Operating Instructions

TDLS GPro 500

Tunable Diode Laser Spectrometer

METTLER TOLEDO

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1 Introduction

1.1 Safety information

Read this manual and ensure that you fully understand its content before you attempt to install, use or maintain the GPro™ 500. Important safety information is highlighted in this manual as WARNINGs and CAUTIONs, which are used as follows:

WARNING
Warnings highlight specific hazards which, if not taken into account, may result in personal injury or death.

CAUTION
Cautions highlight hazards which, if not taken into account, can result in damage to the TDL or to other equipment or property.

This manual also incorporates "be aware of" information, which is used as follows:

☞ This highlights information which it is useful for you to be aware of (for example, specific operating conditions, and so on).

1.2 General

This manual contains information of installation, operation and maintenance of the GPro 500 TDL. A description of the GPro 500 TDL and its basic features is also included.

☞ The GPro 500 TDL is available for use in explosive atmospheres as defined in EN 60079-14 (ATEX) or IEC 60079-10 (ATEX).
For more information on Equipment Protection Levels refer to chapter 8 "Explosion Protection" on page 121 and Relationship of Equipment Protection Levels to ATEX Categories on page 142.

Please read the entire manual carefully before using the GPro 500 TDL. It is a sophisticated instrument utilizing state-of-the-art electronic and laser technology. Installation and maintenance of the instrument require care and preparation and should only be attempted by competent personnel. Failure to do so may damage the instrument and void the warranty.

CAUTION
METTLER TOLEDO strongly recommends having the final installation and commissioning executed under the full supervision of a METTLER TOLEDO representative.
Do not power up the system before the wiring has been fully checked by trained personal.
It is strongly recommended to have the wiring approved by a METTLER TOLEDO Service representative.
Wrong wiring can lead to damage of the sensor head and/or the M400 transmitter.

CAUTION

Do not install the probe into the process without the process side purging being switched on (SP probes and W Wafers).

Without purging, optical components in the probe may be contaminated and therefore affect the GPro 500's ability to measure (see also Chapter 3.1.4 "Signal Optimization" on page 38).

METTLER TOLEDO strongly recommends having the final installation and commissioning executed under the full supervision of a METTLER TOLEDO representative.

1.3 Safety Instructions

1.3.1 For M400 Type 3 4-wire series

☞ Before connecting the M400 to a supply unit make sure that its output voltage cannot exceed 30 V DC, or be less than 20 V DC. Do not use alternating current or main power supply.

WARNING
Installation of cable connections and servicing of this product require access to shock hazard voltage levels.

WARNING
Power supply and relay or open collector (OC) contacts wired to separate power source must be disconnected before servicing.

WARNING
Power supply must employ a switch or circuit breaker as the disconnecting device for the equipment.

WARNING
Electrical installation must be in accordance with the National Electrical Code and/or any other applicable national or local codes.

☞ RELAY RESP. OC CONTROL ACTION: the M400 transmitter relays will always de-energize on loss of power, equivalent to normal state, regardless of relay state setting for powered operation. Configure any control system using these relays with fail-safe logic accordingly.

☞ PROCESS UPSETS: Because process and safety conditions may depend on consistent operation of this transmitter, provide appropriate means to maintain operation during sensor cleaning, replacement of sensor or instrument calibration.

1.3.2 Safety Instructions for installation, operation and maintenance in hazardous locations (ATEX) GPro 500 series

WARNING
Devices of these series are approved for operation in hazardous locations.

WARNING
During installation, commissioning and usage of the device, the stipulations for electrical installations (IEC EN 60079-14/IEC EN 60079-10) in hazardous areas must be observed.

WARNING
When installing the device outside the range of applicability of the 2014/34/EU directive, the appropriate standards and regulations in the country of use must be observed.

WARNING
Manipulations of the device other than described in the instruction manual are not permitted.

The GPro 500 comes with a pre-installed cable and cable gland. Do not attempt to replace the cable as it will void the warranty and violate the ATEX classification!

WARNING
Opening the sensor head voids warranty and violates the ATEX hazardous area classifications!

WARNING
Installation may only be carried out by trained personal in accordance with the instruction manual and as per applicable standards and regulations.

– Cleaning: In hazardous locations the device may only be cleaned with damp cloth to prevent electrostatic discharge.

1.3.3 Connection to supply units

FM APPROVED

US Version:
The US version must be installed using a suitable cabling conduit system in accordance with local codes and regulations. To aid installation, the unit is supplied without an attached cable.

The terminals are suitable for single wires/flexible leads 0.2 mm^2 to 1.5 mm^2 (AWG 24–16).

WARNING
The electrical installation must be performed in accordance with National Electrical Codes of practice and/or any other applicable national or local codes.

WARNING
Wait 2 minutes before opening the enclosure after de-energizing the system.

WARNING
When fitting the enclosure cover onto the sensor head, the 8 x M5 fixing screws must be tightened to 8 Nm torque.

WARNING
For gas group A, sealing of the conduit is required at the enclosure entry. For gas groups B, C and D, no conduit sealing is required.

1.3.4 General safety precautions for installation, operation and maintenance in hazardous locations GPro 500 series

WARNING
Devices of these series are approved for operation in hazardous locations.

WARNING
During installation, commissioning and usage of the device, the stipulations for electrical installations (IEC EN 60079-14/IEC EN 60079-10) in hazardous areas must be observed.

WARNING
When installing the device outside the range of applicability of the 2014/34/EU directive, the appropriate standards and regulations in the country of use must be observed.

WARNING
Operation of this device other than as described in this manual or the addition of non-approved modifications to the product is prohibited.

WARNING
Installation may only be carried out by trained personal in accordance with the instruction manual and as per applicable standards and regulations.

– Cleaning: In hazardous locations the device may only be cleaned with damp cloth to prevent electrostatic discharge.

Connection to supply units

– Devices of the above mentioned series must only be connected to explosion proof power supply units (for input ratings refer to instruction manual EC-Type-Examination Certificate).

– The terminals are suitable for single wires/flexible leads 0.2 mm^2 to 1.5 mm^2 (AWG 24–16).

WARNING
The external power supply used to power the TDL sensor head should not exceed 24 V DC, with a power rating of 5 to 60 watts.

Correct disposal of the unit

– When the unit is finally removed from service, observe all local environmental regulations fro proper disposal.

1.3.5 Installation in closed rooms

When installing a non oxygen analyzer in a closed non ventilated room, the volume of the room should always be equal or bigger than 5 square meters.

1.4 Introduction and Measurement principle

The GPro 500 TDL is a precision optical instrument designed for continuous in-situ or extractive gas measurement, based on tunable diode laser absorption spectroscopy (TDLS). The GPro 500 TDL provides a high performance & flexible gas measurement solution. It is supplied with a process adaption specific optimized for the application. For in-situ applications these include standard purged probes and wafer cells, non-purged probes (with or without integrated particulate filter) & filtered wafer (W) cells. For extractive applications, a variety of extractive cells options are available.

☞ For in-situ applications utilizing the standard purged probe or wafer cell; to ensure reliable measurement performance, it is important that there is flowing process gas at the measurement location. See chapter 2.2 (Flow conditions at measuring point) on page 28 and chapter 3.1.2 (Process side purging) page 31 for further details. (This does not apply to non-purged probes or extractive cells).

☞ GPro 500 TDL is suitable for use in industrial environments or environments where it may be connected to a mains electrical network supplying domestic premises.

The measuring principle used is infrared single-line absorption spectroscopy, which is based on the fact that each gas has distinct absorption lines at specific wavelengths. The absorption lines are carefully selected to minimize cross interference from other (background) gases. Using direct absorption spectroscopy, a spectrum in a specific wavelength range is taken and compared with spectral reference data stored in the on-board database for any given temperature and pressure. The concentration is then calculated. Any inconsistency between reference data and measurement data will trigger an alarm. The detected light intensity varies as a function of the laser wavelength due to absorption of the targeted gas molecules in the optical path between the laser and the detector. The laser line width is a small fraction of the absorption line width so the reproduced spectra is very accurate. The instrument stores the spectral data in its memory and once a scan is obtained a curve fitting to this data is performed yielding a measurement value. Account is also taken to the process gas temperature and pressure and these parameters are measured separately or fixed values for "p" and "T" can be set.

☞ The GPro 500 TDL is a gas analyzer and as such measures the FREE molecules of the specific gas of interest. It will not detect such molecules when they are bound together into larger molecular structures or when attached to particles or dissolved into droplets. This should be carefully considered when comparing measurement results with other measurement techniques.

1.4.1 Dust load

As long as the laser beam is able to generate a signal for the detector, the dust load of the process gases does not influence the analytical result. By amplifying the signal automatically, measurements can be carried out without any negative impact. The influence from high dust load is complex and is dependent on the optical path length, particle size and particle size distribution. At longer path lengths the optical attenuation increases rapidly. Smaller particles also have a significant impact on the optical attenuation: the smaller the particles are, the more difficult the measurement will be. The general impact on the measurement result in high dust load is an increased noise level. For high dust load applications, please consult your local METTLER TOLEDO representative, see "Sales and Service" on page 144.

1.4.2 Temperature

The temperature influence on an absorption line must be compensated for. An external temperature sensor can be connected to the GPro 500. The signal is then used to correct the measurement results. Without temperature compensation the measurement error caused by process gas temperature changes affects the measurement substantially. Therefore, in most cases an external temperature signal is recommended. The mode with fixed temperature value is only recommended with processes where the value is constant and well known.

Temperature sensor requirements: 4 – 20 mA output, either active or loop powered, with range suitable for process temperature range. The sensor must also meet the local hazardous zone requirements.

Temperature sensor accuracy requirements are: Pt100 or equivalent, or better, with configurable 4 – 20 mA output.

Rule of Thumb:
For oxygen measurements, typically a delta of 1 degree C equals 500 ppm O_2 change in reading in normal air, without compensation.

1.4.3 Pressure

The process gas pressure affects the line shape of a molecular absorption line and influences the measurement results. An external absolute pressure sensor can be connected to the GPro 500. When the absolute process gas pressure is supplied, the GPro 500 uses a special algorithm to adapt the line shape and effectively compensate for the pressure influence as well as the density effect. Without compensation the measurement error caused by process gas pressure changes is substantial. Therefore, in most cases an external pressure signal is recommended. The manual mode with fixed pressure value is only recommended with processes where the value is constant and well known.

Pressure sensor requirements: 4 – 20 mA output, either active or loop powered, with range suitable for the process pressure range. The sensor must also meet the local hazardous zone requirements.

Pressure sensor accuracy requirements are: +/– 0,1 % accuracy or better, with configurable 4 – 20 mA output.

Rule of Thumb:
For oxygen measurements, typically a delta of 50 mbar equals 1% O_2 change in reading in normal air, without compensation.

Note: It is recommended that a pressure sensor referenced to absolute pressure is used to negate errors caused by atmospheric pressure variation. The pressure sensor must always be mapped to the TDL input as an absolute sensor, so if a gauge sensor is used, the nominal atmospheric pressure value will need to be added to the values entered for pressure min (4 mA) and pressure max (20 mA).

WARNING
Ensure p & T sensors are connected before applying loop power.

1.4.4 Cross interference

Since the GPro 500 derives its signal from fully-resolved molecular absorption lines, cross interference from other gases is minimized. The GPro 500 is therefore able to measure the desired gas component very selectively.

