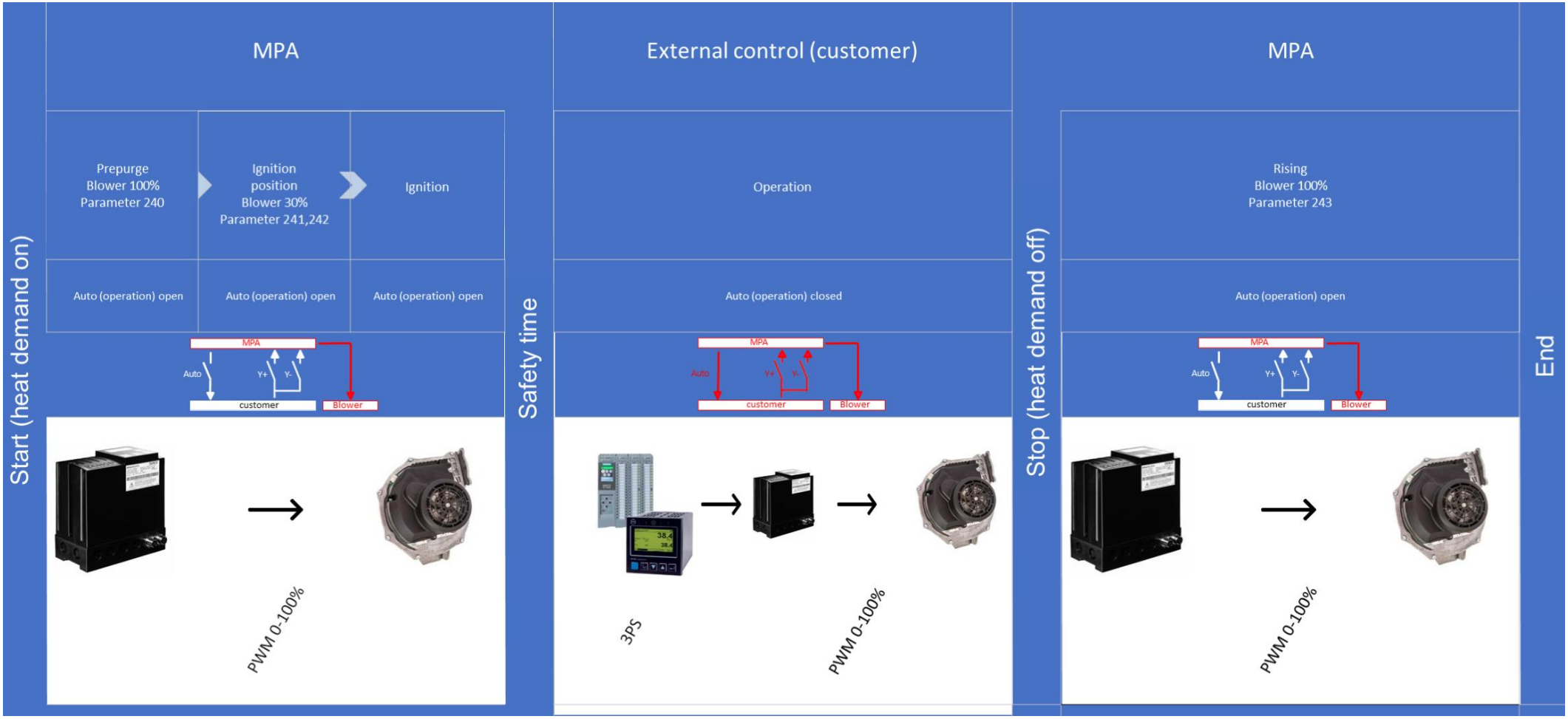
3 Standard P&ID for NFPA 86:2023 with more than 150 kBTU/H (44 kW)



