Embracing Challenge

Gas Dilution Unit

DIL-1, DIL-1/H

Instruction Manual
Version 1.01.00

Dear customer,

Thank you for buying our product. In this instruction manual you will find all necessary information about this M&C product. The information in the instruction manual is fast and easy to find, so you can start using your M&C product right after you have read the manual.

If you have any question regarding the product or the application, please don't hesitate to contact M&C or your M&C authorized distributor. You will find all the addresses in the appendix of this manual.

For additional information about our products and our company, please go to M&C's website www.mc-techgroup.com. There you will find the data sheets and manuals of our products in German and English.

With the release of this version all older manual versions will no longer be valid. The German instruction manual is the original instruction manual. In case of arbitration only the German wording shall be valid and binding.

Version: 1.01.00

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List of Illustrations

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1 GENERAL INFORMATION

The product described in this manual has been built and tested in our production facility.

All M&C products are packed to be shipped safely. To ensure the safe operation and to maintain the safe condition, all instructions and regulations stated in this manual need to be followed. This manual includes all information regarding proper transportation, storage, installation, operation and maintenance of this product by qualified personnel.

Please follow all instructions and warnings closely.

Please read this manual carefully before commissioning and operating the device. If you have any questions regarding the product or the application, please don't hesitate to contact M&C or your M&C authorized distributor.

2 DECLARATION OF CONFORMITY

CE - Certification

The product described in this instruction manual complies with the following EU directives:

EMV-Instruction

The requirements of the EU directive 2014/30/EU "Electromagnetic compatibility" are met.

Low Voltage Directive

The requirement of the EU directive 2014/35/EU "Low Voltage Directive" are met.
The compliance with this EU directive has been examined according to DIN EN 61010.

RoHS Directive

The requirements of the RoHS2 ('Restriction of Hazardous Substances 2') directive 2011/65/EU and its annexes are met.

Declaration of conformity

The EU Declaration of conformity can be downloaded from the **M&C** homepage or directly requested from **M&C**.

3 SAFETY INSTRUCTIONS

Follow these safety directions and instructions regarding installation, commissioning and operation of this device:

Read this instruction manual before starting up and use of the equipment. The information and warnings given in this instruction manual must be heeded.

Any work on electrical equipment is only to be carried out by trained specialists as per the regulations currently in force.

Attention must be paid to the requirements of VDE 0100 (IEC 364) when setting high-power electrical units with nominal voltages of up to 1000 V, together with the associated standards and stipulations.

Check the details on the type plate to ensure that the equipment is connected to the correct mains voltage.

Protection against touching dangerously high electrical voltages:
Before opening the equipment, it must be switched off and hold no voltages. This also applies to any external control circuits that are connected.

The device is only to be used within the permitted range of temperatures and pressures.

Check that the location is weather-protected. It should not be subject to either direct rain or moisture.

The device must not be used in hazardous areas.

Installation, maintenance, monitoring and any repairs may only be done by authorized personnel with respect to the relevant stipulations.

4 WARRANTY

In case of a device failure, please contact immediately M&C or your M&C authorized distributor.

We have a warranty period of 12 months from the delivery date. The warranty covers only appropriately used products and does not cover the consumable parts. Please find the complete warranty conditions in our terms and conditions.

The warranty includes a free-of-charge repair in our production facility or the free replacement of the device. If you return a device to M&C, please be sure that it is properly packaged and shipped with protective packaging. The repaired or replaced device will be shipped free of delivery charges to the point of use.

5 USED TERMS AND SIGNAL INDICATIONS

Danger

This means that death, severe physical injuries and/or important material damage **will occur** in case the respective safety measures are not fulfilled.

Warning

This means that death, severe physical injuries and/or important material damage **may occur** in case the respective safety measures are not fulfilled.

Caution

This means that minor physical injuries **may occur** in case the respective safety measures are not fulfilled.

Caution

Without the warning triangle means that a material damage may occur in case the respective safety measures are not met.

Note

These are important information about the product or parts of the instruction manual which require user's attention.

Qualified personnel

These are persons with necessary qualification who are familiar with installation, use and maintenance of the product.

High voltages!
Protect yourself and others against damage which might be caused by high voltages.

Toxic!
Acute toxicity (oral, dermal, inhalation)! Toxic when in contact with skin, swallowed or inhaled.

Corrosive!
These substances destroy living tissue and equipment upon contact.
Do not breathe vapors; avoid contact with skin and eyes.

Hot surface!
Contact may cause burn! Do not touch!

Wear protective gloves!
Working with chemicals, sharp objects or extremely high temperatures requires wearing protective gloves.

Wear safety glasses!
Protect your eyes while working with chemicals or sharp objects. Wear safety glasses to avoid getting something in your eyes.

Wear protective clothes!
Working with chemicals, sharp objects or extremely high temperatures requires wearing protective clothes.

Use foot protection

Use safety helmet and full protective goggles

6 INTRODUCTION

The non-heated or electrically heated **M&C** dilution unit **DIL-1 /(H)** is used in the analysis technique wherever the measuring method or the handling of the process gas requires a dilution of the sample gas or the components to be measured. Examples are the measurement of extremely toxic gases, the determination of the gas moisture or emission measurement.

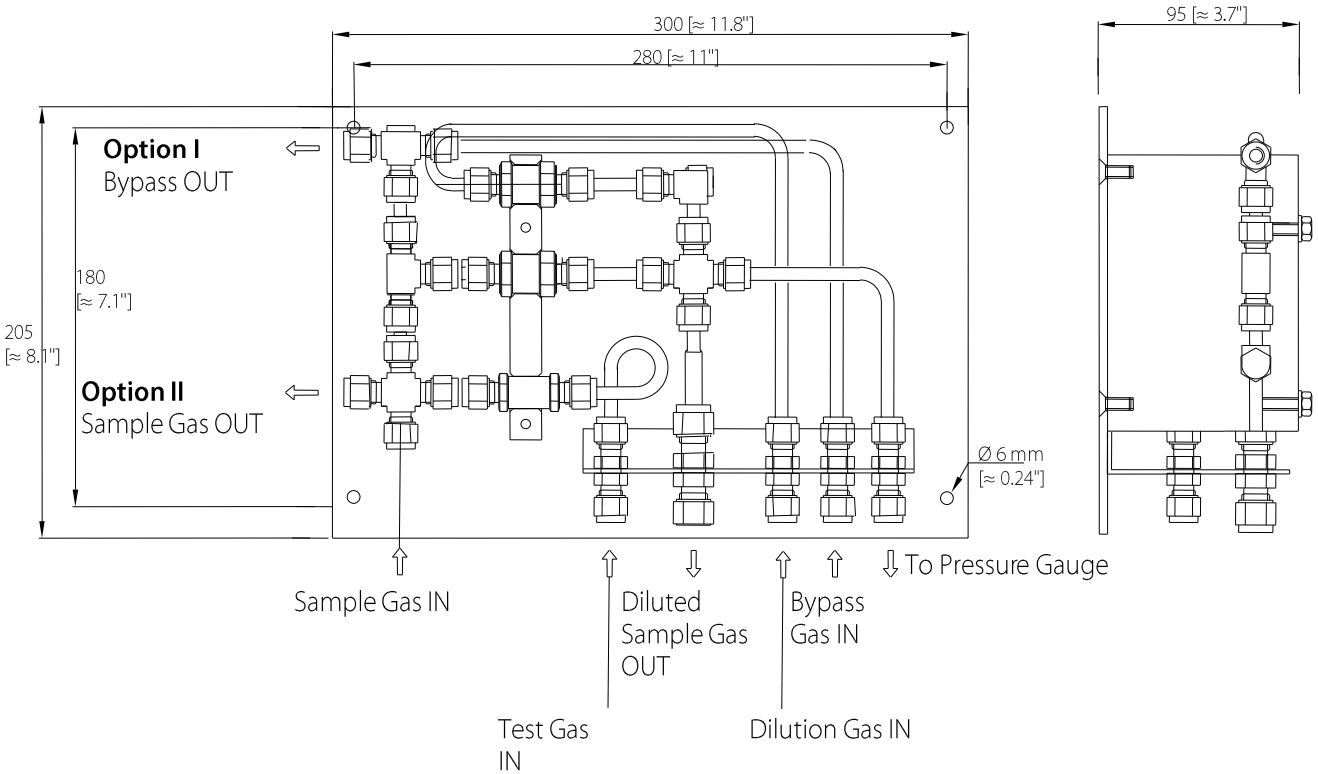
The M&C dilution unit is based on the functional dilution technique which is proved since years in the **M&C** gas sample probe **SP2000-H/DIL.**