CAUTION

Always take great care when choosing the measurement location.
Positions where there are fewer particles, the temperature is lower or there is a more suitable process pressure, are recommended. The more optimized the measurement location is, the better the overall performance of the system will be.
Please consult your METTLER TOLEDO representative (see “Sales and Service” on page 144).

1.5 Instrument description

The GPro 500 TDL normally consists of 4 separate units: the TDL head, process adaption, junction box and the M400 transmitter (user interface). Additionally purging gas, (suitable for the application) and 4–20mA pressure and temperature sensor inputs are required in most cases. The general installation diagrams for purged and non-purged probes, wafer cells and extractive measurements are shown in Figure 1 on page 19.

1.5.1 System Overview

A connecting device is required between the TDL and the M400 transmitter. For ATEX applications, an existing junction box can be used, or one can be ordered as an accessory (see Appendix 2, chapter 2.3 "Accessories" on page 139). The 4–20 mA signals for temperature and pressure compensation are connected to the sensor's head via this junction box. The junction box also provides the connection point for the GPro 500 Ethernet interface connection. For more information in installation in hazardous areas, please refer to chapter 8 "Explosion Protection" on page 121.

In standard configurations the GPro 500 is connected to the M400 transmitter. This offers a flexible user interface that not only displays concentration and other measurement parameters in real-time, but can be used to configure specific analyzer parameters during commissioning and subsequent verification and calibration of the system. This avoids the requirement for using a PC at the measurement location to configure the analyzer. In addition, the M400 offers additional I/O capabilities, i.e. 4x 4…20 mA active analog outputs and 6 relays.

Alternatively, the GPro 500 is supplied as an additional output version. This version provides 2 x 4…20 mA passive analog outputs directly from the sensor head and offers a full Ex-d solution. In this case an M400 transmitter is not necessary and an M400 should not be connected to the sensor head. To configure the optional direct analog outputs, it is necessary to use the MT-TDL software Suite to configure the GPro 500 during commissioning (using the Ethernet connection to the GPro 500, see item 6 in Figure 1 on page 19). For more information on the MT-TDL Software, please refer to chapter 6 "Service" on page 101.

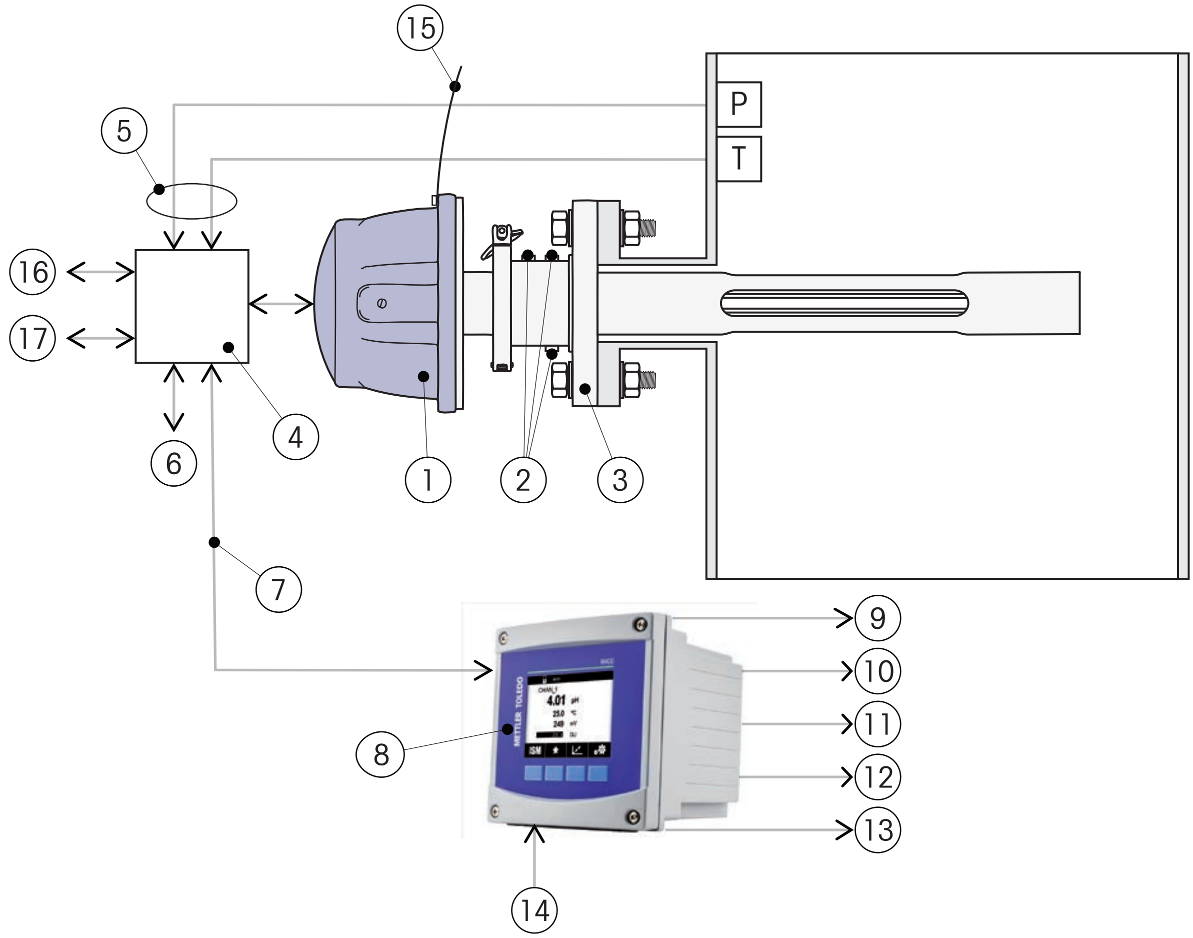


Figure 1 General schematic of standard purge probe (SP) shown.

1 GPro 500 sensor head with insertion probe
2 Purging with N_2, one inlet for the process side and one inlet and one outlet for the sensor side.
3 Process flange
4 Junction box (connecting device)
5 2 x 4...20 mA (pressure and temperature)
6 Ethernet connection
7 RS 485
8 M400 G2 transmitter
9 4...20 mA output for Concentration
10 4...20 mA output for Pressure
11 4...20 mA output for Temperature
12 4...20 mA output for % Transmission
13 Relay outputs for alarm purposes.
The relays are configurable and there are 6 relays available in total.
14 Power for the M400.
15 Grounding for the TDL head.
16 External power supply. 24 VDC, 5 – 60 W for the sensor power head.
17 2 x 4…20 mA direct analog outputs (optional).

	WARNING When connecting the external power supply directly to the sensor head using the junction box, do not exceed the 24 V, 5 to 60 W limit required.

	WARNING When selecting the TDL sensor head external power supply, care should be taken to ensure its output does not exceed 24 V DC, and has a power output rating of 5 watts minimum.

Figure 2 GPro 500, shown with different process adaptions.

The GPro 500 consists of the TDL head which contains the laser module with a temperature stabilized diode laser, collimating optics, the main electronics and data storage. It is housed in a coated aluminum box. The process adaption attaches to the TDL head. Dependent on the application, this may be a purge, purge free or filter probe, in-line wafer cell, extractive cell or cross-pipe. The TDL head has environmental protection to IP65, NEMA 4X. The GPro 500 is installed by assembling the supplied purging and then mounted onto the process flange. The optical alignment is robust and reliable and does not require manual alignment. For the standard purge probe (SP) and wafer cell, process purging prevents dust and other contamination from settling on the optical surfaces. For clean and static processes (for example headspace monitoring), a non-purge probe (NP) may be supplied. In this case process side purge is not required.

The junction box is the connection point for the measurement probe, the pressure sensor, the temperature sensor, Ethernet and M400.

Figure 3 M400 transmitter Type 3

For more information refer to chapter 7.1 "M400" on page 111 and the M400 manual.

☞ Approval for the M400 is Class 1 Div 2/Zone 2 ATEX. For installation in Zone 1 areas, see "Accessories" on page 139 – Purging box for M400.

1.5.2 Sensor head

The combined tunable diode laser and receiver assembly is known as the TDL head. This contains the laser, optics and all the electronics for laser control, signal processing, line locking, detector electronics, data storage/retrieval, current outputs (optional), etc. The sensor head has an Ethernet interface, accessible via the junction box, for high level maintenance by the use of METTLER TOLEDO Process Analytics specific software (MT-TDL Suite). All components of the sensor head are minimum-wetted and are therefore under normal conditions are never in contact with the process stream. The power required for the sensor head is 24 V, 5 – 60 W. The connection between the sensor head and the process adaption (probe, wafer or extractive cell) is a precision mechanical interface. Care should be taken to ensure that the metal surfaces are carefully aligned when installing the sensor head to prevent damage.

ATEX Version:

In the ATEX Version, the sensor head is supplied with a pre-configured cable already installed. Do not open the sensor head for removing, altering, or replacing the cable. The standard cable length is 5 m, but optional lengths of 15 m, 25 m and 40 m are also available. For the ATEX version, note that this cable must not be removed or changed by the user as opening the TDL blue cover will void the ATEX hazardous area certification.

> WARNING
> Opening the sensor head voids warranty and violates the ATEX hazardous area classifications.

US Version:

The US version must be installed using a suitable cabling conduit system in accordance with local codes and regulations. To aid installation, the unit is supplied without an attached cable. METTLER TOLEDO recommends the use of suitable cables listed as accessories in Appendix 2 "Spare Parts and Accessories" on page 136

The terminals are suitable for single wires/flexible leads 0.2 mm^2 to 1.5 mm^2 (AWG 24–16).

> WARNING
> The electrical installation must be performed in accordance with National Electrical Codes of practice and/or any other applicable national or local codes.

> WARNING
> Wait 2 minutes before opening the enclosure after de-energizing the system.

	WARNING When fitting the enclosure cover onto the sensor head, the 8 x M5 fixing screws must be tightened to 8 Nm torque.

	WARNING For gas group A, sealing of the conduit is required at the enclosure entry. For gas groups B, C and D, no conduit sealing is required.

1.5.3 Insertion probes

Probes exists in several versions, including purged (SP), non-purged (NP) depending on the application. Both material of construction (windows, metals, O-rings, etc.) and insertion length can be customized to particular needs.

1.5.4 M400 type 3 transmitter

This is the GPro Series user interface. With the M400 the user can set the necessary parameters for operation, and control the alarm and I/O setup. The M400 will of course also display the measured gas concentration, the process temperature and pressure as well as the transmission (signal quality/strength). It features class 1 Div 2 FM approval (ATEX zone 2) and four 4–20 mA active analog outputs.

M400 also features ISM – Intelligent Diagnostics – which provides the following features:

- Time to Maintenance Indicator (TTM). Real time, dynamic prediction of when the next maintenance cycle is required for best operation. Action: Clean the optics (window, corner cube)
- Dynamic Lifetime Indicator (DLI). Based on the DLI information, the transmitter tells you when it's time to replace the TDL. Action: Replace TDL (Expected lifetime >10 years)

1.6 Software

Software for the GPro 500 TDL consists of 2 programs:

- A program not visible to the user and integrated in the CPU electronics, running the micro controller on the CPU card. The program performs all necessary calculations and self-monitoring tasks.
- MT-TDL Suite: a Windows based program running on a standard PC connected through the Ethernet connection. This program enables communication with the instrument during installation, service, calibration and normal operation. See chapter 6 "Service" on page 101 for more details.