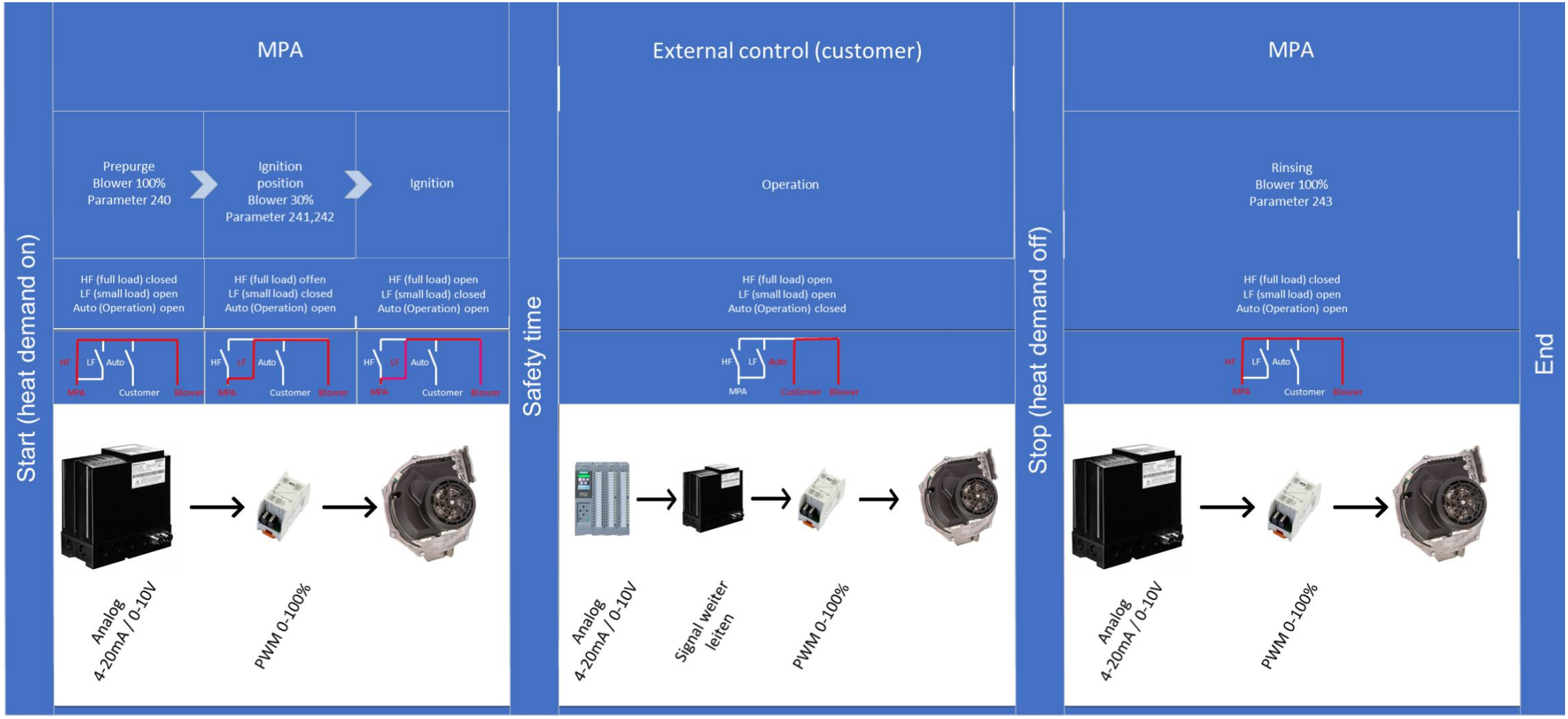
4 Standard P&ID for NFPA 86:2023 with more than 400 kBTU/H (117 kW)