For further information or personal advice, we have pleasure to be at your disposal. Further you may contact our internet pages with our complete product catalogue under:

www.mc-techgroup.com

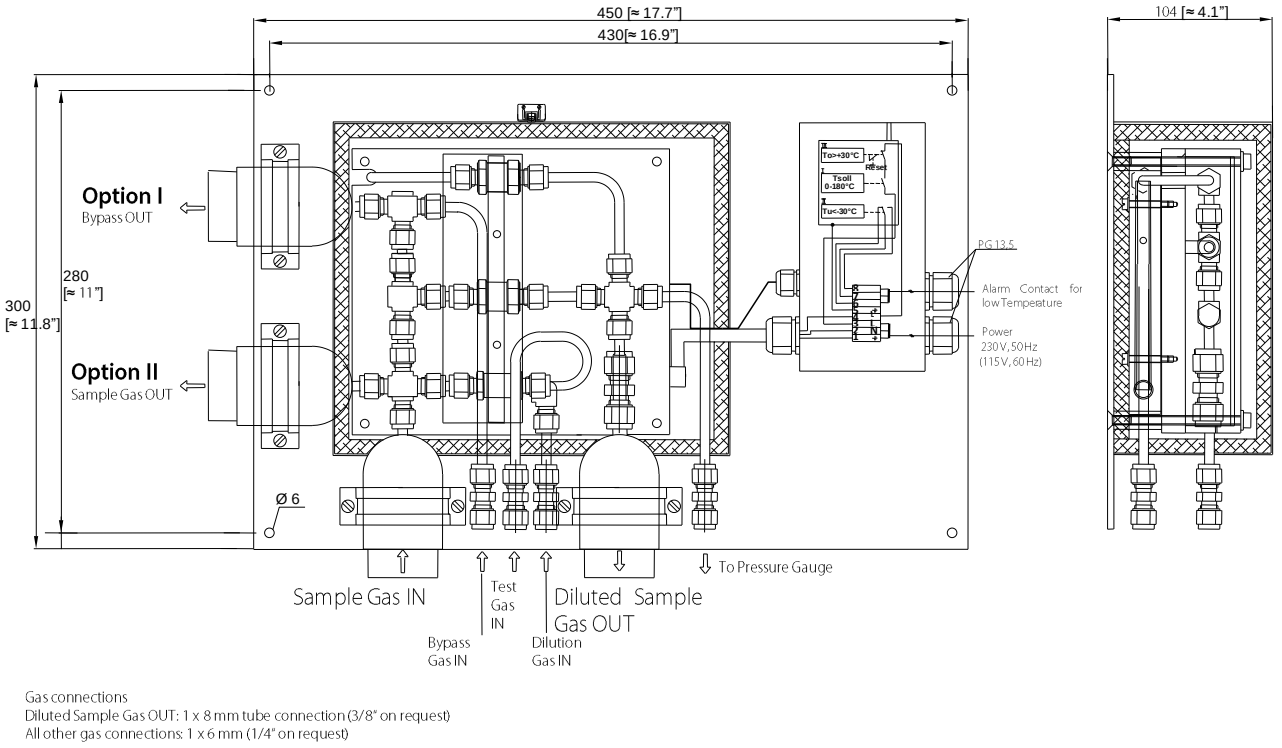
7 APPLICATION

The following illustrations show versions **DIL-1** and **DIL-1/H**.



Gas connections
Diluted Sample Gas OUT: 1 x 8 mm tube connection (3/8" on request)
All other gas connections: 1 x 6 mm (1/4" on request)

Figure 1 Dilution unit DIL-1



Gas connections
Diluted Sample Gas OUT: 1 x 8 mm tube connection (3/8" on request)
All other gas connections: 1 x 6 mm (1/4" on request)

Figure 2 Dilution unit DIL-1/H

The **M&C** dilution units **DIL-...** are mounted on a plate for wall mounting. The operating temperature of the non-heated version **DIL-1** is the ambient temperature. Version **DIL-1/H** is heated up to 180 °C and is equipped with a heat insulated cover (Version for 320 °C on request).

The temperature is regulated by an integrated capillary thermostat, adjustable from 0-180 °C, including an excess temperature limiter and a low temperature alarm. (Optional: Temperature sensor PT100 or thermocouple "K" for external temperature controller on request)

The connection of the heated lines is made without cold bridges into the heated part. Before the dilution gas enters the dilution unit, it is heated up to the operating temperature via a gas pre-heater. In order to protect the dilution part against contaminations, internal protective filters are installed for the sample gas and the dilution gas stream.

For calibration of the analyzer, test gas can be supplied via the integrated test gas connection. A precision pressure controller with manometer is used for adjustment of the necessary dilution gas admission pressure. Via a vacuum pressure gauge, the function of the dilution injector is controlled. Both, pressure controller and pressure gauge have to be ordered separately. Two versions are available: Set **-A (-A1)** for direct mounting on the mounting plate and control panel type **-S (-S1)** for external 19" rack mounting. A shut-off valve and a flowmeter for adjustment of the calibration gas are included in the version **–S (-S1).**

The dilution unit can realize dilution ratios of 10:1 to 500:1. In case of high dilution ratios, a respective small quantity of gas is sampled from the process. Optionally, a bypass injector **–B** (Option **I**) is available in order to shorten the response time in case of operation with atmospheric pressure. The bypass injector is integrated right in front of the dilution unit.

The pressure regulator versions **–A / -S** include a pressure regulator with manometer for the dilution gas as well as a manometer for control of the depression on the critical orifice. In case of option **I,** an additional pressure controller with manometer is included in both mounting versions **-A1 / -S1.**
The construction of the dilution unit guarantees easy operation and maintenance being independent from process temperature.

7.1 VARIATIONS

The two basic versions **DIL-1** and **DIL-1/H** can be extended by several options.

Option I
Includes a bypass for dilution gas with bypass injector for a fast suction of sample gas in order to shorten for example the response time in case of high dilution ratios.

Option II
Includes an additional sample gas outlet "non-diluted".

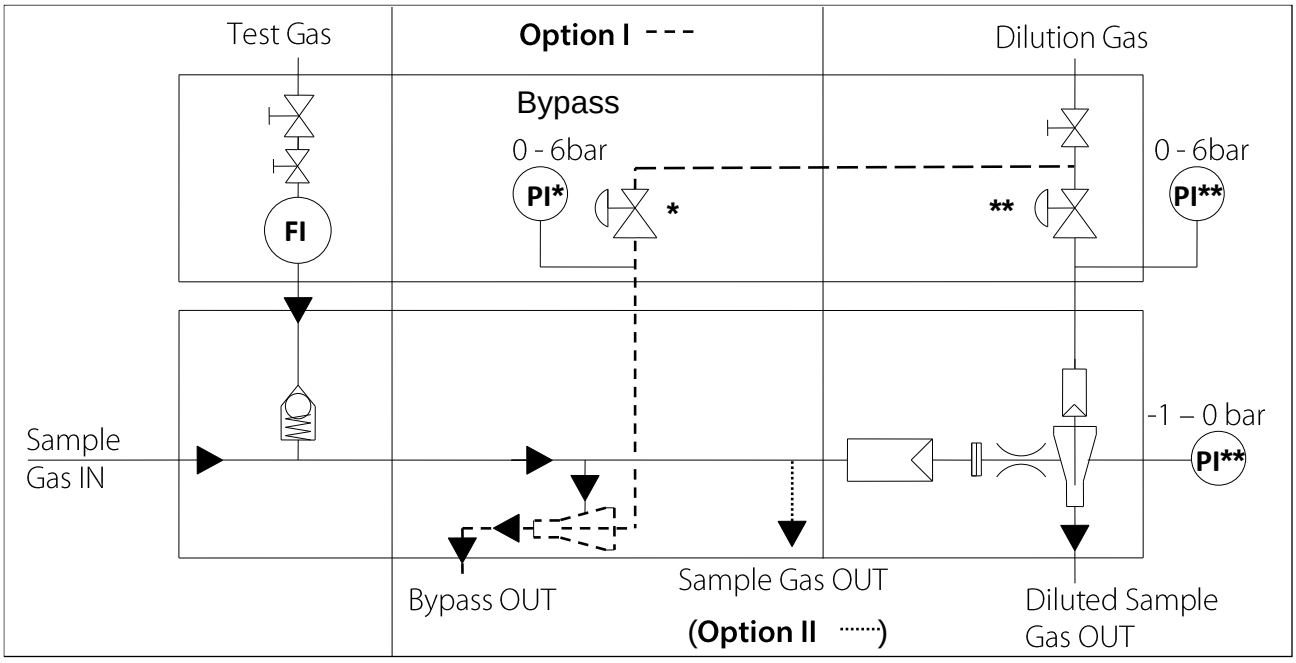
Option –A
Includes a pressure regulator with manometer and a manometer for control of the low pressure on the critical orifice. These are mounted directly onto the dilution unit. (see figure 6).

Option –A1
Includes in addition to option -A a pressure regulator with manometer for operating the bypass of option I. This option is also mounted directly onto the dilution unit (see figure 6).

Option –S
Includes the necessary pressure regulator with manometer, shut-off valves and flowmeter, incorporated externally in a 19" control panel (see figure 5). The connection of the sampling or the supply lines to the downstream analysis system have to be executed by the client. Connections which are marked accordingly are available on the back side of the 19" unit.

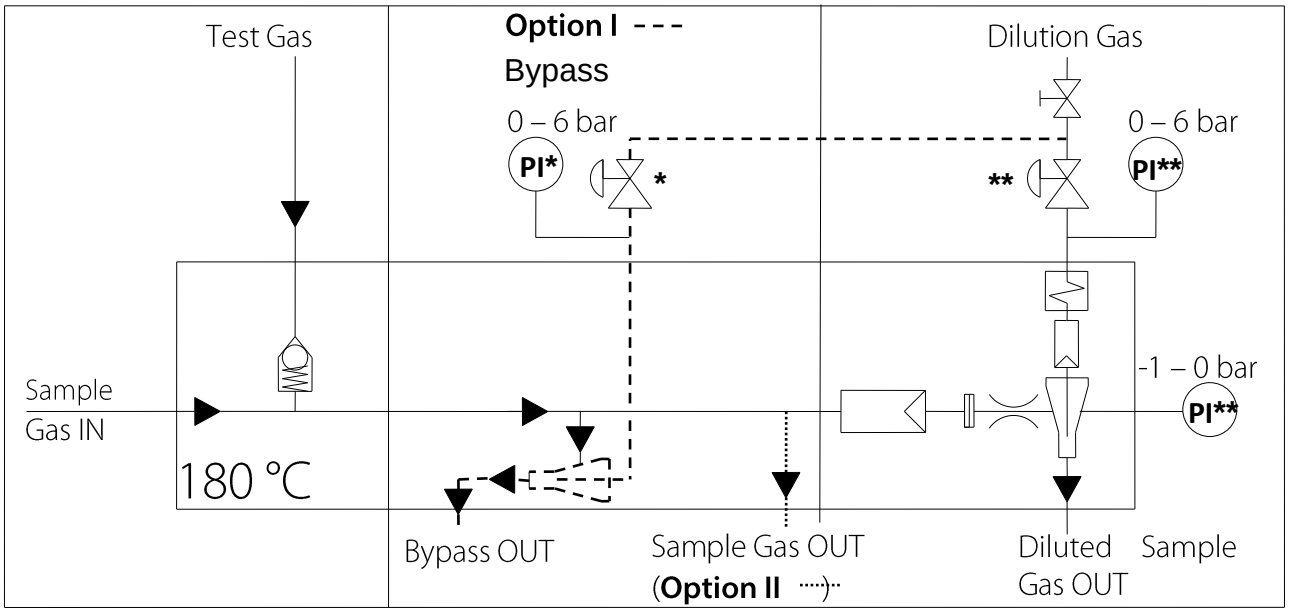
Option –S1
Includes in addition to option -S the pressure regulator with manometer for operating the bypass of option I, mounted externally into the 19" control panel (see figure 5). The connection of the sampling or supply lines to the downstream analyse system has be made by the client. Connections which are marked accordingly are available on the back side of the 19" unit.