☞ It is only necessary to connect a PC for advanced maintenance, normal installation and service/calibration can be done via M400. Both communication ports (Ethernet and RS 485) to the M400 can be used at the same time. However, during access with a PC no changes are allowed on the M400. For GPro500 systems with direct analog outputs, the configuration can only be done using a PC.

1.7 Laser classification

The diode lasers used in the GPro 500 TD L operate in the near infrared (NIR). It has an output power which, according to IEC 60825-1 latest edition, classifies the GPro 500 TDL as a **Laser Class 1M** product.

WARNING
Class 1M laser product
Laser radiation – do not view directly with optical instruments
Note that the laser emits invisible light!

1.8 Product data

Table 1 Product data sensor head

	Size and weight	
	Dimensions	524,5 x Ø175,5 mm
	Weight	8 kg

	Material of construction	
	Steel	316L
	Optical elements	AR coated Quartz, AR coated Borosilicate, AR coated Sapphire
	Seals	Kalrez® 6375, 6230, 6380, 0090, EPDM FDA, Graphite compounds
	Blue cover-Aluminum	Paint finish – Chemically resistant epoxy resin coating

	Electrical inputs and outputs	
	Cable length	5 m (16.4 ft), 15 m (49.2 ft), 25 m (82.0 ft), 40 m (131.2 ft)

Measurement (All measurement specifications with reference to standard conditions T & p with no dust or particulates)

	O_2	CO (ppm)	CO (%)
Optical path length	**• Optical path length (OPL) can vary between 100 mm and 10 m depending on the selected process adaption (see "4 Dimensions and Drawings" on page 56). • The OPL can be multiplied by 2 (MR2) or 3 (MR3) when using the multi-reflection cell (MR).**		
Measurement range and standard conditions (ambient temperature and pressure, 1 m path length)	0–100 %	0–2 %	0–100 %
Lower Detection Limit (in 1 meter path length at ambient standard conditions, dry gas, no dust load, in N_2 background)	100 ppm-v	1 ppm-v	1500 ppm-v
Accuracy	1 % of reading or 100 ppm O_2 (whichever is greater)	2 % of reading or 1 ppm (whichever is greater)	2 % of reading or 1500 ppm, (whichever is greater)
Linearity	Better than 1 %	Better than 1 %	Better than 1 %
Resolution	< 0…01 % vol O_2 (100 ppm-v)	1 ppm-v	1500 ppm-v
Drift	Negligible (< 2 % of measurement range between maintenance intervals)	Negligible (< 2 % of measurement range between maintenance intervals)	Negligible (< 2 % of measurement range between maintenance intervals)
Sampling rate	1 second	1 second	1 second
Response Time (T90)	O_2 in N_2 21 % > 0 % in < 2 sec	CO in N_2 300 ppm-v to 0 % in < 4 sec	CO in N_2 1% to 0% in < 4 sec
Warm up time	Typically <1 hour	Typically <1 hour	Typically <1 hour
Repeatability	± 0.25 % of reading or 0.05 % O_2 (whichever is greater)	± 0.25 % of reading or 5 ppm-v CO (whichever is greater)	± 0.25 % of reading or 0.75 %-v CO (whichever is greater)
Process pressure range	0.1 bar – 10 bar (abs) / 4.35 psi – 145.03 psi (abs)*	0.8 bar – 2 bar (abs) / 11.63 psi – 29.00 psi (abs)	0.8 bar – 1.5 bar (abs) / 11.63 psi – 21.75 psi (abs)
Process temperature range	0 to + 250 °C (+ 32 to + 482 °F) Standard 0 to + 600 °C (0 to +1112 °F) with additional thermal barrier and high temperature configuration. 0 to +150 °C (+ 32 to + 302 °F) (White cell, PFA, PTFE filter)		

* from Firmware 6.23 or higher

Measurement (All measurement specifications with reference to standard conditions T & p with no dust or particulates)

	H_2O	**H_2O ppm**	**CO_2 (%)**
Optical path length	**• Optical path length (OPL) can vary between 100 mm and 10 m depending on the selected process adaption (see "4 Dimensions and Drawings" on page 56).** **• The OPL can be multiplied by 2 (MR2) or 3 (MR3) when using the multi-reflection cell (MR).**		
Measurement range and standard conditions (ambient temperature and pressure, 1 m path length)	0–20 %	0 – 1 %	0–100 %
Lower Detection Limit (in 1 meter path length at ambient standard conditions, dry gas, no dust load, in N_2 background)	5 ppm-v	1 ppm-v	1000 ppm-v
Accuracy	2 % of reading or 10 ppm, (whichever is greater)	2 % of reading or 1 ppm, (whichever is greater)	2 % of reading or 1000 ppm, (whichever is greater)
Linearity	Better than 1 %	Better than 1 %	Better than 1 %
Resolution	5 ppm-v	1 ppm-v	1000 ppm-v
Drift	Negligible (<2 % of measurement range between maintenance intervals)	Negligible (<2 % of measurement range between maintenance intervals)	Negligible (<2 % of measurement range between maintenance intervals)
Sampling rate	1 second	1 second	1 second
Response Time (T90)	H_2O in N_2 1 % to 0 % in <4 sec	H_2O in N_2 1 % to 0 % in <4 sec	CO_2 in N_2 1 % to 0 % in <4 sec
Warm up time	Typically <1 hour	Typically <1 hour	Typically <1 hour
Repeatability	±0.25 % of reading or 50 ppm-v H_2O (whichever is greater)	±0.25 % of reading or 10 ppm-v H_2O (whichever is greater)	±0.25 % of reading or 5000 ppm-v CO_2 (whichever is greater)
Process pressure range	0.8 bar–2 bar (abs) / 11.63 psi–29.00 psi (abs)	0.8 bar–5 bar (abs) / 11.63 psi–72.50 psi (abs)	0.8 bar–2 bar (abs) / 11.63 psi–29.00 psi (abs)
Process temperature range	0 to +250 °C (+32 to +482 °F) Standard 0 to +600 °C (0 to +1112 °F) with additional thermal barrier and high temperature configuration. 0 to +150 °C (+32 to +302 °F) (White cell, PFA, PTFE filter)		

Measurement (All measurement specifications with reference to standard conditions T & p with no dust or particulates)

	CO_2 %/CO %	CO ppm/CH_4 %	HCl (ppm)
Optical path length	**• Optical path length (OPL) can vary between 100 mm and 10 m depending on the selected process adaption (see "4 Dimensions and Drawings" on page 56). • The OPL can be multiplied by 2 (MR2) or 3 (MR3) when using the multi-reflection cell (MR).**		
Measurement range and standard conditions (ambient temperature and pressure, 1 m path length)	0–100 % (CO_2 and CO)	0–2 % (CO) 0–10 % (CH_4)	0–3 %
Lower Detection Limit (in 1 meter path length at ambient standard conditions, dry gas, no dust load, in N_2 background)	1000 ppm-v (CO_2) 1500 ppm-v (CO)	0–200 °C: 1 ppm-v CO, 5 ppm-v CH_4 200–600 °C: 5 ppm-v (CO), 25 ppm-v (CH_4)	0.6 ppm-v
Accuracy	2 % of reading or 1000 ppm (whichever is greater)	2 % of reading or 1 ppm (CO)/ 25 ppm-v (CH_4) (whichever is greater)	2 % of reading or 0.6 ppm (whichever is greater)
Linearity	Better than 1 %	Better than 1 %	Better than 1 %
Resolution	1000 ppm-v	1 ppm-v (CO), 3 ppm-v (CH_4)	0.6 ppm-v
Drift	Negligible (<2 % of measurement range between maintenance intervals)	Negligible (<2 % of measurement range between maintenance intervals)	Negligible (<2 % of measurement range between maintenance intervals)
Sampling rate	1 second	1 second	1 second
Response Time (T90)	CO_2 in N_2 1 % to 0 % in <4 sec	CO/CH_4 in N_2 2 % to 0 % in <4 sec	HCl in N_2 1 % to 0 % in <4 sec
Warm up time	Typically <1 hour	Typically <1 hour	Typically <1 hour
Repeatability	±0.25 % of reading or 5000 ppm-v CO_2 or CO (whichever is greater)	±0.25 % of reading or 5 ppm-v CO/500 ppm-v CH_4 (whichever is greater)	±0.25 % of reading or 3 ppm-v HCl (whichever is greater)
Process pressure range	0.8 bar–2 bar (abs)/ 11.63 psi–29.00 psi (abs)	0.8 bar–2 bar (abs)/ 11.63 psi–29.00 psi (abs)	0.8 bar–3 bar (abs)/ 11.6 psi–43.5 psi (abs)
Process temperature range	0 to +250 °C (+32 to +482 °F) Standard 0 to +600 °C (0 to +1112 °F) with additional thermal barrier and high temperature configuration. 0 to +150 °C (+32 to +302 °F) (White cell, PFA, PTFE filter)		

Measurement (All measurement specifications with reference to standard conditions T & p with no dust or particulates)

	H_2S (%)	CH_4 ppm	NH_3 ppm/H_2O%
Optical path length	• **Optical path length (OPL) can vary between 100 mm and 10 m depending on the selected process adaption (see "4 Dimensions and Drawings" on page 56).** • **The OPL can be multiplied by 2 (MR2) or 3 (MR3) when using the multi-reflection cell (MR).**		
Measurement range and standard conditions (ambient temperature and pressure, 1 m path length)	0–50 %	0–1 %	0–1 % (NH_3) 0–40 % (H_2O)
Lower Detection Limit (in 1 meter path length at ambient standard conditions, dry gas, no dust load, in N_2 background)	20 ppm-v	1 ppm-v	0.4 ppm-v (NH_3)1); 1 ppm-v (NH3 at 400 °C with H_2O concentration equal or lower than 40 %) 1,000 ppm (H_2O)
Accuracy	2 % of reading or 20 ppm (whichever is greater)	2 % or 1 ppm (whichever is greater)	2 % of reading or ± 0.4 ppm, whichever is greater (NH_3)1); 5 % of reading or ± 1,000 ppm, whichever is greater (H_2O)
Linearity	Better than 1 %	Better than 1 %	Better than 1 %
Resolution	20 ppm-v	1 ppm	1 ppm-v (NH_3) / 1,000 ppm (H_2O)
Drift	Negligible (<2 % of measurement range between maintenance intervals)	Negligible (<2 % of measurement range between maintenance intervals)	Negligible (<2 % of measurement range between maintenance intervals)
Sampling rate	1 second	1 second	2 second
Response Time (T90)	H_2S in N_2 1 % to 0 % in <4 sec	CH_4 in N_2 1% to 0% in <4 sec	NH_3 in N_2 1% to 0% in <10 sec
Warm up time	Typically <1 hour	Typically <1 hour	Typically <1 hour
Repeatability	±0.25 % of reading or 100 ppm-v H_2S (whichever is greater)	±0.25 % of reading or 5 ppm-v CH_4, (whichever is greater)	2 % of reading or 0.4 ppm, whichever is greater (NH3), 5 % of reading or 1,000 ppm, whichever is greater (H2O)
Process pressure range	0.8 bar–2 bar (abs) / 11.6 psi–29 psi (abs)	0.8 bar–3 bar (abs) / 11.63 psi–43.5 psi (abs)	0.8 bar–3 bar (abs) / 11.63 psi–43.5 psi (abs)
Process temperature range	0 to +250 °C (+32 to +482 °F) Standard 0 to +600 °C (0 to +1112 °F) with additional thermal barrier and high temperature configuration. 0 to +150 °C (+32 to +302 °F) (White cell, PFA, PTFE filter)		