Appendix 3: Block diagrams

Appendix 3.1: Block diagram 3-point step



Appendix 3.2: Block diagram analog control



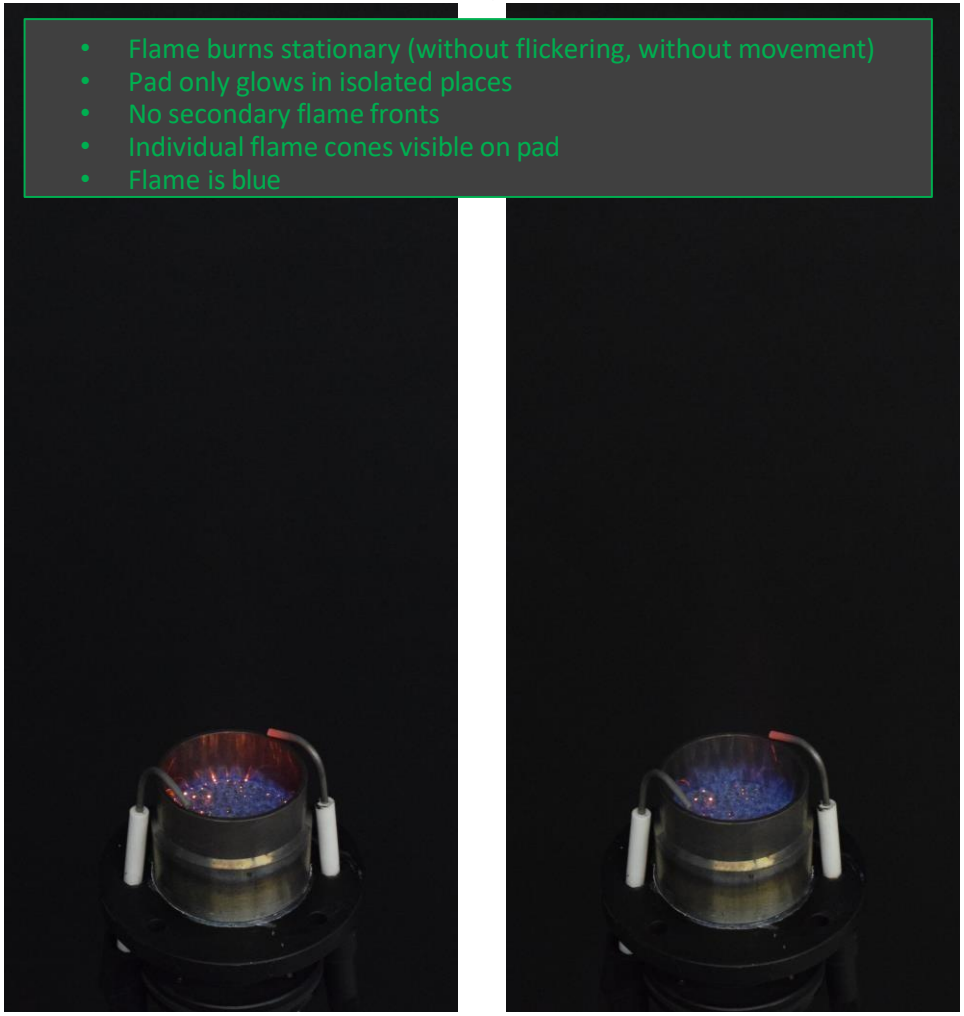
Appendix 4: Flame pattern catalogue

Appendix 4.1: Flame pattern catalogue Point-style

Point-style Correct settings

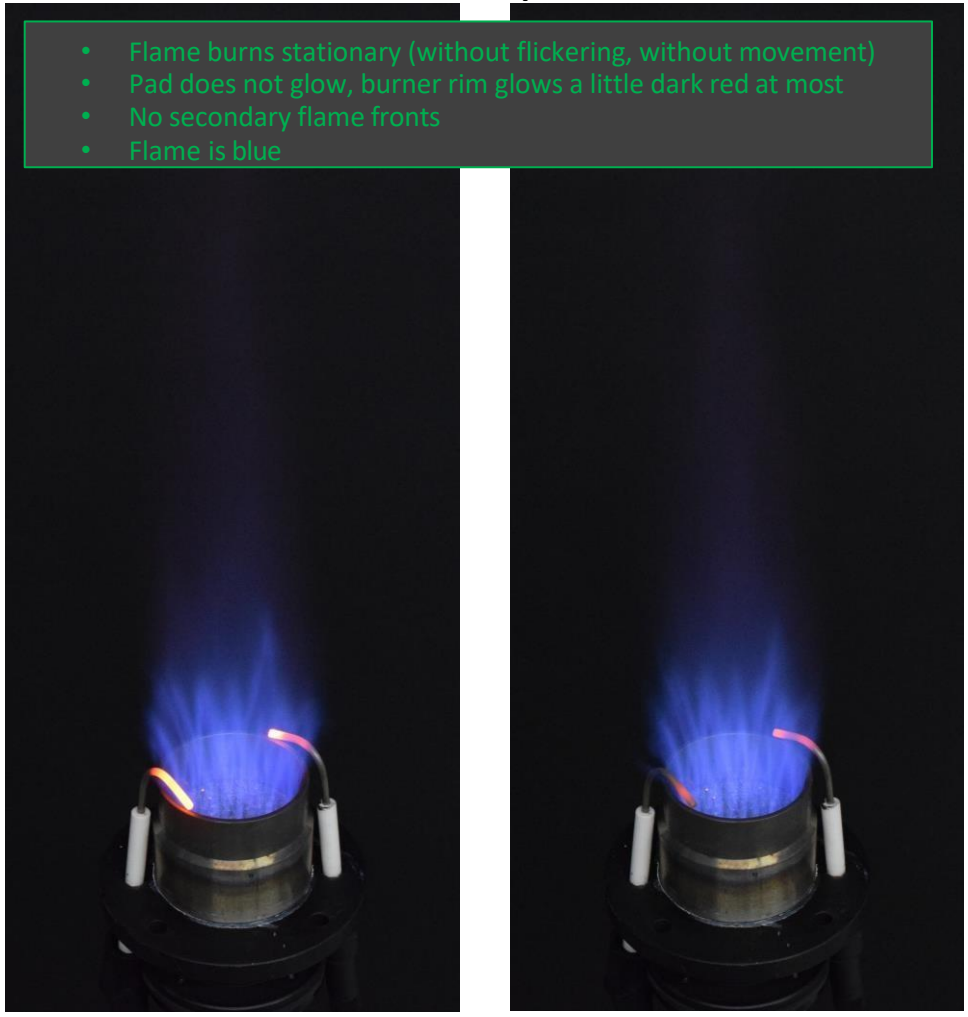
Minimum power

- Flame burns stationary (without flickering, without movement)
- Pad only glows in isolated places
- No secondary flame fronts
- Individual flame cones visible on pad
- Flame is blue



Maximum power

- Flame burns stationary (without flickering, without movement)
- Pad does not glow, burner rim glows a little dark red at most
- No secondary flame fronts
- Flame is blue

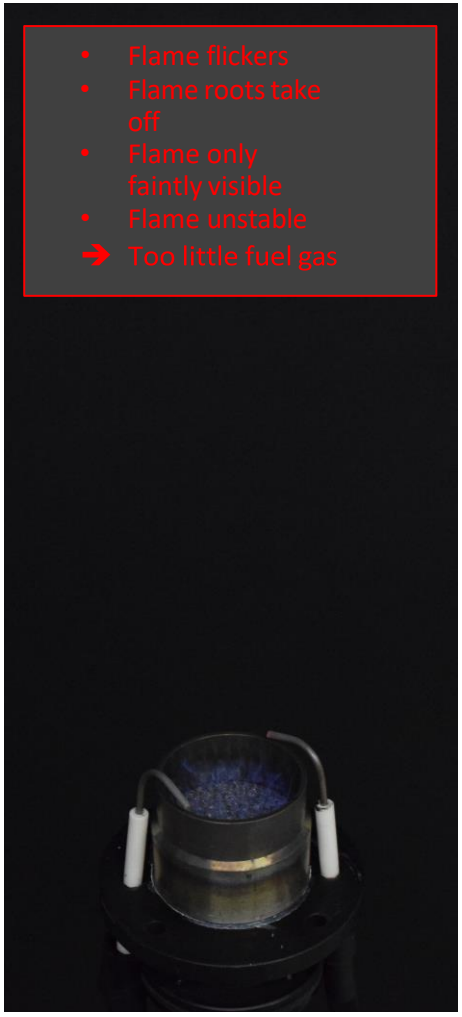


Point-style Incorrect settings

Minimum power too lean!