The following illustrations show the gas flow of the dilution units **DIL-1** and **DIL-1/H** with all possible options.



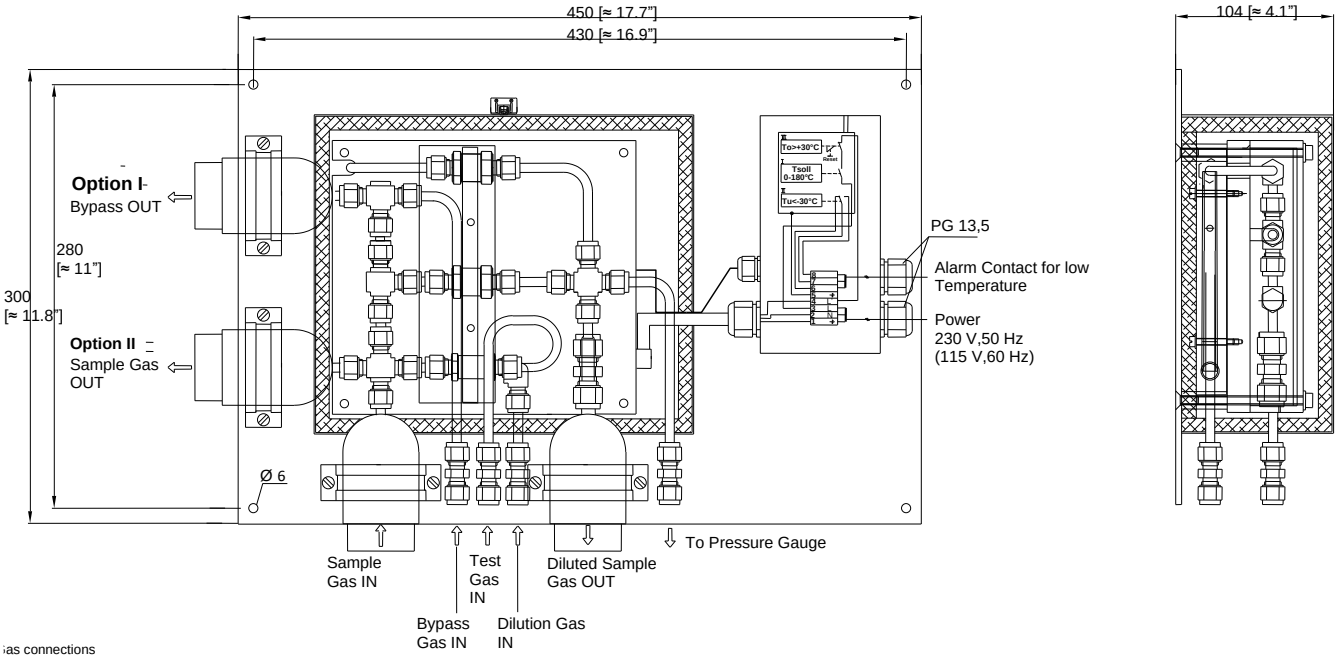
** Components for version/control panel -A or -S
* Additional components for -A or -S for version/control panel -A1 or -S1

Figure 3 **Gas flow diagram DIL-1 with possible options**



** Components for version/control panel -A or -S
* Additional components for -A or -S for version/control panel -A1 or -S1

Figure 4 **Gas flow diagram DIL-1/H with possible options**



as connections
iluted Sample Gas OUT: 1 x 8 mm tube connection (3/8" on request)
ll other gas connections: 1 x 6 mm (1/4" on request)

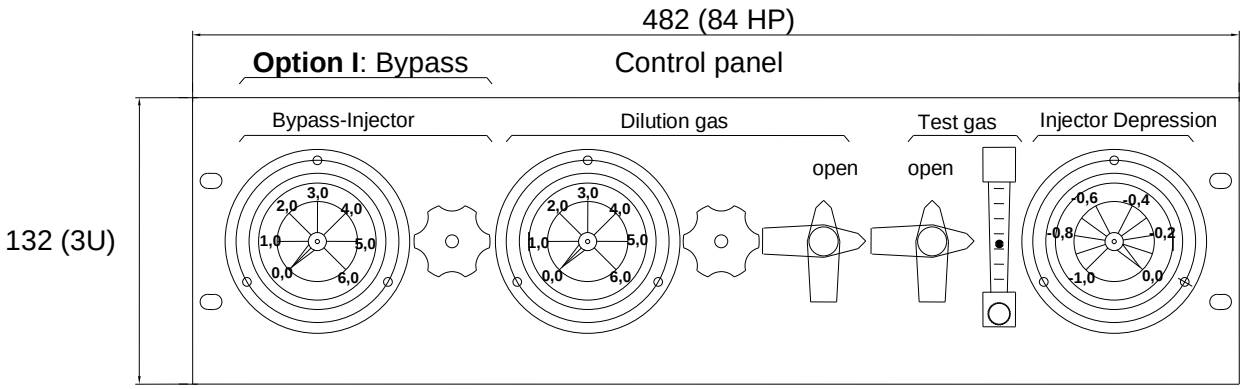
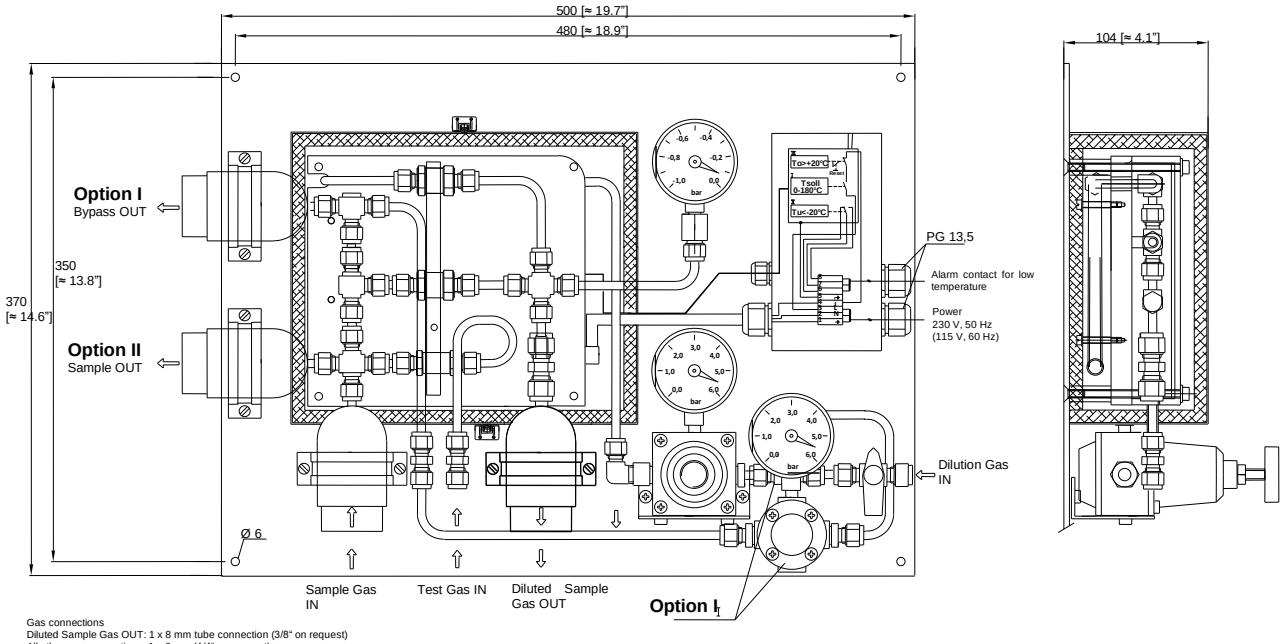


Figure 5 Dilution unit DIL-1/H with control panel –S or -S1



Gas connections
Diluted Sample Gas OUT: 1 x 8 mm tube connection (3/8" on request)
All other gas connections: 1 x 6 mm (1/4" on request)

Figure 6 Dilution unit DIL-1/H with set -A or -A1

8 TECHNICAL DATA

Dilution ratios of the critical orifices “a“ to “g“	a	b	c	d	e	f	g
	500	200	100	50	30*	20	10:1
Sample flow rate with critical orifices “a“ to “g“	1.4	2.7	5.5	11	19*	28	55 l/h[1)]
Possibility to adapt the dilution factor	With dilution gas pressure adjustment -5 % to +30 %[2)]						
Dilution gas flow rate with injector version I or II	I: 480 - 600 Nl/h, optional II: 1800 – 3000 Nl/h						
Dilution gas pressure on inlet of pressure controller	Min. 4.5 bar, max. 16 bar						
Bypass injector /B: pressure / Gas consumption / flow rate	Approx. 2 bar : injector gas approx. 300 l/h : sample gas approx. 150 l/h						
Process pressure	0.9 to 2 bar abs. at constant pressure						
Fault caused by process temperature variations	No fault, operation independent of process temperature						
Fault caused by process low or over pressure	Influence negligible at pressure changes ≤ 200mbar and if test gas is given to the probe under process conditions. Otherwise proportional to pressure changes.						
Fault caused by atmospheric pressure variations	< 1 % with a variation of 50 mbar						
Material in contact with the sample gas	Stainless steel 316Ti, quartz glass, FKM, graphite						
Power supply for DIL-1/H	230 V 50 Hz, (optional 115 V 60 Hz), 800 W						
Temperature controller for DIL-1/H	Capillary thermostat adjustable 0 - 180 °C, with excess temperature limiter and low temperature alarm as changeover contact, potential free alarm point T30 °C to T_{Set}, contact rating max. 250 V 3 A~ 0.25 A =						
Weight	Approx. 8 kg						

* Standard, others to be indicated along with order, intermediate values possible.
[1)] Approx at 3 bar dilution gas.
[2)] -5 %, however not possible with orifice “g“.
Please note: Nl/h and Nl/min refer to the German standard DIN 1343 and are based on these standard conditions: 0 °C [32 °F], 1013 mbar.