Electrical inputs & outputs	
Number of direct outputs (analog)	2 (optional)
WARNING: Do not connect the M400 and the direct passive analog outputs at the same time.	
Current outputs	Passive 4…20 mA outputs, galvanically isolated, alarms to 3.6 mA or 22 mA conform to NAMUR NE43 guidelines
Measurement error through analog outputs	Non-linearity <±0.002 mA over the 1 to 20 mA range Offset error <±0.004 mA (zero scale) Gain error <±0.04 mA (full scale)
Analog output configuration	Linear
Load	Max 500 Ohms
Hold mode input	Yes, via Ethernet (using the MT-TDL Suite)
Hold state	Automatic (when Ethernet port in use, during calibration): last, fixed or live
Communication interface	RS 485 (to M400)
Service interface	Ethernet (to PC) as direct service interface for FW updates (not using the M400 transmitter), for off-line diagnostics and configuration database up- and download
Memory slot interface* * **Note:** For ATEX and IECEx versions the TDL head must not be opened.	SD card reader/writer for data retrieval (measurement & diagnostics), FW update (via SD card swap) and remote diagnostics (configuration file up/download) (to be accessed inside the housing). Space for data storage: 4 GB.
Analog inputs	2 x 4...20 mA for pressure and temperature (optional: calculated values) Display on M400.
Power supply	24 VDC, 5 to 60 W minimum

Calibration	
Calibration (factory)	Full calibration
Calibration (user)	One-point and process calibration

Operating conditions	
Ambient temperature range	−20 … +55 °C (−4 … +131 °F) during operation; −40 … +70 °C (−40 … +158 °F) during transport and storage (< 95 % non-condensing humidity)
Temperature & pressure compensation	Using analog 4 … 20 mA input signals or manually set values in M400 compensation (menu configure / measurement. Automatic plausibility check of analog inputs

Installation	
Warm up time	1 hour

	Instrument side purging	
	Instrument side purging (for space between TDL window and process window)	All process adaptions (SP and NP probes, wafer, cross-pipe and extractive cells) require instrument-side purging. For oxygen applications, nitrogen with a purity >99.7% (minimum recommended) at a flow rate of about <0.5 l/min (application dependent) is required. For other gas applications, instrument grade air can be used instead of nitrogen. All purge gases should be clean/dry and conform to standard ISO 8573.1. class 2 3, for Instrument air quality.

	Data logger	
	Function	Logging of all sensor data on SD card
	Interval	See chapter 6.2.3 "Data logging" on page 105.
	Format	SPC

Table 2 Product data probe

	Size and weight	
	Process adaption dimensions	Please see chapter 4 "Dimensions and Drawings" on page 56.
	Weight	– 4–6 kg, depending on length (SP, NP, C, E process adaptions) – 10–15 kg, depending on diameter (wafer cells)

	Material of construction	
	Steel (medium-wetted)	1.4404 (comparable to 316L), 1.4571 steel, C22 Hastelloy
	Optical elements	AR coated Quartz, AR coated Borosilicate, AR coated Sapphire
	Seals	Kalrez® 6375, 6230, 6380, 0090, EPDM FDA, Graphite compounds
	Instrument cover (Blue)	Aluminum – Paint finish – Chemically resistant epoxy resin coating

Other materials of construction as well as different probe lengths are available upon request.

	Process side purging	
	Process side purging – For purged (SP), cross-pipe (C) and wafer (W)	For standard purged (SP), cross-pipe (C) and wafer (W), a process side purge is normally required. For oxygen applications, nitrogen with a purity >99.7% (minimum recommended) at a flow rate of between 0.5 and 10 l/min (application dependent) is required. For other gas applications, instrument grade air can be used instead of nitrogen. All purge gases should be clean/dry and conform to standard ISO 8573.1. class 2 3, for Instrument air quality.
	WARNING: Check valve is required (not provided with GPro 500 – see "Accessories" on page 139).	
	Corner cube purging (for standard purged (SP) and wafer (W)	Yes, via process side purging

Operating conditions		
	Temperature range	0… +250 °C (+ 32 … +482 °F) optional: 0… +600 °C (+ 32 … 1112 °F) with additional thermal barrier, graphite gaskets and quartz optics.
	Design Pressure (see measurement table for maximum operating pressure for specific gases)	max. pressure: 20 bar (290.1 psi). Process adaption dependent
	Max. dust load @ nom. OPL	Application dependent
	Ambient temperature range	–20 … +55 °C (– 4… +131 °F) during operation; –40 … +70 °C (– 40 … +158 °F) during transport and storage (< 95 % non-condensing humidity)

Installation		
	Probe Flange size	DN50/PN25, DN50/PN16, DN80/PN16, DN100/PN25. ANSI 2"/300lb, ANSI 2"/150lb, ANSI 3"/150lb, ANSI 4"/300lb. See Figure 35 on page 76 till Figure 41 on page 77 for further details.

Table 3 Product data M400

Electrical inputs & outputs		
	Communication interface	RS 485 (to sensor head), HART
	Analog outputs	4 x 4...20 mA (22 mA): process temperature, pressure, % conc, % transmission (on M400)
	Relays	6 relays (on M400)
	Power supply	24 VDC or 85...250 VAC, 50/60 Hz @100 VA
	Fuse	2 A slow

ISM diagnostics parameters		
	% Transmission	Available as a 4 … 20 mA analog output
	Window fouling	Time to Maintenance Indicator (TTM). Real time, dynamic prediction of when the next maintenance cycle is required for best operation. Action: Clean the optics (window, corner cube)
	Laser lifetime	Dynamic Lifetime Indicator (DLI). Based on the DLI information, the transmitter tells you when it's time to replace the TDL. Action: Replace TDL (Expected laser diode lifetime >10 years)

Alarms triggers		
	Too low transmission	Min. transmission value to be set in M400 menu Config/ISM setup
	Other	All alarms (incl. SW/HW errors etc.) are listed in Chapter 7.6 General Alarm and chapter 7.7 ISM Sensor Alarm of the M400 manual.

2 Preparations

2.1 Tools and other equipment

The following tools are necessary to install GPro 500:

- 2 pcs open-end spanners for M16 bolts
- 1 pcs Allen key 5 mm for the locking screws on flanges and Tx lid screws
- 1 pcs Allen key 3 mm for the RS 232 cover screws
- 1 pcs flat screwdriver 2.5 mm for electrical connections
- 1 pcs flat (6 mm) or cross head (No 2) screwdriver for Rx lid screws
- Adjustable wrench for purge connections
- 1 pcs Cross pipe positioning kit (for cross-pipe varient only)
- Calibration cell (for oxygen)
- Accessory ND-Filter Verification Tool (for cross-pipe and MRX variants only)

Other equipment necessary, not supplied by METTLER TOLEDO

- Check valve
- Flaw meter (0–10 L/min.) for all probes
- Flow meter (0–20 L/min.) for standard purged probe and wafer cells with purging

2.2 Flow conditions at measuring point

When deciding the placement of the GPro 500 TDL in the process, we recommend a minimum of 5 pipe diameters of straight duct before and 3 pipe diameters of straight duct after the point of measurement. This will lead to laminar flow conditions which is favorable for stable measurement conditions.

2.3 Measuring head placement (probe installations)

The TDL head should be easily accessible. A person should be able to stand in front of it and adjust the M16 fixing bolts using two standard spanners. There should be at least 60 cm free space measured from the flange fixed to the stack and outwards as shown below.

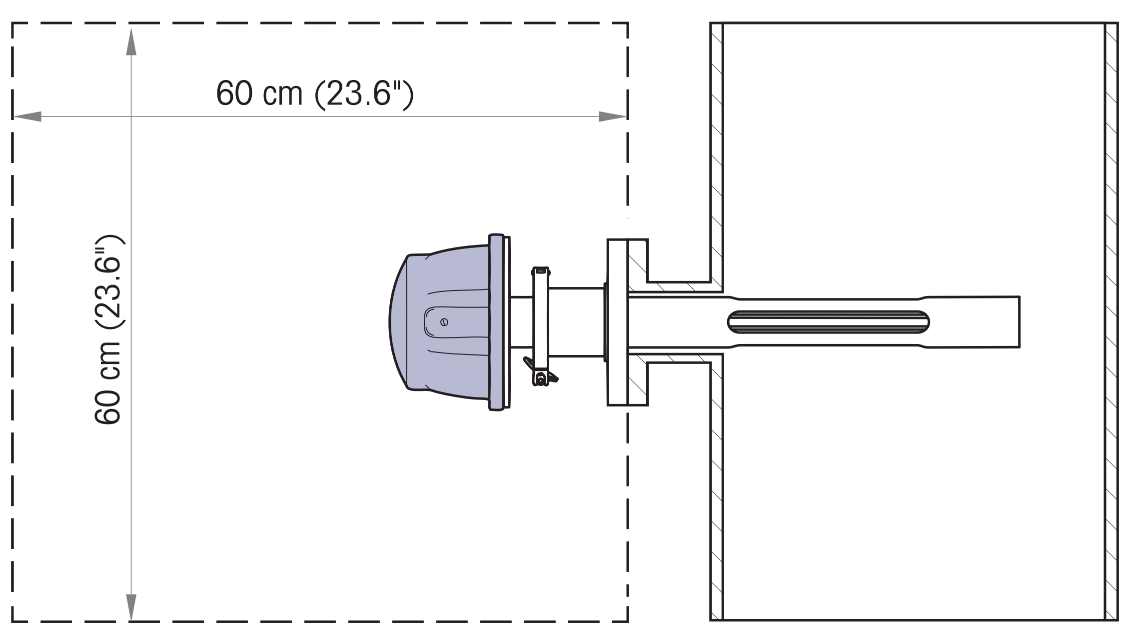


Figure 4 Minimum free space at the process flange.

US Version:

Installation in a Division 1 area requires conduit as well as cable glands approved for the area. The explosionproof probe head will need final adjustment which requires movement of the probe head. To faciliate this, you will need to provide and install an explosionproof flexible coupling (for example: Killark ECF/EKJ) in close proximity to the probe head. The coupling needs to be long enough and installed within your conduit system to minimize vibration and to facilitate final adjustment of the probe head which may include rotation by max. ±90 degrees. Please be sure to provide a coupling which is suitably long.

2.4 Flanges and stack hole requirements (Probe installations)

The probe requires one hole, at least 54 mm in diameter. Standard flange used for connection is DN50/PN25 or ANSI 2"/300 lb. The flange can either be welded directly to the process, or optionally be part of a bypass system. Gasket is not provided.

☞ When the process flange is mounted it is important that the free space in front of it is at least 60 cm to facilitate installation and maintenance. See Chapter 2.3 "Measuring head placement (probe installations)" on page 32.

2.5 Cables and electrical connections

The TDL and M400 are connected with a RS 485 cable. The user should verify that the cable length for the 4–20 mA analogue current output from the TDL does not influence the measurements (due to inductance etc.). If electrical connections have to be made at installation, refer to chapter 5 "Electrical Connections" on page 81.

ATEX Version:

WARNING
The GPro 500 comes with a pre-installed cable and cable gland.
Do not attempt to replace the cable as it will void the warranty
and violate the ATEX classification!

RS 485 cable specifications for the ATEX version: Lead area must be at least 0.5 mm^2 and the maximum length is 200 m. The specification for the Ethernet cable is CAT5.