- Flame flickers
- Flame roots take off
- Flame only faintly visible
- Flame unstable

➔ Too little fuel gas

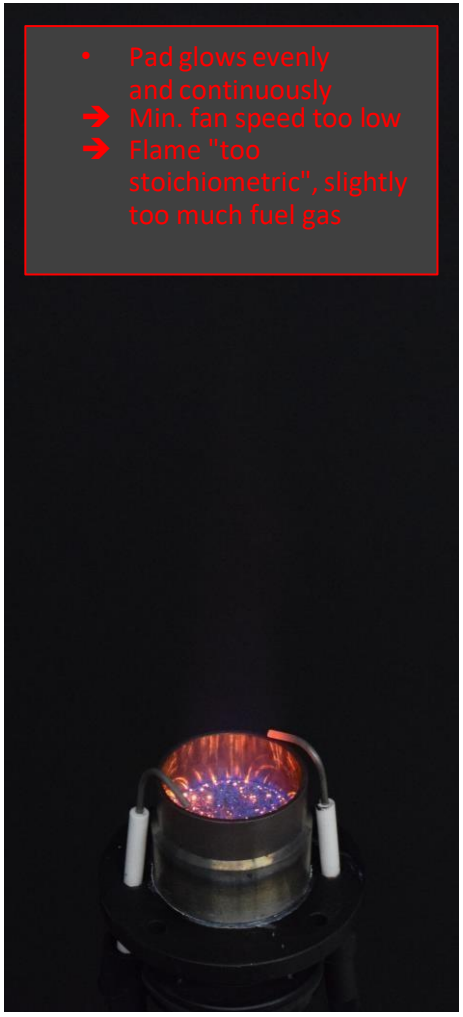


Minimum power pad glows!

- Pad glows evenly and continuously

➔ Min. fan speed too low

➔ Flame "too stoichiometric", slightly too much fuel gas



Minimum power too rich

- Flame cones on pad change from blue to turquoise-greenish
- Secondary flame front, wobbling

➔ Too much fuel gas

Point-style Incorrect settings

Maximum power too lean!

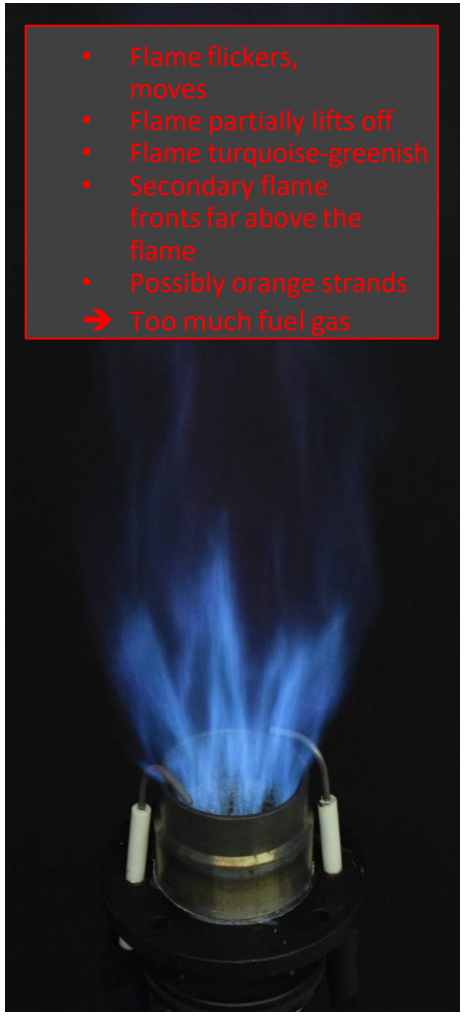
- Flame flickers, moves
- Flame partially lifts off
- Flame faint blue

➔ Too little fuel gas

Maximum power too rich!

- Flame flickers, moves
- Flame partially lifts off
- Flame turquoise-greenish
- Secondary flame fronts far above the flame
- Possibly orange strands