Type	**M&C Dilution unit DIL-1/(H) with orifice “e“, dilution ratio 30:1, Standard**
DIL-1	Dilution unit non heated
DIL-1/H(a)	Dilution unit electrically heated to 180 °C, (a) = voltage 115 V 60 Hz
Option I	Bypass injector **–B**
Option II	Additional sample gas outlet undiluted
DIL-1/..-A	Option: mounting set for dilution unit, 1 pressure controller and 2 manometers
DIL-1/..-A1	Option: mounting set for dilution unit/Bypass injector, 2 pressure controllers and 3 manometers
DIL-1/..-S	Option: control panel with 1 pressure controller, 2 manometers, flowmeter, 2 shut-off valves
DIL-1/..-S1	Option: control panel with 2 pressure controller, 3 manometers, flowmeter, 2 shut-off valves

9 DILUTION PRINCIPLE

The functional principle of the dilution unit is based on ultrasonic flow through a critical orifice (see Fig. 4). The flow through the orifice is constant when the differential pressure via the orifice is higher than 500 mbar. For the atmospheric inlet pressure (P_{IN} = 1020 mbar), this means a pressure at the orifice outlet (P_{OUT}) of less than 520 mbar absolute.
The necessary vacuum at the orifice outlet is produced by an injector operated with dilution gas.

Depending on the critical orifice selected, dilution rates can be between 10:1 and 500:1. The table below gives an overview of the dilution factor and sample gas volume using the injector I (480 – 600 Nl/h):

Orifice type	**a**	**b**	**c**	**d**	**e**	**f**	**g**
Dilution ratio*	500:1	200:1	100:1	50:1	30:1	20:1	10:1
Volume flow through the orifice [Nl/h]	1.4	2.7	5.5	11	19	28	55

* with Injector II 50:1 to 2000:1 at 1800 to 3000 Nl/h

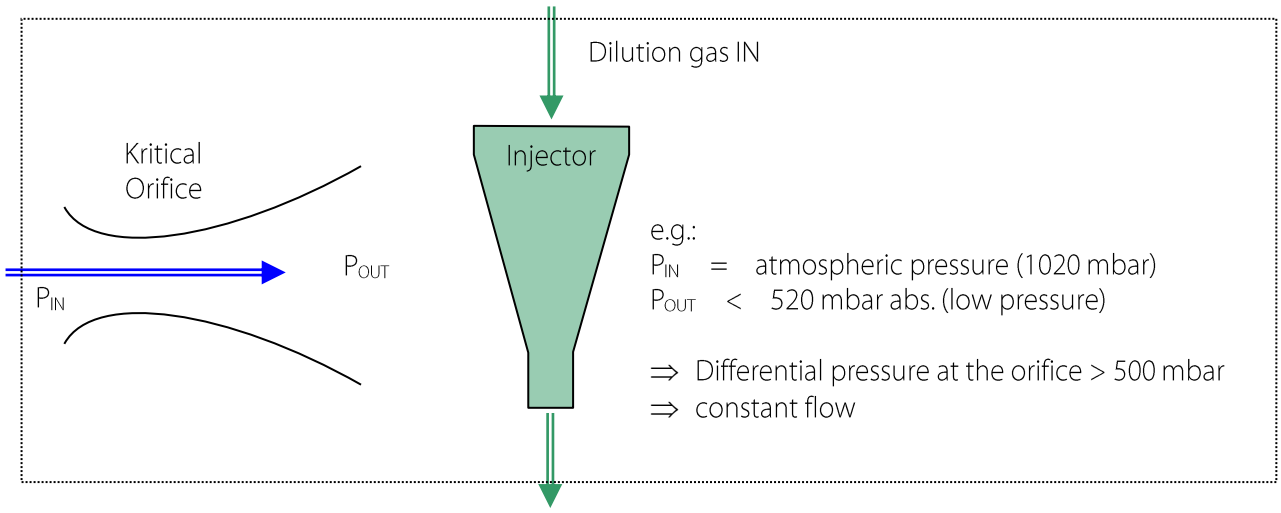


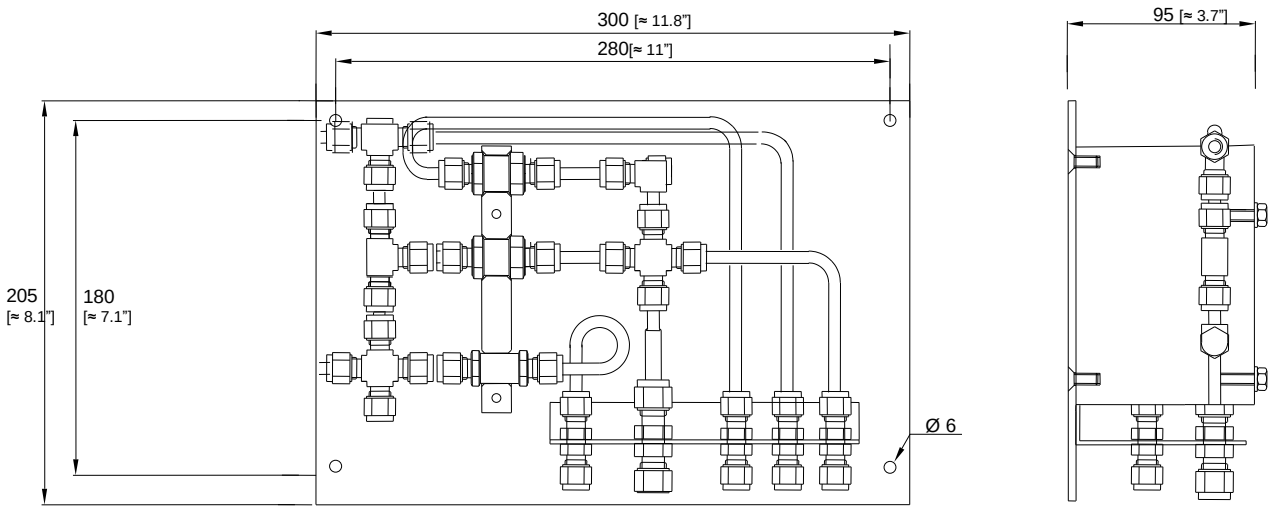
Figure 7 Dilution principle

How to check the dilution ratios and the exact adjustment of the pressure conditions are described in chapter 15.1.

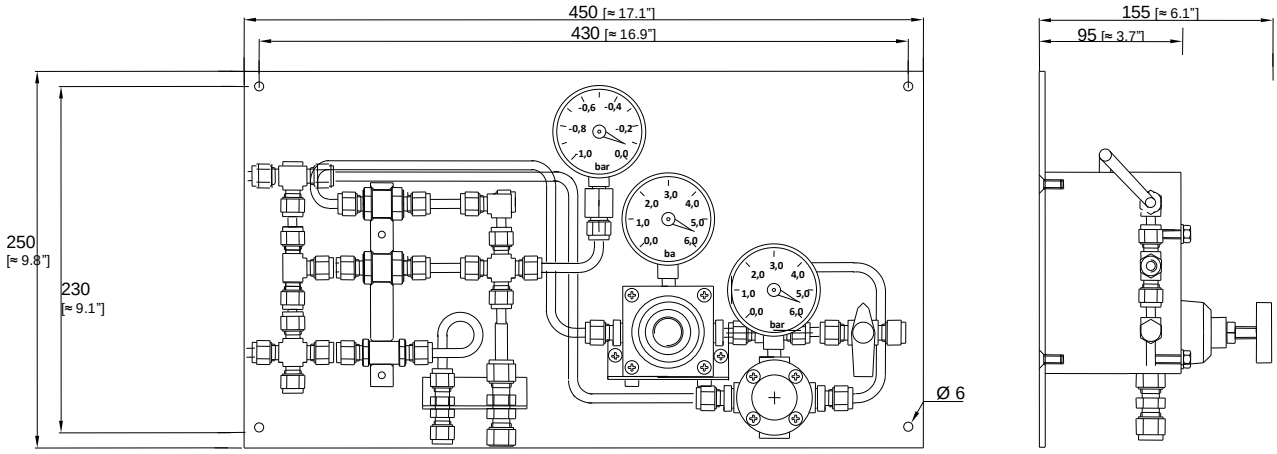
10 DIMENSIONS

The following illustration shows the dimensions of the dilution units **DIL-1** and **DIL-1/H**.