US Version:

FM
APPROVED

The FM version must be installed using a suitable cabling conduit system in accordance with local codes and regulations. To aid installation, the unit is supplied without an attached cable.

WARNING
The electrical installation must be performed in accordance with National Electrical Codes of practice and/or any other applicable national or local codes.

3 Installation and Start-up

This chapter describes the steps and measures needed to be taken during commissioning of the GPro 500.

3.1 Installation and adjustments

3.1.1 Mechanical installation

The GPro 500 is designed to be very easy to install. The optical path is aligned in the factory so the installation procedure is simply to bolt it to the process flange, mount the purging tube (6 mm or optional 1/4" tube fitting) and mount the cables.

☞ For efficient installation you must make sure that the pre-installation requirements are met prior to the visit of the Mettler-Toledo technician.

☞ For purged (SP) probes and purged wafer (W) cells, if the process is running or if the optical surfaces will be exposed to contaminates or condensates following initial installation, it is essential to connect and turn on the process purge. It is recommended to initially run the purge gas at maximum flow (typically 10 l/min) to protect the optics. This flow will be adjusted and optimized later during final measurement setup.

3.1.2 Process side purging (not applicable to non-purged probe [NP] and extractive cell [E])

Depending on the type of process adaption supplied, there may be requirement for either one or two optical purges. These are called Instrument purge and Process purge.

Figure 6 on page 40 and Figure 16 on page 45 provides further details on the purge requirements for the standard purge (SP) probe together with the typical configuration of the required external flowmeters (rota meters) used to supply and control the purge gas flow.

Purge and non purge Probes without filter.

If installing an SP or NP probe without filter, ensure that the holes/slots are facing the process (verify that the flat gasket between the probe and the sensor head is well installed) and ensure the flange gasket is in place.

Non-purged with filter

Prior to inserting an NP probe with an installed filter, mark the position/angle of the DUST SHIELD on the flange. When installing the probe, ensure that the DUST SHIELD is facing the process in coming flow and ensure the flange gasket is in place.

Instrument Purge

The GPro 500 TDL head attaches to the process adaption via a precision mechanical interface. Between the optical window of the TDL head and the adaption’s process window, there is a small cavity. This cavity forms part of the optical path of the analyzer and therefore it is important that there are no traces of the gas to be measured, i.e. O_2 or H_2O or other, in this space, otherwise this will add to the measurement concentration. The instrument purge is therefore used to flush this space. In addition, in the unlikely event of a breakage of the process window, the purge will flush process gas away from the cavity.

Typical purge gas flow for instrument purge is <0.5 l/min

Note: All current process adaption types require instrument purge.

Process Purge

For standard purged (SP) probes, cross-pipe (C) and purged in-line wafer (W) cells, in addition to the instrument purge described above, these also utilize a process purge to protect the optical windows from direct contact with process gas. The process purge flow is adjusted during commissioning to provide sufficient flow to provide this protection and to set the optical path length through the probe.

Note. Process purge is critical for the protection of the process wetted optical components and for correct operation of the analyzer and therefore must be running at all times.

For oxygen applications nitrogen purge is required, or alternatively another clean, non-explosive, non-corrosive and dry O_2 free gas. For other gas measurements, instrument grade air is normally recommended. The GPro 500 standard purged probes (SP) and purged wafer cells (W) are designed to consume as little purge gas as possible while still keeping the process optical surfaces clean.

When bulk plant nitrogen (or instrument air for non O_2 measurements) is not available gas cylinders can alternatively be used. The purge consumption during normal operation is less than 1 l/min. which means that if you have ten bottles with 3300 Std Liters (Liters of gas when at "standard" room temperature and pressure) filled to 2500 psi (172 bar), which is typically large bottles, they will last at least 3 weeks. Process purge gas consumption rarely exceeds 10 l/min.

The purging of the probe optics is essential to avoid contamination of the probe optics during process operation. After installation ensure that purging is operating before you start the process. The details are described in chapter 3 of the operating instructions.

WARNING
Always start purging at maximum flow before starting the process.

WARNING
Purging must always be switched on in order to avoid dust and/or condensate deposition onto the optical surfaces.

Another alternative is to use a nitrogen generator (for O_2 applications) or local compressed air supply (for non-O_2 applications), as long as it is oil free and non-condensing and meets the quality requirements laid out in ISO 8573.1, class 2–3, for instrument air.

The purging is attached to the 6 mm or 1/4" tube fitting. The purge gas then exits in front of the first window and in front of the corner cube at the end of the probe see Figure 5 "Optimizing the purge flow" on page 37.

WARNING
The purge gas inlet for the process side must have a check valve to avoid contamination of the purging system from process gas.

WARNING
Do not remove and/or disassemble the purge gas inlet for processes (2). If disassembled, the PED pressure certificate is void.

WARNING

Do not connect instrument and process side purging in series, otherwise when disassembling the sensor head the probe purging will stop.

WARNING

The failure of the purging system (both instrument and process side) must trigger an alarm. This alarm has to be implemented in the DCS by the user.

3.1.3 Adjusting the purging flow (for standard purged [SP], cross-pipe [C] and in-line wafer [W] cells)

The flow rate of the purging will affect the effective path length and consequently the measurement value. Therefore the following procedure should be used. Start with a very high flow rate and gradually decrease it. The measurement value will then start at a low value and increase with decreasing purge flow. At some point it will level out and stay constant for a while and then again start increasing. Choose a purge flow in the middle of the constant region.

CAUTION

If the process flow rate remains constant this will be a good purge flow but the effective path length will always be a function of the process flow rate so be observant on this.

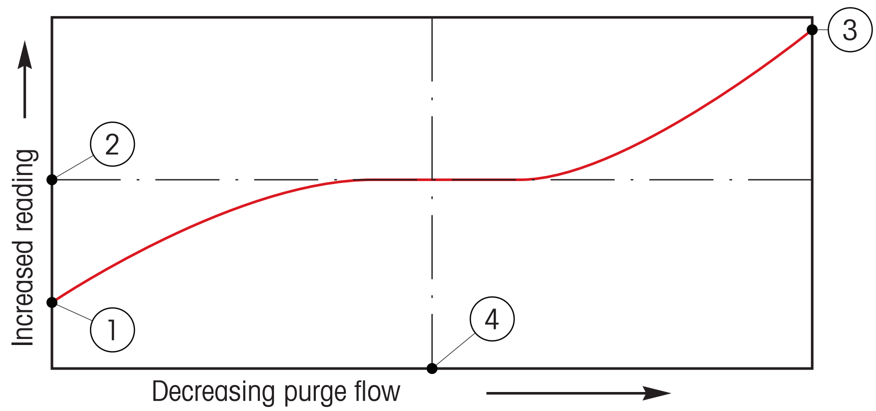


Figure 5 Optimizing the purge flow

On the x-axis there is purge flow and on the y-axis there is the instrument concentration reading.

1. Concentration reading with high purge flow. The path length is now shorter than the effective path length since the purge tubes is completely filled with purging gas and some of the purging gas is flowing into the measurement path.
2. Concentration reading with optimized purge flow. The path length is now equal to the effective path length since the purge tubes are completely filled with purge gas. See the illustration below.
3. Concentration reading with no purge flow. The path length is now equal to the nominal path length since the probe is completely filled with process gas.
4. The optimized purge flow.

3.1.4 Signal Optimization

When in installation mode, the current value of % transmission and the noise signal level (NSL) will be displayed for 5 minutes on the M400 transmitter display, before automatically returning to measurement mode. These two diagnostics values aid in optimizing the laser signal quality. This is accomplished by loosening the securing clamp and slowing rotating the blue TDL head. Continue to rotate the head until the NSL value is less than 40 and the transmission value is above 70%. Finally fully tighten the Tri-Clamp and confirm the values are still acceptable. (See also chapter 3.3 "Settings for Tunable Diode Laser (TDL) Analyzer" on page 54).

⚠	WARNING The GPro 500, when fitted with the standard purged (SP) probe, can not operate in process conditions where process gas stream velocity is typically <1 m/s. This would make the effective path length (see "Dimensions and Drawings" on page 56) too variable. For applications with sample flows <1 m/s, an in-line wafer cell option is available. For static processes where the process gas is clean and dry (non-condensing), for example; tank head space measurement, a non-purge probe option is available.

3.1.5 Setting process purge flow using the NSL (Noise Signal Level)

The NSL (Noise Signal Level) diagnostic provides an indication of signal quality at a glance. It is independent of the optical pathlength, gas concentration or the sample pressure and temperature or process adaption used. Using the NSL together in conjunction with the following simple procedures provides a quick and reliable method for setting process side purging flowrate on process adaptions using such purging.

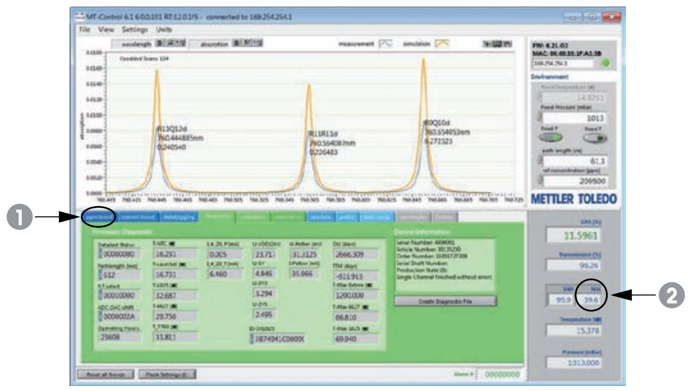
Start with process purge flowrate at maximum.

1) Using M400 G2

- PATH: ⌂\Config\Measurement\TDL Quick Setup\
- Scroll down and click on the button marked Transmission.
- A window opens showing transmission and NSL values
- Adjust the process purge flowrate while observing the transmission and NSL values, varying the flowrate up and down to achieve an NSL value of 40 or lower, while maintaining a good transmission value (>70%).
- This will achieve the optimal process purge flowrate and best signal quality.

2) Using the MT-TDL Software Suite

- From the main screen, select the ppm trend tab and observe the signal and the displayed NSL value, while adjusting the process purge flow rate.
- Adjust the process purge flowrate to achieve an NSL of 40 or lower, while maintaining a good transmission value.
- This will achieve the optimal process purge flowrate and best signal quality.



1 ppm trend tab
2 NSL

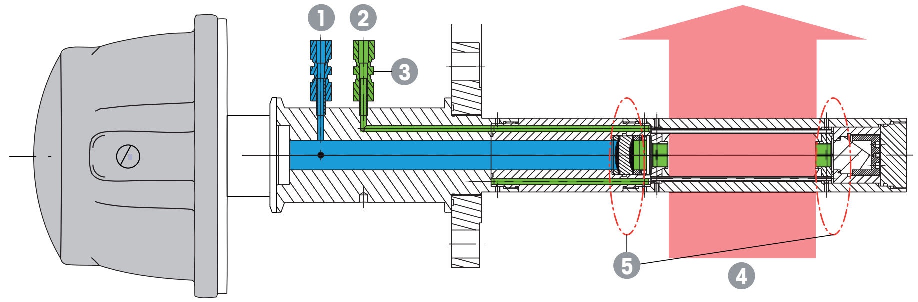


Figure 6 Purging configuration for standard purged probe (SP)

1 Purge gas inlet for instrument side (blue). Purge outlet is at 90 degrees facing away and is not shown in this view. 6 mm Tube Fitting for DIN, ¼" for ANSI versions.
2 Purge gas inlet for process side (green). Must have a check valve to be supplied by the user.
3 Mandatory check valve (to be supplied by the user)
4 Process gas flow
5 Cut-off zone: region that defines the boundaries of the effective path length. See chapter "3.1.3 Adjusting the purging flow (for standard purged [SP], cross-pipe [C] and in-line wafer [W] cells)" on page 37.