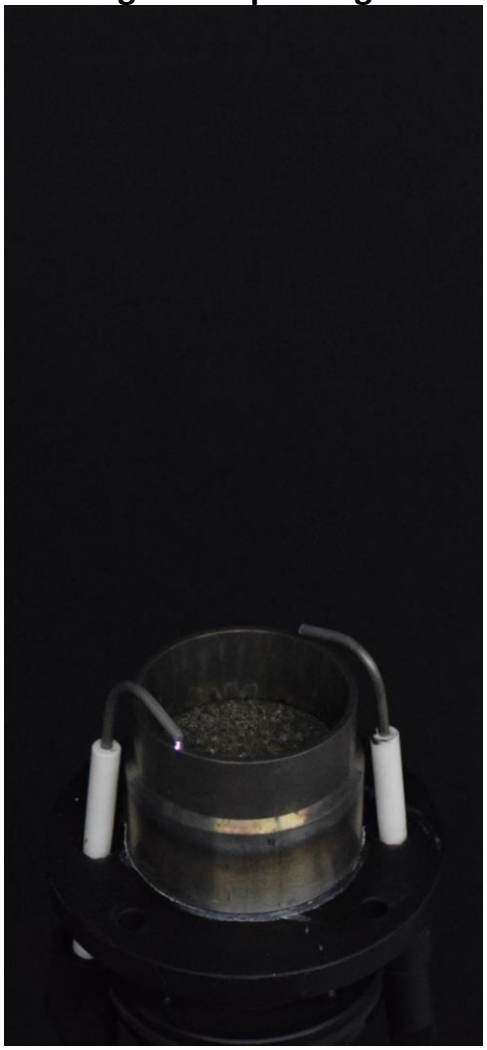
➔ Too much fuel gas



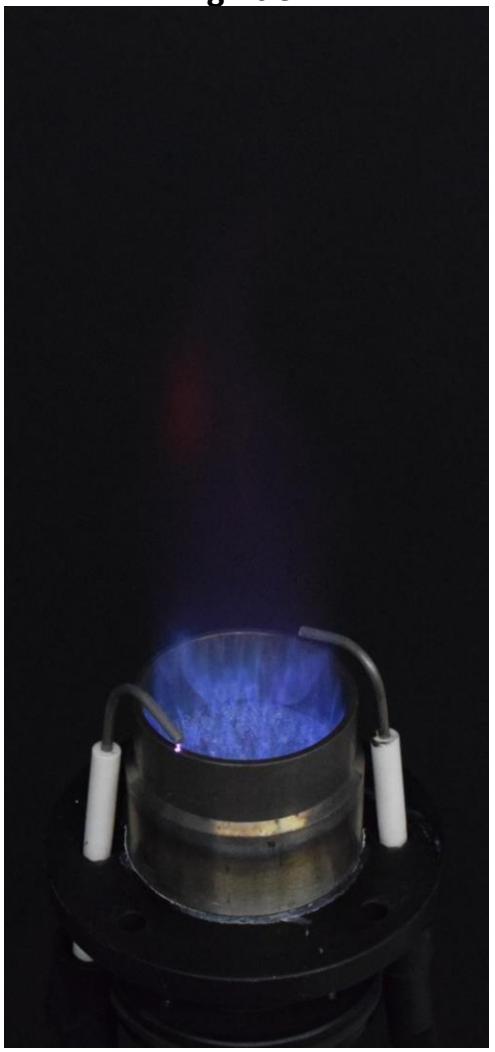
Point-style ignition sequence Correct settings

1. Pre-purge (blower max)
2. Blower on ignition power

3. Ignition spark + gas on



4. Ignition

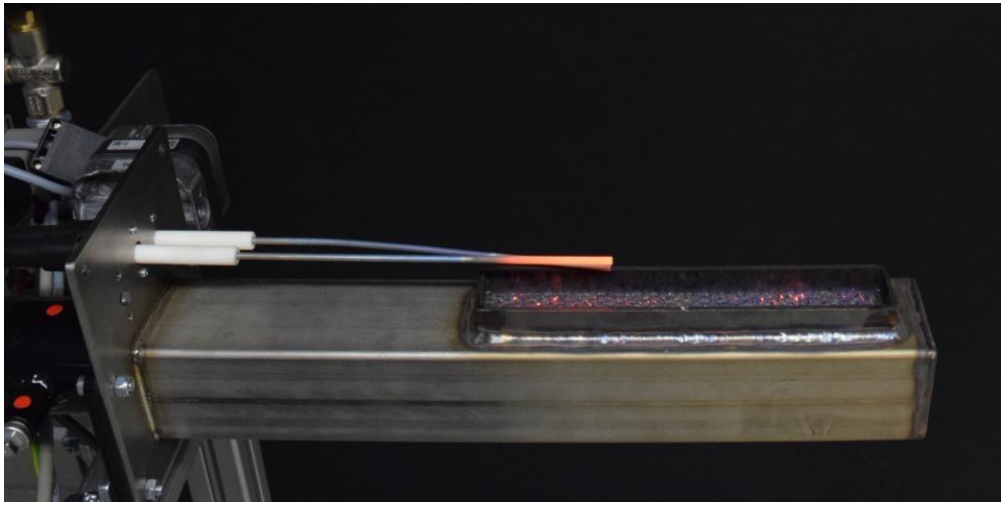


5. Stabilization

Appendix 4.2: Flame pattern catalogue Line-style

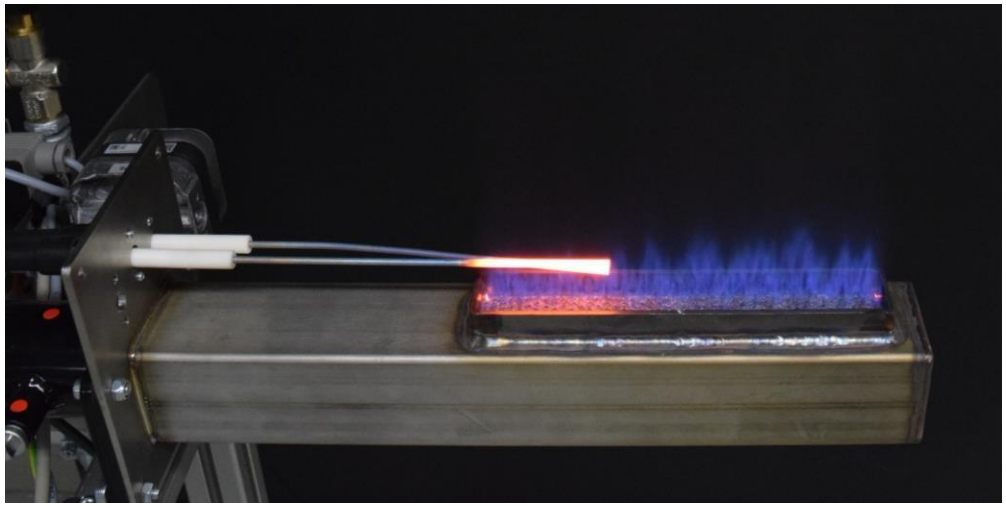
Line-style Correct settings

Minimum power



- Flame burns stationary (without flickering, without movement)
- Pad only glows in isolated places
- No secondary flame fronts
- Individual flame cones visible on pad
- Flame is blue