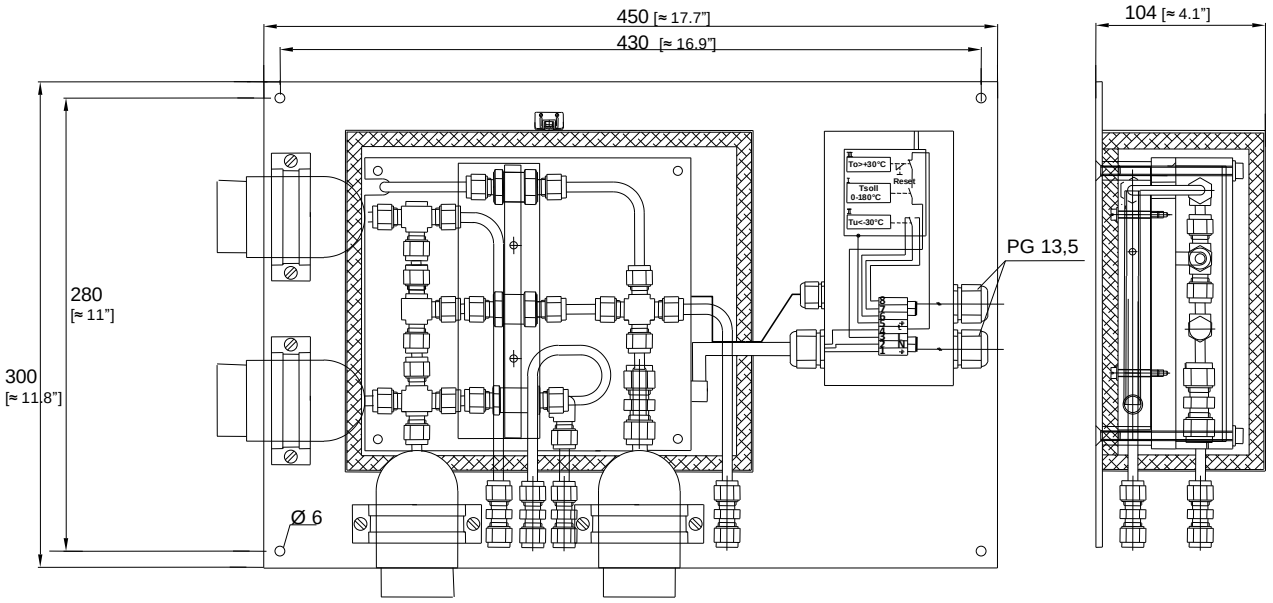
DIL-1:



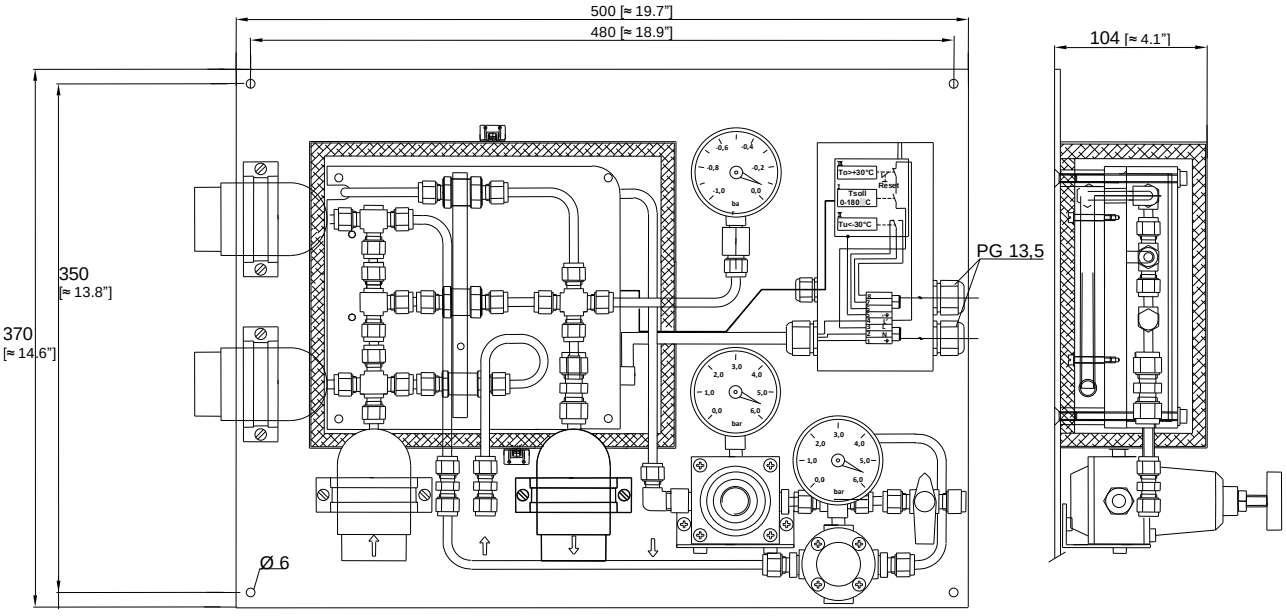
DIL-1 with /A or /A1:



DIL-1/H:



DIL-1/H with /A or /A1 :



Option control panel –S or -S1:

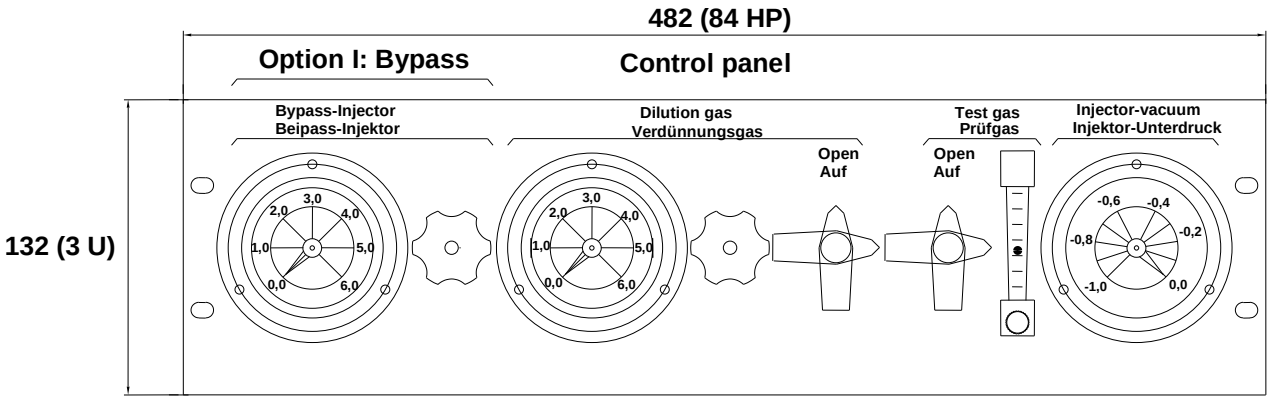


Figure 8 Dimensions (mm) dilution units DIL–1.. and control panel –S or –S1

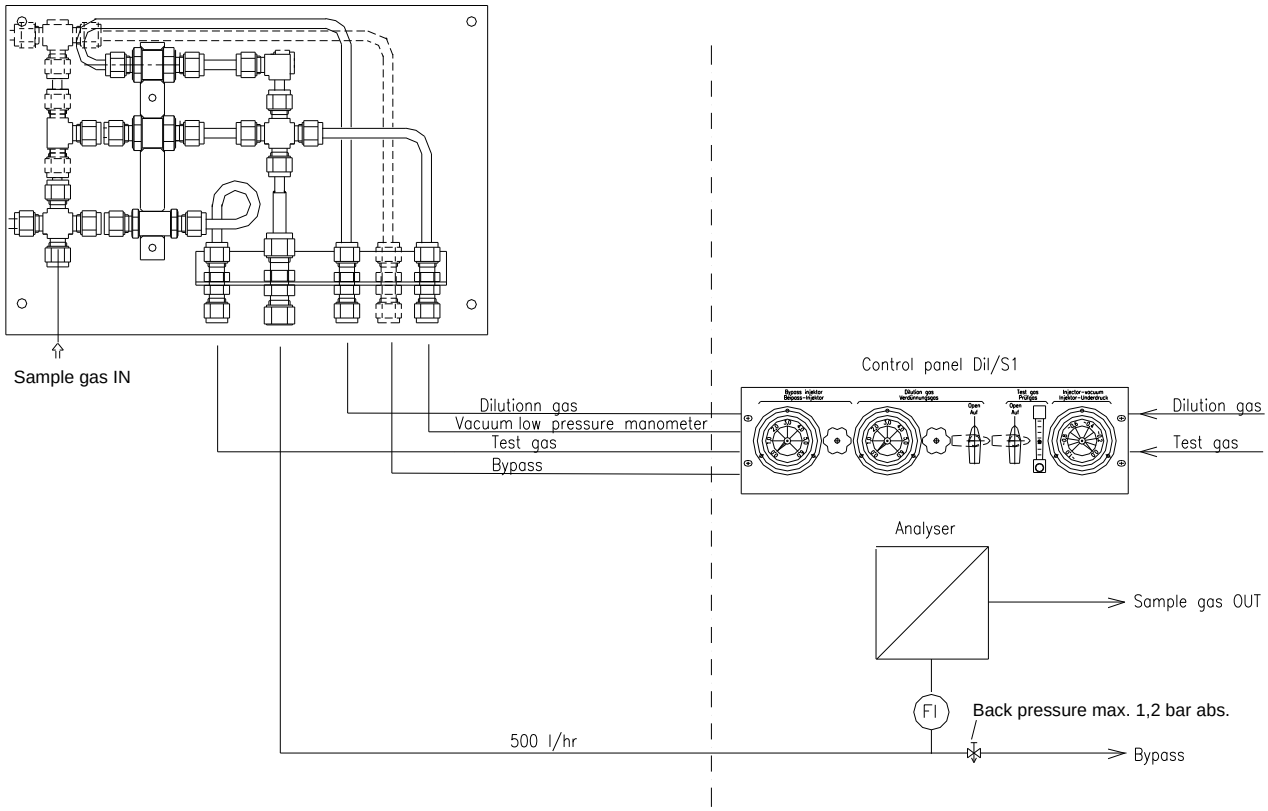


Figure 9 DIL-1 with control panel -S1

11 RECEIPT AND STORAGE

- Carefully remove the dilution unit and any accessories from the transport packaging immediately after receipt and check the completeness of the delivery against the packing list.
- Check the goods for possible transport damage and, if necessary, notify immediately your transport insurer of any damage.

Note

The dilution unit should be stored in a protected, frost-free room!

12 INSTALLATION INFORMATION

The safety rules and regulations for the prevention of accidents must be observed during installation and also subsequent operation. The information in chapter 3 "Important Safety Information" must be observed.

The following also applies:

- Select the optimal sampling point according to the generally applicable directives or coordinate with the responsible departments.

Note

The dilution unit must be checked for its suitability for use with the available operating parameters prior to installation (see type plate).

13 INSTALLATION

The **M&C** dilution units **DIL-1...** are designed for stationary use. With correct selection of the sample point and proper installation, they will work for many years with a minimum of maintenance required.