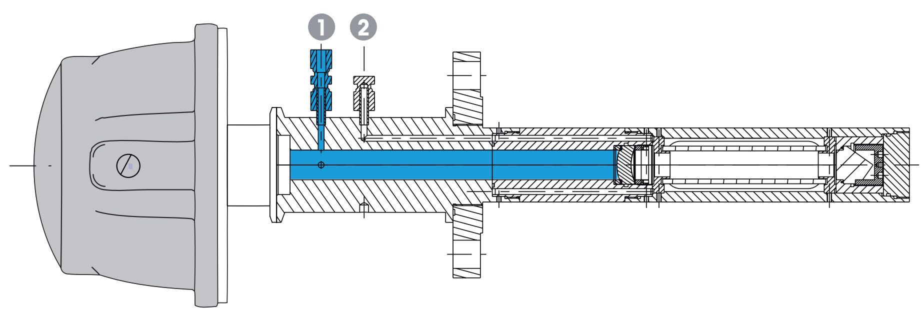


Figure 7 Purging configuration for non-purged probe (NP) with and without filter

1 Instrument purge inlet (blue).
Purge outlet is at 90 degrees facing away and is not shown in this view.
2 Not used; closed.

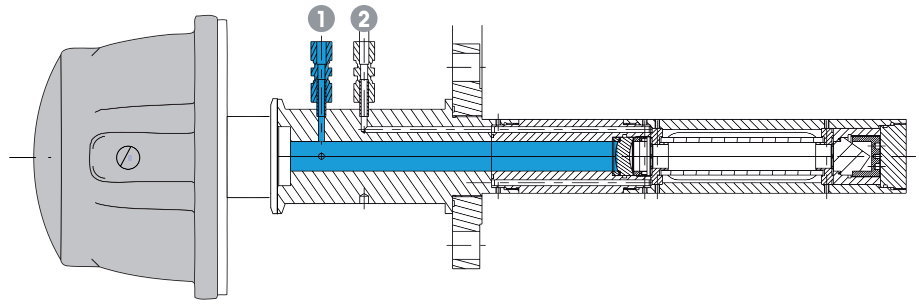


Figure 8 Purging configuration for non-purged probe (B) with Blow-Back

1 Instrument purge inlet (blue).
Purge outlet is at 90 degrees facing away and is not shown in this view.

2 Blow back inlet; Check valve necessary.

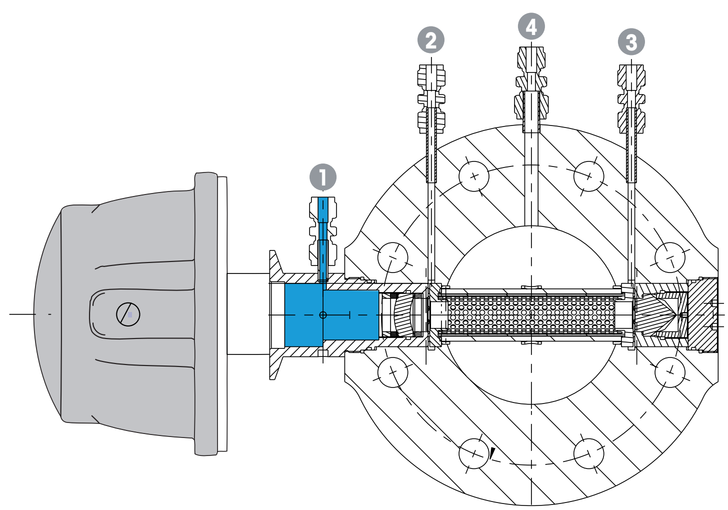


Figure 9 Purging configuration for Wafer (W)

1 Instrument purge inlet (blue).
Purge outlet is at 90 degrees facing away and is not shown in this view.

2 Process purge inlet 1; Check valve necessary.

3 Process purge inlet 2; Check valve necessary.

4 Connection for temperature sensor.

- Filter as an option

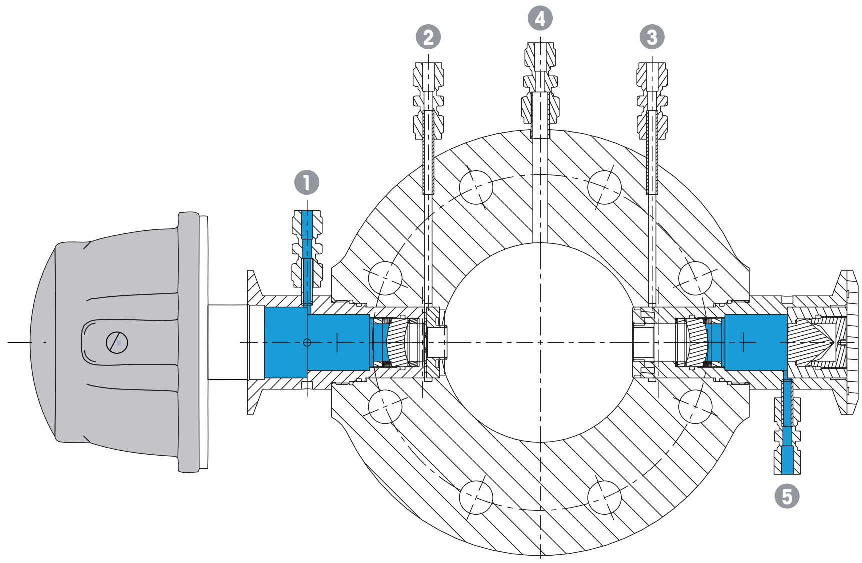


Figure 10 Purging configuration for dual window wafer

1 Instrument purge inlet (blue).
Purge outlet is at 90 degrees facing away and is not shown in this view.
2 Process purge inlet 1; Check valve necessary.
3 Process purge inlet 2; Check valve necessary.
4 Connection for temperature sensor.

- Filter as an option

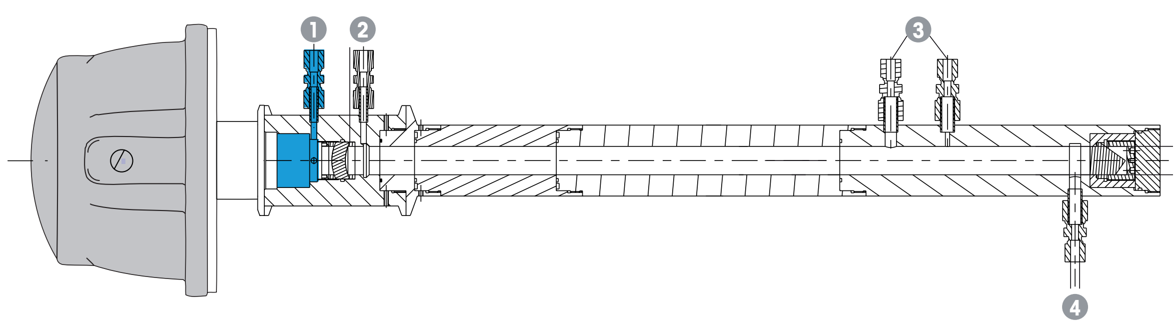


Figure 11 Purging configuration for Extractive cell (E)

1 Instrument purge inlet (blue).
Purge outlet is at 90 degrees facing away and is not shown in this view.
2 Process gas inlet.
3 External pressure and temperature sensor ports.
4 Process gas outlet.

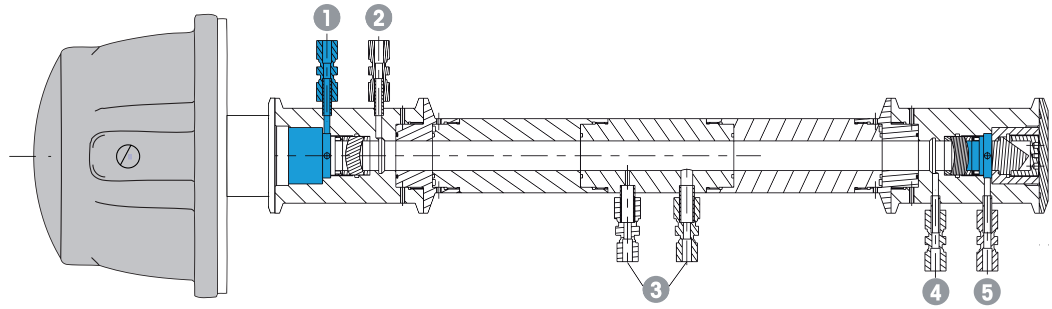


Figure 12 Purging configuration for Extractive Probe Dual Window

1	Instrument purge inlet (blue).
	Purge outlet is at 90 degrees facing away and is not shown in this view.
2	Process gas inlet.
3	External pressure and temperature sensor ports.
4	Process gas outlet.
5	2nd instrument purge (inlet).
	Purge outlet is at 90 degrees facing away and is not shown in this view.

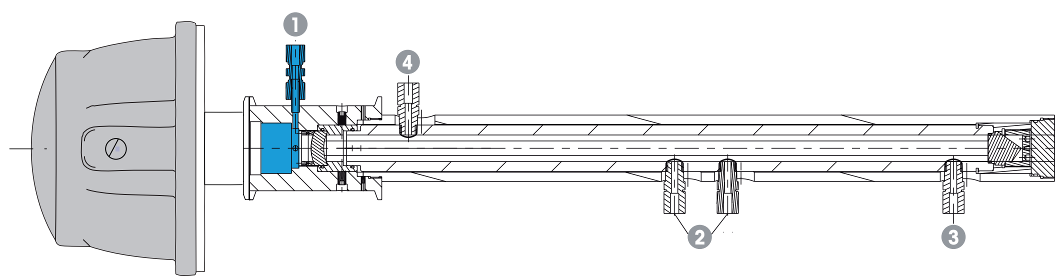


Figure 13 Purging configuration for Extractive Cell PFA

1	Instrument purge inlet (blue).
	Purge outlet is at 90 degrees facing away and is not shown in this view.
2	External pressure and temperature sensor ports.
3	Process gas outlet.
4	Process gas inlet

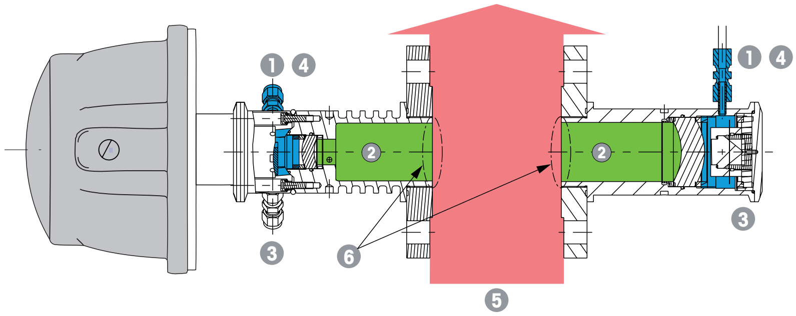


Figure 14 Purging configuration for cross-pipe

1 Purge gas inlet for instrument side (blue). 6 mm Tube Fitting for DIN, ¼" for ANSI versions.
2 Purge gas inlet for process side (green). Must have a check valve to be supplied by the user.
3 Purge gas outlet for instrument side. 6 mm Tube Fitting for DIN, ¼" for ANSI versions.
4 Mandatory check valve (to be supplied by the user)
5 Process gas flow
6 Cut-off zone: region that defines the boundaries of the effective path length. See chapter "3.1.3 Adjusting the purging flow (for standard purged [SP], cross-pipe [C] and in-line wafer [W] cells)" on page 37.