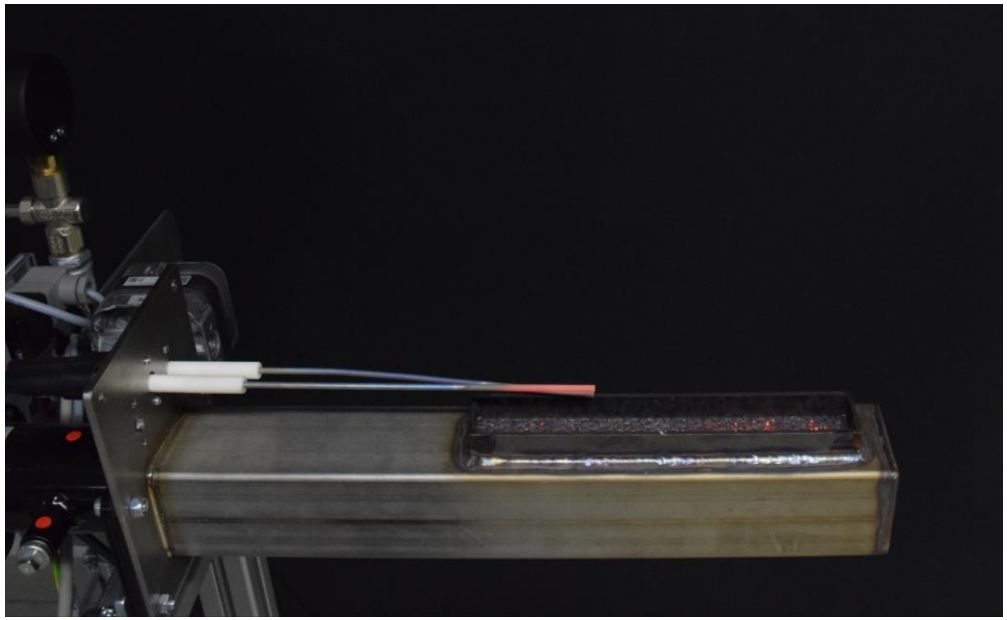
Maximum power



- Flame burns stationary (without flickering, without movement)
- Pad does not glow, burner rim glows a little dark red at most
- No secondary flame fronts
- Flame is blue

Line-style Incorrect settings

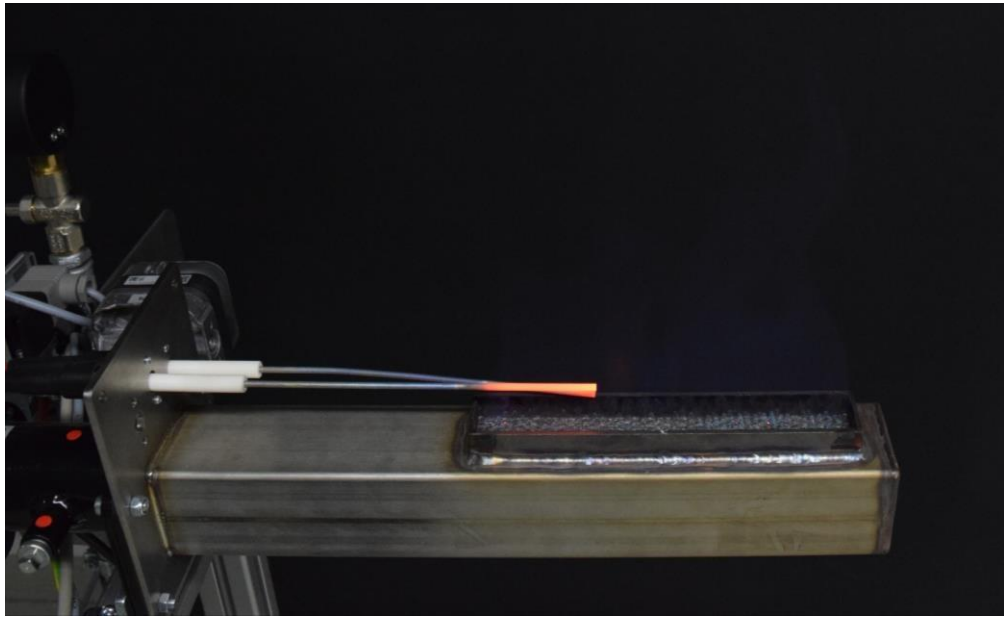
Minimum power too lean!



- Flame flickers
- Flame roots take off
- Flame barely visible
- Flame unstable

➔ Too little fuel gas

Minimum power too rich!