13.1 CONNECTION OF THE SUPPLY OR SAMPLE LINES

Note

Increases of pressure due to use of long sample gas lines at the outlet may have a great influence on the measuring result. For this reason, we recommend the following nominal widths and lengths for the sample lines in dependence on the type of injector:

Injector type I:

$Ø_i$ 6 mm	max. 50 m
$Ø_i$ 8 mm	max. 150 m

Injector type II:

$Ø_i$ 8 mm	max. 15 m
$Ø_i$ 10 mm	max. 40 m
$Ø_i$ 12 mm	max. 80 m

The connections for the supply and sample lines are as follows:

Connection	Dimension
Sample Gas IN	Tube 6 x 1 mm
Testgas IN	Tube 6 x 1 mm
Dilution Gas IN	Tube 6 x 1 mm
Low pressure manometer	Tube 6 x 1 mm
Diluted Sample Gas OUT	Tube 8 x 1 mm
Option I:	
Bypass Gas IN	Tube 6 x 1 mm
Bypass Gas OUT	Tube 6 x 1 mm
Option II:	
Sample gas OUT	Tube 6 x 1 mm

13.2 CONNECTION OF SAMPLE GAS AND HEATED SAMPLE LINES

All connections for the sample gas or heated sample lines are tube connectors out of stainless steel suitable for connection of stainless steel tubes or hose pipes with dimension 6 x 1 mm. Only the outlet of the diluted sample gas is dimensioned for stainless steel tube or flexible tube of 8 x 1 mm.

Note

When connecting hose pipes to stainless steel fittings, a supporting sleeve must always be used.
The connection must be checked for tightness.

The connection to the non-heated versions **DIL-1** is made directly to the respective fittings (see Figure 1).

The connection of the heated sample lines to the heated versions **DIL-1/H** is shown in Figure 2.

- Remove the protective cover
- Open the fastening clamp
- Mount the hose pipe or tube to the respective fittings
- Shut the fastening clamp again
- Install the protective cover again.

13.3 CONNECTION OF DILUTION GAS OR BYPASS GAS

For connection of the supply lines, tube connectors with dimension of 6 x 1 mm are available. The connection fittings of the heated dilution units are located outside the cover and can be connected without disassembly. Only when using the heated versions and option I, a heated "undiluted" sample line is connected to the bypass outlet. Please act as follows:

- Remove protective cover
- Open the fastening clamp
- Mount the hose pipe or tube to the respective fitting
- Shut the fastening clamp again
- Install the protective cover again.

When using option **–A** (only dilution gas) or **–A1** (dilution and bypass gas), the supply lines are connected to the connection fittings of the precision pressure regulator.

When using the 19" control panels **–S** or **–S1**, corresponding connectors for the supply gases are provided at the rear of the unit.

13.4 CONNECTION OF CALIBRATION GAS

For all versions of **DIL-1** and **DIL-1/H**, a tube connector 6 x 1 mm is available for connection of the calibration gas (see figure 4).

13.5 ELECTRICAL CONNECTION

The temperature setting on the dilution unit **DIL-1/H** is made on the internal capillary thermostat.

Warning

The incorrect mains voltage can destroy the unit. Check the type plate for the correct voltage prior to connection!

The dilution units must be mounted in such a way that touching the live parts is excluded!

In any case, we recommend the use of temperature resistant cables!
The alarm contact for low temperature must be monitored!

In case of a low temperature alarm (failure of heating or sensor) the dilution gas or bypass gas supply must be interrupted to avoid serious damage of the dilution unit. We recommend switching the low temperature alarm onto external solenoid valves that provide the above mentioned function!

For the erection of power installations with nominal voltages of up to 1000V, the requirements of VDE 0100 and its associated standards and specifications must be observed.
A main switch must be provided externally.

Note

The supply circuit of the unit must be equipped with a fuse with the correct rating (over current protection); the electrical details see technical data.

- Remove cover of the connection box.
- Insert the mains cable (min. 3 x 1.5 mm^2) through the cable gland and connect to the appropriate terminals.
- Insert the signal cable (low temperature alarm) through the cable gland and connect to the appropriate terminals (contact position T_u shows alarm event).
- Screw cover back in place.

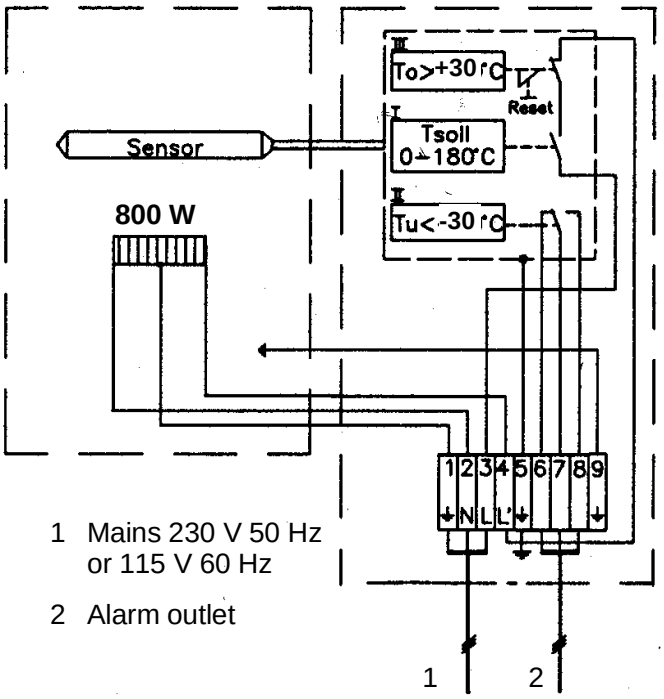


Figure 10 Electrical connection for DIL-1/H..

Warning

We recommend the use of temperature resistant cables!

14 PREPARATIONS FOR COMMISSIONING

Before initial startup, all plant- and process-specific safety measures must be observed. It is mandatory for the operator to complete the enclosed risk assessment of the product.
The gas exposure risk must be assessed by the operator with regard to the hazards posed by process and calibration gas and the setup at the installation site (e.g. tubing, system cabinet/container/plant). If the risk assessment reveals increased exposure hazards, further measures are required.
A visible label must be attached to the installation site in accordance with the risk assessment provided by the operator.

15 INITIAL STARTING

Prior to initial use, system and process-specific safety measures must be observed.

The relevant safety requirements and procedures for the medium to be sampled must be heeded.

Warning

The supply of gas to the injectors is only allowed when the heated dilution unit has reached its operating temperature (see technical data).

Prior to initial use, make sure that the mains voltage corresponds to the voltage indicated on the type plate!

Do not touch the surface of the heated dilution unit during operation. Due to its high surface temperatures, it may cause burns.

Protective gloves must be worn and the dilution unit must be protected against unauthorised access!

The following step-by-step procedure is recommended:

- If possible, separate the dilution unit from the sample point, e.g. above the ball valve.
- In case of heated versions, check the set temperature on the installed thermostat.

Note

If the set temperature on the capillary controller should be reduced by more than 30 °C in one step, the excess temperature cut-off on the thermostat is activated (for re-starting press the reset button).

- For heated versions, switch on the mains voltage.

Note

The total heating time is about 2 hours. After about 1 hour, the lower threshold value (30 °C below set value) is exceeded.

- Open the valve for the dilution gas (for heated version: wait until the complete dilution unit is heated, approx. 2 h). Set the precision pressure reducer to the pressure specified on the enclosed injector data sheet (see Figure 11).

Note

For safety reasons, the low-pressure gauge must show a low pressure of > -0.6 bar. With a low pressure of < -0.6 bar, the critical orifice will not function properly. If the necessary low pressure will not be reached, the dilution gas supply pressure must be increased.

- The following table shows an example of an injector data sheet (extract).

Injektortyp Injector type	I	Injektor-Nr. Injector No.	689	Für Verdünnungssys-tem-Nr. For dilution system No.	8652/222835	Typ Type	DIL-1/H-A1

Betriebsdruck Operating pressure [bar]	Durchfluss Flow [l/h]	Unterdruck ohne kritische Düse Vacuum without critical orifice [bar]	Unterdruck mit kritischer Düse Vacuum with critical orifice 5.1 l/h [bar]
2.4	415	-0.62	-0.61
2.6	435	-0.65	-0.64
2.8	460	-0.68	-0.67
3.0	490	-0.80	-0.77
3.2	510	-0.79	-0.77
3.4	535	-0.79	-0.77
3.6	560	-0.78	-0.76
3.8	585	-0.77	-0.76
4.0	605	-0.77	-0.75

Überprüfung des Verdünnungsfaktors Check of the dilution ratio			Messgasdruck Sample gas pressure	atmosphärisch atmospheric	
Kritische Düse Critical nozzle	Verd.gas Dilution gas	Verdünnungsgasdruck Dilution gas pressure	Messgas Sample	Verdünnung Dilution	Messwert d. verd. Gases Meas. value of the dil. gas
5.1 l/h	100 % N_2	3.2 bar	100 % O_2	100:1	1.0 % O_2

Figure 11 Extract from an injector data sheet (example)

- For the operation of an installed bypass injector, the necessary pressure must be set on the pressure regulator (see Figure 12).

Note

The attached bypass injector table shows the suction flows at corresponding by-pass gas pressures for two different process pressures, 1 bar and 0.9 bar absolute (see Figure 12).

Bypassgas / Bypass gas		Prozessgas / Sample gas	
Betriebsdruck Operating pressure [bar]	Durchfluss Flow [l/h]	Ansaugvolumenstrom bei 1 bar abs. Suction flow at 1 bar abs. [l/h]	Ansaugvolumenstrom bei 0.9 bar abs. Suction flow at 0.9 bar abs. [l/h]
0.5	110	45	-
1.0	155	115	-
1.5	190	200	65
2.0	235	250	135
2.5	270	300	200
3.0	310	350	250
3.5	355	370	270
4.0	395	390	305
4.5	430	425	350

Figure 12 Suction flow at 0.9 or 1bar abs. in dependence on the bypass gas pressure

Warning

In the event of low temperature (failure of the heating) the supply of dilution gas must be interrupted!

15.1 CALIBRATION

A calibration of the downstream analytical measuring system or a check of the dilution factor must always be performed under operating conditions.