The process side purge connection is fitted with a seal between the fitting and the purge housing to conform to the pressurized equipment directive (PED). To ensure the integrity of this seal and to prevent damage when connecting the purge tube to the fitting, a back spanner (wrench) must be used to securely hold the fitting body as the purge pipe nut is tightened, as illustrated in Figure 15 below.

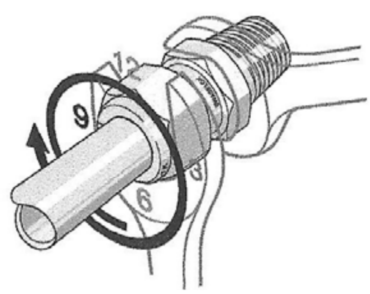


Figure 15 Connecting purge pipe to process side purge fitting.

> **WARNING**
> Do not remove and/or disassemble the purge gas inlet for process.
> If disassembled, the PED pressure certificate is void.

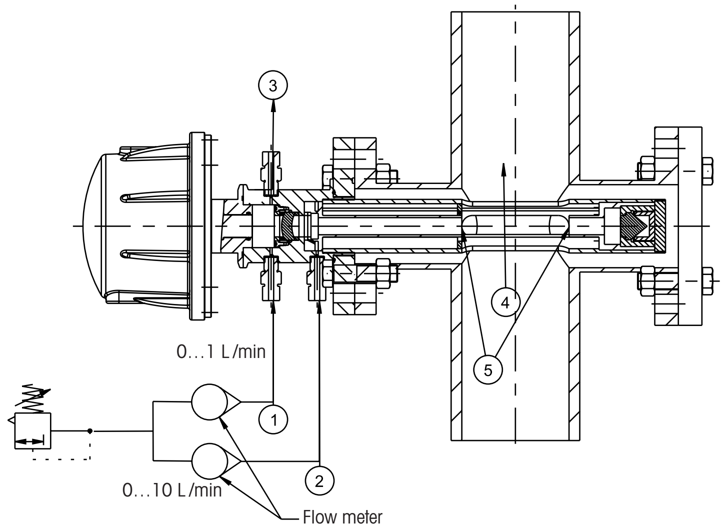


Figure 16 Purge gas rotameter connections for standard purge (SP) probe

1 Purge gas inlet for instrument side (6 mm or ¼" tube fitting).
2 Purge gas inlet for process side (must have a check valve).
3 Purge gas outlet for instrument side (6 mm or ¼" tube fitting).
4 Process gas flow.
5 Region that defines the boundaries of the effective path length.

WARNING
Always start purging at maximum flow before starting the process.

WARNING
Purging must always be switched on in order to avoid dust deposition onto the optical surfaces.

WARNING
Do not remove and/or disassemble the purge gas inlet for processes (2). If disassembled, the PED pressure certificate is void.

WARNING
Do not connect instrument and process side purging in series, otherwise when disassembling the sensor head the probe purging will stop.

WARNING
Instrument side purging must be sufficient in order to maintain the temperature of the sensor head below the maximum acceptable limit of < 55 °C (< 130 °F).

WARNING
The temperature difference between process gas and process purge/blow-back gas should be small enough to avoid stress and cracking on the process window.

WARNING
When the process gas stream is on, the instrument side purging must always be on in order to avoid possibility of ingress of process gas stream into the sensor head in the unlikely event of a TDL sensor head window failure.

3.1.6 Solar radiation and process radiated heat.

Exposure of the TDL head to very high temperatures, for example, solar radiation and/or excessive localized heat sources (such as radiated heat from process walls or adjacent equipment) can cause internal overheating of the device. It is therefore important under these circumstances that adequate protection is provided, either in the form of a roof for solar protection, or a suitable heat shield in the case of excessive radiated heat from nearby processes or equipment. If the TDL is exposed to excessive heat for prolonged periods, the measurement may be withdrawn and the TDL will display a laser source error message. If this should occur, the device should be allowed to cool to its normal operating temperature range and suitable remedial measures made to prevent further overheating occurring. Should the sensor head be exposed to excessive high temperatures beyond the specification, the laser may shutdown, and a laser source error message may be indicated. If this should occur, power should be disconnected and the sensor head allowed to cool before restarting the device.

Note: The solar shield/roof should not enclose the TDL head, as a free flow of air should be allowed to circulate at all times.

3.2 Alignment

The GPro 500 is carefully aligned when it leaves the factory and normally doesn't require any alignment during normal use. If misalignment is suspected you need to contact METTLER TOLEDO or you local supplier, see "Sales and Service" on page 144, and send the GPro 500 back to the factory for re-alignment.

When the GPro 500 sensor head is removed from the probe (or from the thermal barrier should this be installed), for example for verification, it is not necessary to realign it when mounting it back onto the probe (or heat barrier). However, we should recommend to turn the head until the maximum transmission is reached. Consult the M400 manual on how to see the live transmission value on its display. For cross-pipe installations follow the laser signal optimization procedure as detailed in chapter "Sales and Service" on page 52.

3.2.1 Cross-Pipe Process Adaption – Laser beam optimization procedure

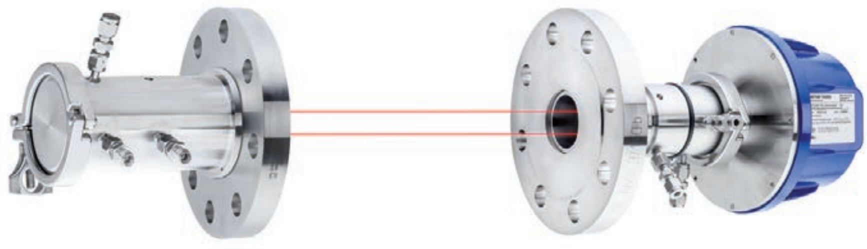


Figure 17 Cross-pipe adaption

The GPro 500 cross-pipe adaption does not require the complex and time consuming alignment procedures common to other in-situ cross pipe analyzers. The unique design offers a simple and fast beam positioning process, which is a one-time set-up and only requires adjustment from the spectrometer side of the pipe.

In addition, due to the sophisticated corner cube array, precision beam positioning is not necessary to achieve good transmission and reliable measurement performance.

There are two possible beam positioning procedures that can be used, dependent largely on the installation conditions. These are described in table below and each procedure detailed in chapter 3.2.1 "Cross-Pipe Process Adaption – Laser beam optimization procedure" on page 47.

Laser Beam Positioning **Reflective Mode**	Laser Beam Positioning **Direct Mode**
Provides fast, single-sided laser beam adjustment using single corner cube mount and reflective target. Used in bright ambient conditions. Optimized to provide a bright laser beam spot to aid adjustment.	Simple and fast, single-sided laser beam adjustment using direct target mounted to reflector side. Used where access to the reflector side of the pipe is possible and as an initial, rough positioning

To facilitate the positioning of the laser beam of the instrument, a beam positioning kit is available as an accessory item (Figure 18 on page 48). Alternatively, METTLER TOLEDO or its local partners can provide a full commissioning service. The kit provides all necessary items to complete each type of beam positioning procedure.

The beam positioning accessory kit comprises of:

– 1x Single corner cube mount
– 1x Laser pointer/reflective mode target assembly
– 1x Direct mode positioning target plate
– 4x Hex wrench
– 1x direct target
– 2x tri-clamps
– 2x spare button cells (for laser pointer)

Figure 18 Beam positioning kit

⚠	WARNING Danger of explosion. The Laser pointer/reflective mode target assembly is not suitable for use in hazardous areas, without prior approval and with a valid hot work permit.

Regardless of which beam positioning procedure is used, adjustment is achieved by simple adjustment of 4 laser beam adjustment screws (Figure 19 on page 48). These screws are recessed into the TDL head flange assembly.

Before starting any beam positioning procedure, all four laser beam adjustment screws should be slightly loosened. This will aid the adjustment process. Hold the loosened end of the cross pipe flange in one hand while beaming the laser to the center of the target (direct or reflective mode)

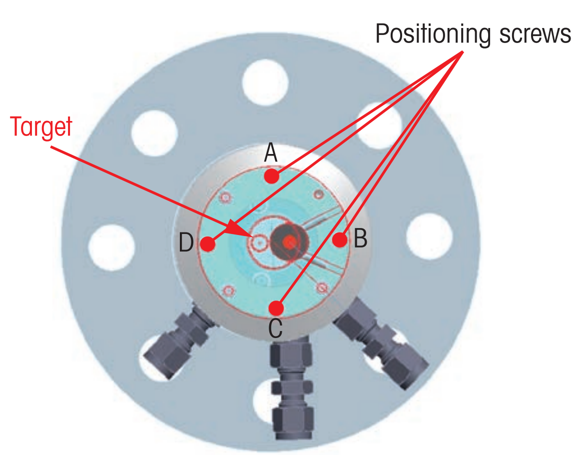


Figure 19 Beam positioning screw location.

To achieve the fastest laser beam adjustment, it is best to work first in one axis and then the opposite direction. The screw adjustment cross shown in Figure 20 on page 49 outlines this process. The same procedure applies to either reflective or direct mode. Only small adjustments to the screws should be made. For longer optical pathlengths, smaller adjustments should be made. As a rule of thumb, for OPLs up to 3 m, turn screws by 1 turn each time, for 3 – 4m, 0.5 turns and for 4 – 6m, 0.25 turns. Continue this sequence of tightening steps until all 4 hex screws (A, B, C and D) are firmly tightened. In this manner, the laser dot remains in the middle of the target while the screws get progressively tightened.

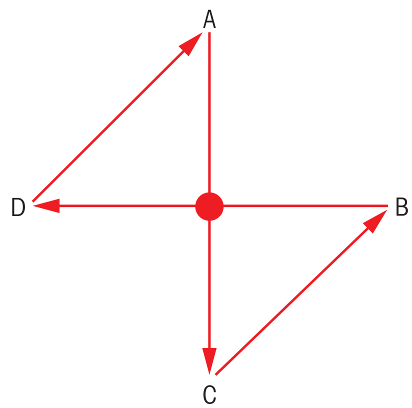


Figure 20 Adjustment cross

Note that precision alignment is not necessary to achieve good transmission and reliable measurement performance of the analyzer.

3.2.2 Beam Positioning – Reflective Mode

The reflective mode uses a temporary single corner cube plate accessory (see Figure 18 on page 48).

In reflective mode, a temporary single corner cube plate is fitted in place of the corner cube array. This offers a brighter and narrow reflected laser beam pattern, which is best suited when installing in bright ambient locations, as it will be easier to see the laser beam on the reflective target.

The laser pointer positioning tool is fitted onto the TDL head mounting flange, as shown in Figure 19 on page 48

⚠	WARNING Do not displace or remove the laser from its holder. It has been factory aligned and its displacement would make the positioning procedure impossible.