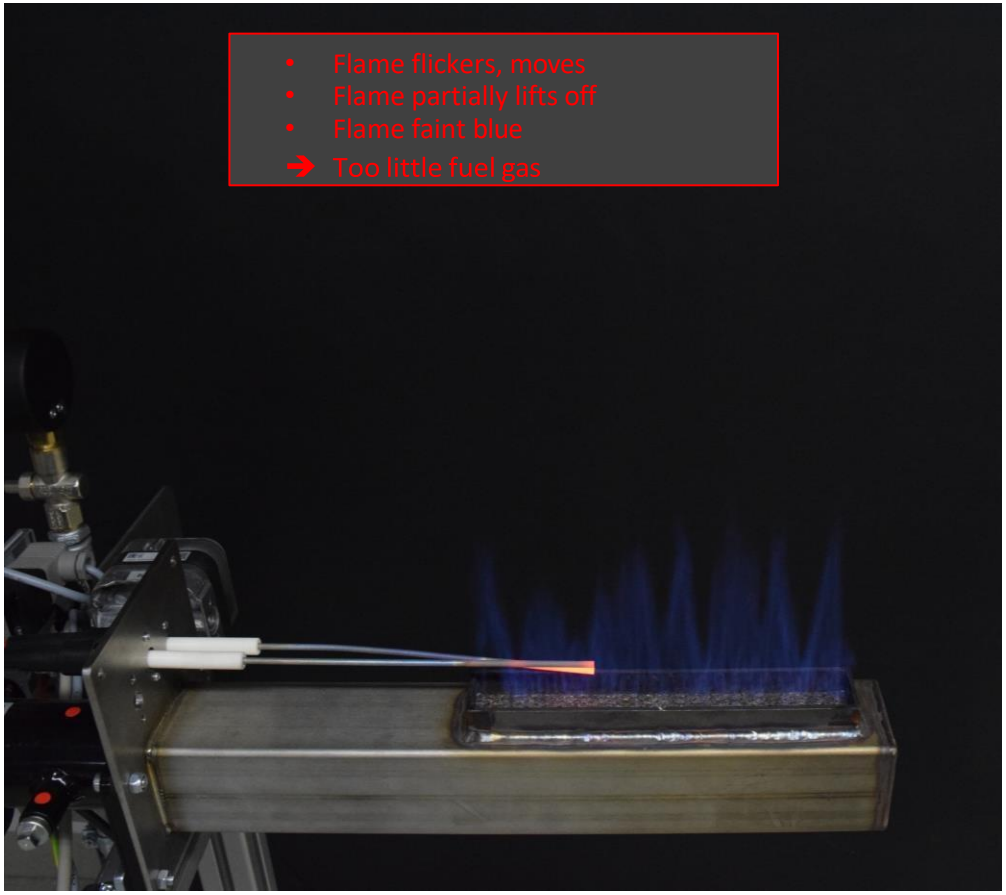


- Flame cones on pad change from blue to turquoise-greenish
- Secondary flame front, wobbling
- Possibly orange strands

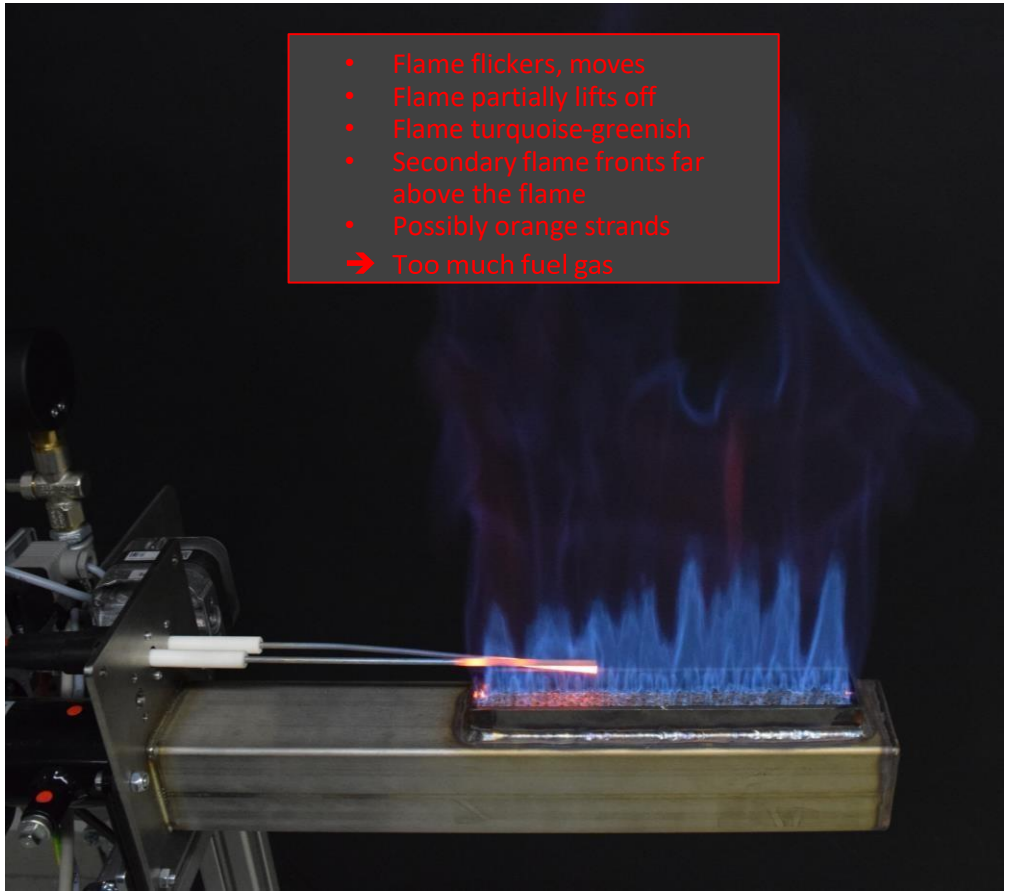
➔ Too much fuel gas

Line-style Incorrect settings

Maximum power too lean!