An appropriate test gas can be supplied via the test gas valve.

Note

The gas pressure must be above 0.7 bar, because the pressure control valve installed has an opening pressure of 0.7 bar.
When using the control panel, the respective ball valve for the test gas supply must be opened and the flow rate be set on the flowmeter.

The procedure for calibration or checking the dilution ratio is as follows:

- Supply test gas of a concentration you know.
- Check the dilution ratio on the downstream analyzer and, if necessary, correct the pressure on the pressure regulator of the dilution gas.

Test gas feeding without bypass injector
In order to assure that sufficient test gas is available, the test gas quantity should be at least threefold of the flow quantity passing through the critical orifice (see injector data sheet).

Test gas feeding with bypass injector
The test gas quantity must be approximately 10 % above the quantity of the volume flow passing though the bypass (see Figure 12) and the critical orifice (see Figure 11).

16 CLOSING DOWN

Prior to closing down, the heated dilution unit should be purged with inert gas or air to prevent the condensation of aggressive components from the process gas.

17 MAINTENANCE

Prior to any maintenance of repairing works, system and process specific safety measures must be observed.

Warning

Aggressive condensate possible.

Wear safety glasses and appropriate protective clothing!

Do not touch the surface of the dilution unit during operation as this can cause burns due to the high surface temperatures.

Wear protective gloves. The dilution unit must be protected against unauthorized access!

Before carrying out maintenance work on electrical components, the mains voltage must be disconnected in all poles. This also applies to any connected alarm and control circuits!

No recommendation for maintenance intervals can be given. Maintenance intervals must be determined depending on the particular process conditions and specific application.

The maintenance of the dilution unit is limited mainly to the cleaning of the filter elements, inspection of the seals and maintenance of the dilution systems.

Note

The dilution unit does not need to be removed for repair or maintenance.

17.1 DISASSEMBLY OF THE CROSSPIECE

For disassembling of the crosspiece, the heating of the heated dilution unit should be switched off so that the unit can cool down.

Figure 13 shows the explosion drawing of the dilution crosspiece.

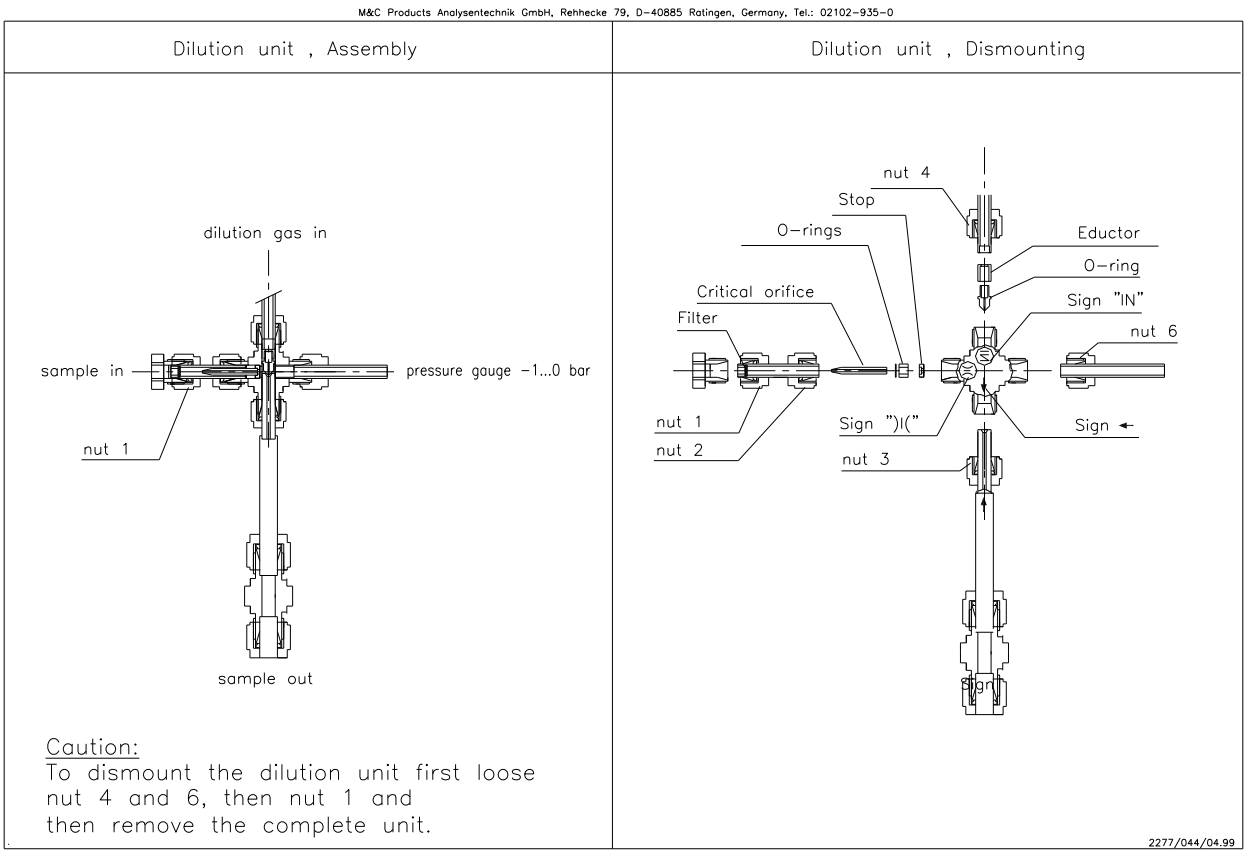


Figure 13 Explosion drawing of the dilution crosspiece

We recommend proceeding according to the following steps:

- Remove the insulation cover of the dilution unit, if applicable.
- Remove all tube connectors on the dilution crosspiece. These are:
- - Depression manometer nut 6
- - Dilution gas inlet nut 4
- - Sample gas outlet nut 5
- - Removal of nut 1.

Warning

Nut 2 must only be removed after having disassembled the dilution cross. Disregard may lead to destruction of the critical orifice!

- Now, the dilution crosspiece is accessible for further maintenance and repair work.

17.2 CLEANING OF THE CRITICAL ORIFICE AND CHECK OR CHANGE OF THE O-RINGS

Warning

Do not clean the critical orifice mechanically.
Clean the critical nozzle in an ultrasonic bath!

Figure 14 shows the position of the orifice in the crosspiece and the O-ring seals.

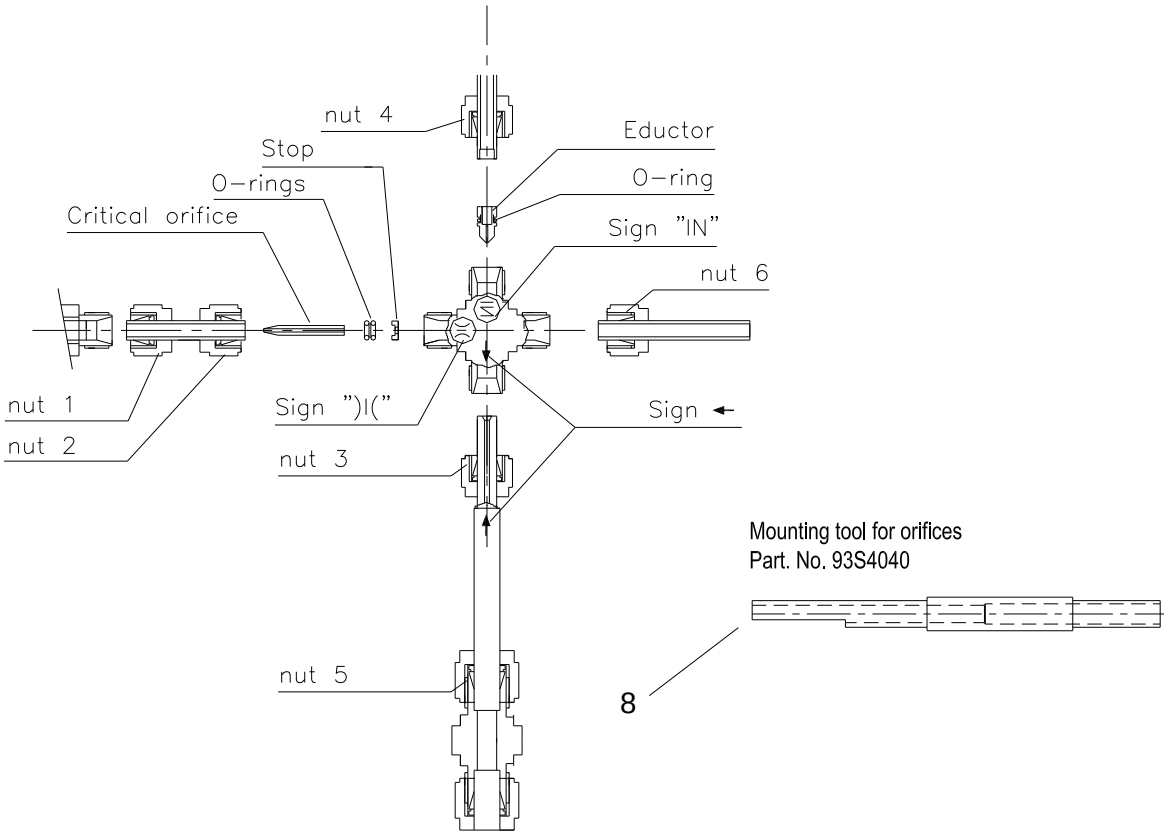


Figure 14 Crosspiece with critical orifice and O-ring seals

- Please proceed as follows:
- Loosen union nut 3 and remove the jet pipe;
- Loosen nut 2 and remove the pipe piece with both nuts;
- Push the injection nozzle out of the jet pipe side by using the mounting tools (item 8, Figure 14);
- Push the critical orifice with its nozzle seat and O-ring carefully from the back side of the crosspiece by using the mounting tool (item 8, Figure 14);
- Check the O-rings and change them if necessary;
- Push the new orifice or the cleaned old one into the O-rings until block.
- Now, the dilution unit can be reassembled in reverse order.

Warning

The Swagelok® fittings must be carefully tightened to avoid damage of the internal components. Do not tighten the fittings too fast.
If a fitting is believed to be leaking, do not tighten further. Disassemble the fitting completely and tighten it again.

17.3 CHANGE AND CLEANING OF THE INJECTION NOZZLE

Note

For cleaning the injector, it is not necessary to remove the nozzle out of the crosspiece. The nozzle can be cleaned together with the complete crosspiece in an ultrasonic bath.

For changing the injector nozzle, see Figure 14:

- Loosen nut 3 and remove jet pipe;
- Push the injection nozzle out of the jet pipe side by using the mounting tools (item 8, Figure 14);
- Check the O-ring and change it if necessary;
- Push the new nozzle with O-ring until blocking.

17.4 REMOVING THE BYPASS T-PIECE

For cleaning or changing the bypass injector, the bypass T-piece can be completely disassembled. The following figure shows the bypass T-piece.

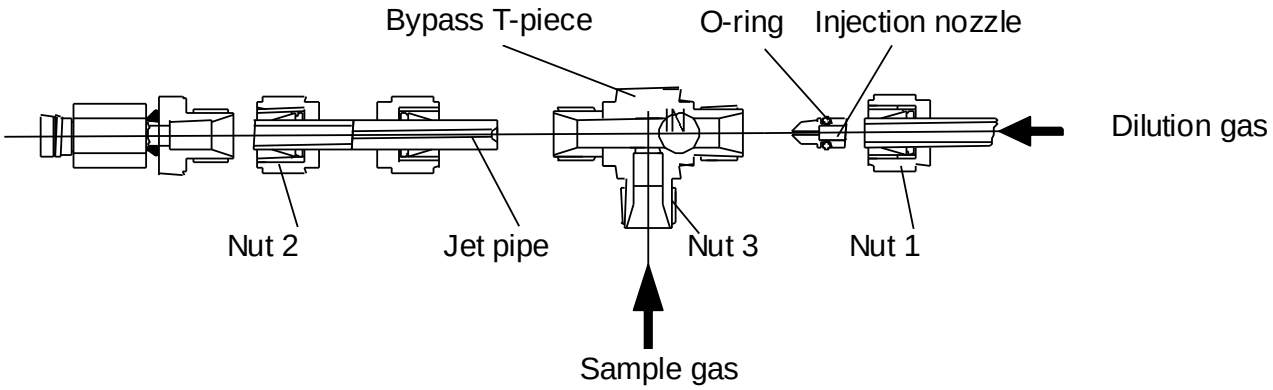


Figure 15 Bypass T-piece with injection nozzle and O-ring

Dismantle the T-piece as follows:

- Romove insulation cover if applicable;
- Remove all tube connectors on the bypass-T. These are: (see Figure 15):
- - Bypass inlet union nut 1
- - Union nut 2 (jet pipe side)
- - Union nut 3 (sample inlet).
- The bypass-T is now ready for further maintenance and repair.

17.5 CHANGE AND CLEANING OF THE BYPASS INJECTION NOZZLE AND CONTROL OR CHANGE OF THE O-RING

- Push the injection nozzle out of the jet pipe side by using the mounting tools (item 8, Figure 14);
- Check the O-ring and change if necessary;
- Push in the new or cleaned old nozzle with O-ring until blocking.

Note

For cleaning the injection nozzle, you need not necessarily pull the nozzle out of the T-piece. The nozzle can be cleaned together with the complete T-piece in an ultrasonic bath.
If you blow through the nozzle, this must be done from the jet pipe side.

18 PROPER DISPOSAL OF THE DEVICE

At the end of the service life of our products, it is important to take care of the appropriate disposal of obsolete electrical and non-electrical devices. To help protect our environment, follow the rules and regulations of your country regarding recycling and waste management.

19 SPARE PARTS LIST

The wear, tear and spare part requirements depend on the specific operating conditions.
The following table shows an extract of the recommended spare parts for the diluiton units **DIL-1** and **DIL-1/H** :

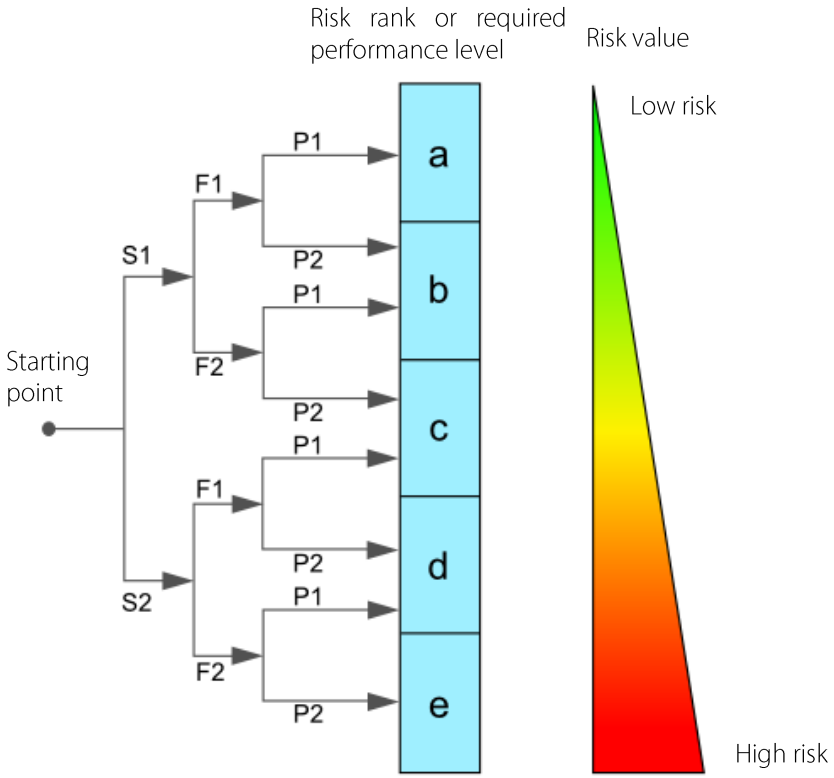
Recommended spare parts	
Part No.	**Description**
20S4300	Complete set critical orifice incl. 2 x O-rings. Material: glass # Please specify dilution ratio along with order. #
93S4000	Injection nozzle incl. O-ring (crosspiece)
93S4006	Dilution crosspiece empty, without any inserts, material: SS316
93S4016	Bypass T-piece empty, without any inserts, material: SS316
93S4020	Crosspiece complete. # Please specify dilution ration along with order #
93S4025	Bypass T-piece complete
93S4035	Suction tube for DIL 6 x1 mm with integrated filter sieve incl. Swagelok® nuts, silver-plate cutting ring for dilution crosspiece, material SS316
93S0010	Spare thermostate 0 – 180 °C
93S0015	Spare heating cartridge HLP, 230 V 800 W
93S0017	Spare heating cartridge HLP, 115 V 800 W
93S0018	Heat conductivity paste for insertion of heating cartridge
93S4015	Eductor incl. O-ring for bypass-T-piece

20 RISK ASSESSMENT

The risk assessment provided in this chapter is intended for all work activities on the product. The hazards can occur in the work steps of assembly, commissioning, maintenance, disassembly and in the event of a product fault. During normal operation, the product is protected by a system cabinet or appropriate covers.
Only qualified personnel is permitted to perform the work. The following minimum knowledge is required for the work:

- Employee instruction provided in process engineering
- Employee instruction provided in electrical engineering
- Detailed knowledge of the instruction manual and the applicable safety regulations

The product complies with the current regulations according to state-of-the-art science and technology. Nevertheless, not all sources of danger can be eliminated while observing technical protective measures. Therefore, the following risk assessment and the description of exposure hazards refer to the work steps mentioned above.



Severity of injury:
S1 = 1 = minor (reversible injury)
S2 = 2 = serious (irreversible injury, death)

Frequency and duration:
F1 = 1 = infrequent or short exposure to hazard
F2 = 2 = frequent (more than once per hour/shift)

Possibility of preventing or limiting the damage
P1 = 1 = possible
P2 = 2 = hardly possible

Figure 16 Overview risk assessment

Aggressive condensate possible

Risk rank group A
Chemical burns due to aggressive media possible!
This applies to all liquids in vessels and in the product.
In general, for electrical and mechanical work on the product, wear personal protective equipment (PPE) in accordance with the risk assessment.

Caution hot surfaces

Risk rank group A
The temperature inside the product can be higher than > 180 °C.
The hot parts are shielded by mechanical devices. Before opening the products, they must be disconnected from the power supply and a cooling time of more than > 180 minutes must be observed. In general, for electrical and mechanical work on the product, wear personal protective equipment (PPE) in accordance with the risk assessment.

Caution electric shock

Risk rank group C
When installing high-power systems with nominal voltages of up to 1000 V, the requirements of VDE 0100 and their relevant standards and regulations must be observed!
This also applies to any connected alarm and control circuits. Before opening the products, they must always be disconnected from the power supply.

Gas hazard

Risk rank group A-B-C
The hazard potential mainly depends on the gas to be extracted.
If toxic gases, oxygen displacing or explosive gases are conveyed with the product, an additional risk assessment by the operator is mandatory.
In principle, the gas paths must be purged with inert gas or air before opening the gas-carrying parts.
The escape of potentially harmful gas from the open process connections must be prevented.
The relevant safety regulations must be observed for the media to be conveyed. If necessary, flush the gas-carrying parts with a suitable inert gas. In the event of a gas leakage, the product may only be opened with suitable PPE or with a monitoring system.
Furthermore, the work safety regulations of the operator must be observed.

Caution crushing hazard

Risk rank group A
The work must be performed by trained personnel only.
This applies to products weighing less than < 40 kg [≈ 88.2 lbs]:
The product can be transported by 1 to 2 person(s). The instructions for appropriate personal protective equipment (PPE) must be observed.
The weight specifications are contained in the technical data of this product.
Furthermore, the work safety regulations of the operator must be observed.

21 APPENDIX

Further documentation of our products can be seen in our internet catalogue:
www.mc-techgroup.com