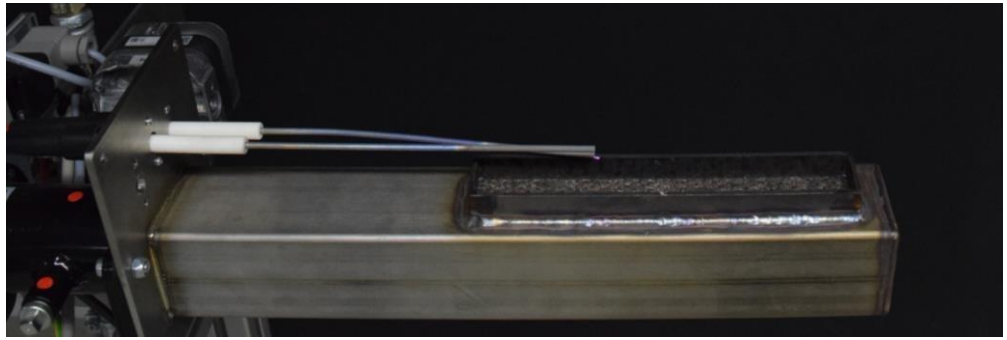


Maximum power too rich!

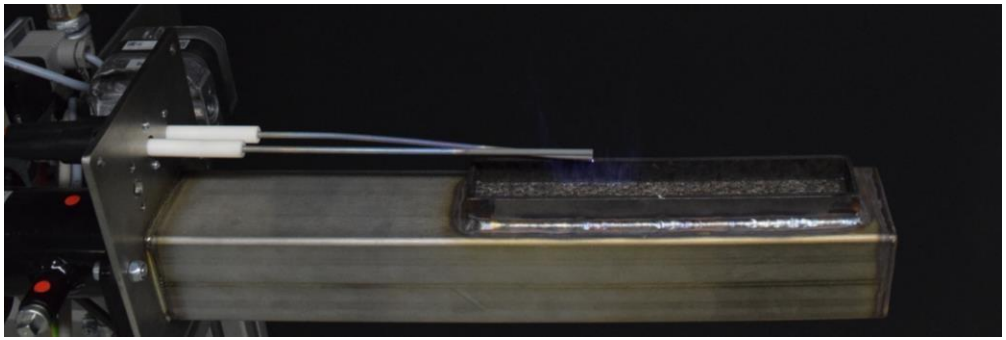


Line-style ignition sequence Correct settings

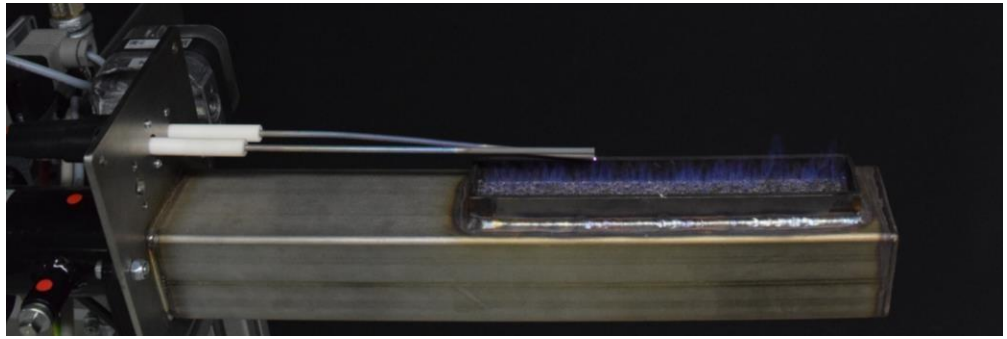
1. Pre-purge (blower max)
2. Blower on ignition power
3. Ignition spark + gas on



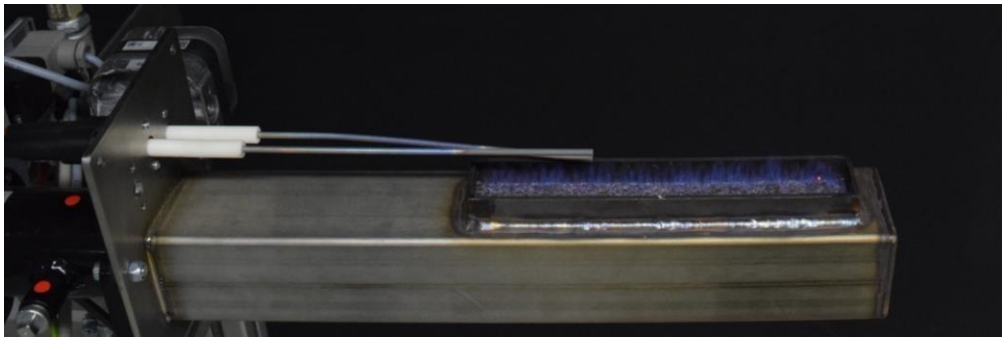
4. Local ignition



5. Through-ignition line-style burner



6. Stabilization



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