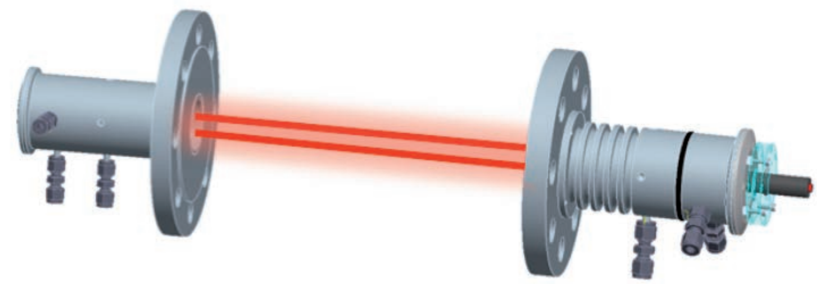


Figure 21 Fitting of laser pointer/reflective mode target to TDL head mounting.

1 Attach laser pointer/reflective target assembly to TDL head flange (see Figure 21 on page 50).
2 Loosen the 4 laser beam positioning adjustment screws (see Figure 19 on page 48).
3 Switch on the laser pointer.

For reflective mode, remove the tri-clamp from the reflector flange assembly and carefully extract the corner cube array and store carefully. Install the single corner cube mount accessory onto the flange and attach the tri-clamp.

4 With reference to the beam positioning pattern (see Figure 20 on page 49), place the laser spot in the middle of the target by hand holding the movable part of the cross pipe flange in one hand. This spot location will become the final position after all hex screws have been tightened. Insert one hex wrench in every one of the four hex screw heads.
5 Adjust first the A screw by tightening it enough to have the laser spot move slightly downwards, but not enough to move the spot outside of the target circle.
6 Continue with tightening the hex screw C to bring again the laser spot in the middle of the target. Again, do not tighten the hex screw too much to avoid losing the spot outside the target circle.
7 Repeat the operation with the horizontal axis by tightening the hex screw B and move the laser spot to the right, Do not over tighten to avoid losing the spot.
8 Now tighten the hex screw D to move the spot to the left and keep it in the middle of the target circle. Repeat the steps 4, 5, 6, 7 a until the 4 hex screws are fastened enough to carry the weight of the analyzer.
9 Remove the laser pointer/reflective target tool and attach the GPro 500 TDL.
10 Refer to chapter 3.2.4 "Final Adjustments" on page 51, to complete the beam positioning process.

3.2.3 Laser Beam Positioning – Direct Mode

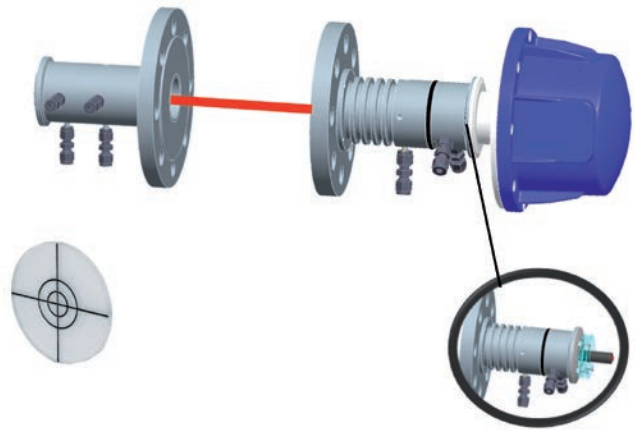


Figure 22 Laser Beam Positioning – Direct Mode

Optimized for quick adjustment where access to the reflector flange assembly is possible

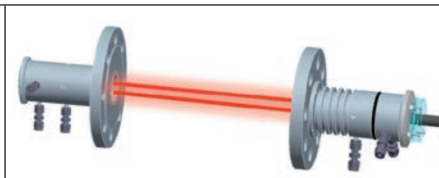
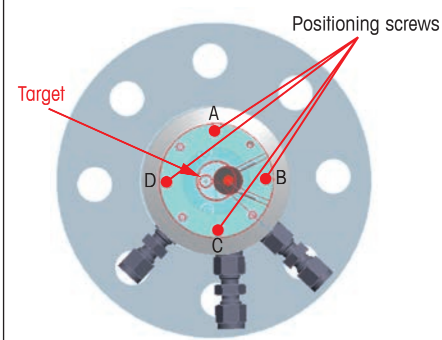
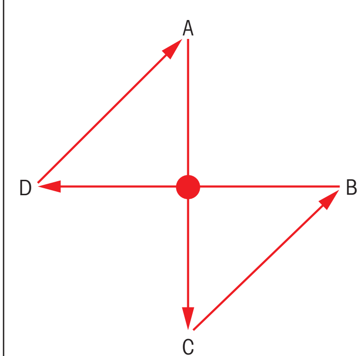
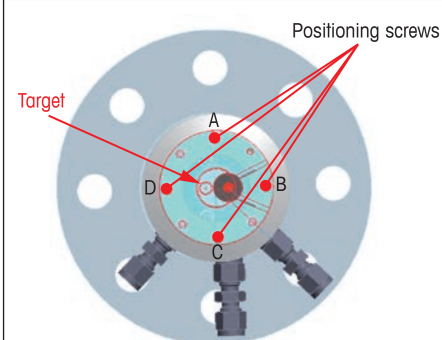
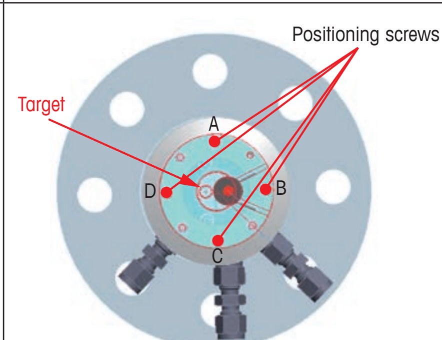
In situations where access to the reflector flange assembly is available, the direct beam positioning procedure can be used. In this procedure, a direct mode target plate is temporarily attached in place of the corner cube array. Although this procedure can be performed while working alone, the process can be optimized if an assistant can monitor the target while the alignment screws are adjusted.

3.2.4 Final Adjustments

Once the laser adjustment procedure has been successfully completed, remove the laser pointer and attach the GPro 500 TDL head. If the corner cube array was removed during the alignment process (Beam Positioning- Reflective Mode 2, or Direct mode), then this should also be carefully re-attached and the tri-clamp tightened.

Once the analyzer has been fully installed onto the pipe and all services connected, power can be applied. Once stabilized, the final beam position and purge flow can be optimized to achieve the best transmission and lowest NSL value, as indicated on the M400 display (installation mode) or via the TDL software suite (see chapter "3.1.5 Setting process purge flow using the NSL (Noise Signal Level)" on page 38. Once the transmission and NSL values have been optimized, tighten the TDL spectrometer tri-clamp.

Quick laser optimization guide

1	Attach laser pointer/reflective target assembly to TDL head flange (see Figure 21 on page 50).	
2	Loosen the 4 laser beam positioning adjustment screws (see Figure 19 on page 48).	
3	Switch on the laser pointer and hold the movable part in one hand while finding the spot in the target.	
4	With reference to the beam positioning pattern (see Figure 20 on page 49), adjust one of the vertical axis alignment screws a few turns (top/bottom screws A, C).	
5	Tighten first the hex screw A and then C in vertical axis while observing the reflective target on the laser pointer/reflective mode target. The laser spot must stay within the target circle at all times.	
6	Tighten first the hex screw B and then D in horizontal axis while observing the reflective target on the laser pointer/reflective mode target. The laser spot must stay within the target circle at all times.	
7	Carefully tighten each screw checking that the laser beam position is not disturbed.	

3.2.5 Signal Optimization

Note that when in installation mode, the current value of % transmission and the noise signal level (NSL) will be displayed for 5 minutes on the M400 transmitter display, before automatically returning to measurement mode. These two diagnostics values aid in optimizing the laser signal quality. This is accomplished by adjusting the process side flow in order to minimize the NSL. Continue to adjust the flow until the NSL value is less than 40 and the transmission value is above 70%. Finally fully tighten the clamp and confirm the values are still acceptable. (See also chapter "3.3 Settings for Tunable Diode Laser (TDL) Analyzer" on page 54).

WARNING

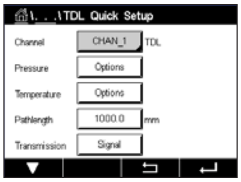
The purge gas for the thermal barrier must always be turned on when the process is running in order to protect the sensor head from permanent damage.

WARNING

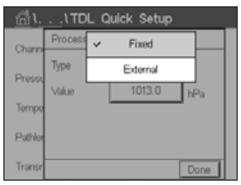
The failure of the instrument side and thermal barrier purging system must trigger an alarm. This alarm has to be implemented in the DCS by the user.

3.3 Settings for Tunable Diode Laser (TDL) Analyzer

(PATH: ⌂\Config\Measurement\TDL quick setup)



If a TDL analyzer is connected, while during the channel setup Auto has been chosen, the parameters Pressure, Temperature and Path length can be set or adjusted. The same parameters will be displayed if during the channel setup not Auto but TDL has been set.



Press the button for Pressure.

– External: current external pressure value coming from a pressure transducer of 4 … 20 mA analog output
– Fixed: pressure compensation uses a fixed value to be set manually.
Note: if this pressure compensation mode is selected, a considerable gas concentration measurement error resulting from a non-realistic pressure value can take place.

If External compensation is selected, then the minimum (4 mA) and maximum (20 mA) analog output signals from the pressure transducer must be mapped to the corresponding analog input of the TDL. Key in the minimum and maximum values of the pressure in the following units:

– hPa – mmHg – mbar
– psi – kPa

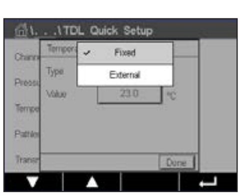
In general, METTLER TOLEDO recommends the use of absolute pressure transducers for more accurate signal compensation over a broad pressure range.

If, however, small pressure variations around atmospheric pressure are to be expected, relative pressure sensors will produce better results; but the variations of the underlying barometric pressure will be ignored.

For relative pressure sensors, the minimum and maximum values must be mapped so that the TDL can interpret the analog pressure signal as "absolute", i.e. a fixed barometric pressure of 1013 mbar (for example) has to be added to the mapped values.

If Fixed compensation is selected, the fixed pressure value with which the measurement signal will be calculated has to be keyed in manually. For the fixed pressure, the following units can be used:

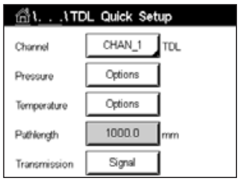
– hPa – mmHg – mbar
– psi – kPa



Press the button for Temperature.

If External compensation is selected, then the minimum (4 mA) and maximum (20 mA) analog output signals from the temperature transducer must be mapped to the corresponding Analog input of the TDL. Key in the minimum and maximum values of the temperature in °C.

If Fixed compensation is selected, the fixed temperature value with which the measurement signal will be calculated has to be keyed in manually. For the fixed temperature, only °C can be used.



Last, select the initial optical path length corresponding to the probe length installed:

- 200 mm
- 400 mm
- 800 mm

This initial value is valid when instrument purging on the instrument and on the process side is running. Depending on the process conditions and after the optimum of the process purging flow has been found (see next chapter), this value may have to be slightly adapted.

4 Dimensions and Drawings

4.1 Standard purged probe (SP)

The GPro 500 is available with 3 different probe lengths. It can also be supplied with various flange sizes to suit the installation (see page 44 for flange dimensions). This will increase the number of available applications where the GPro 500 will fit smoothly. The dimensions of the TDL heads as well as of the flanges and the thermal barrier are shown below.

☞ There are four different lengths that should be observed. The most relevant from the standpoint of measuring performance is the **Effective path length**.

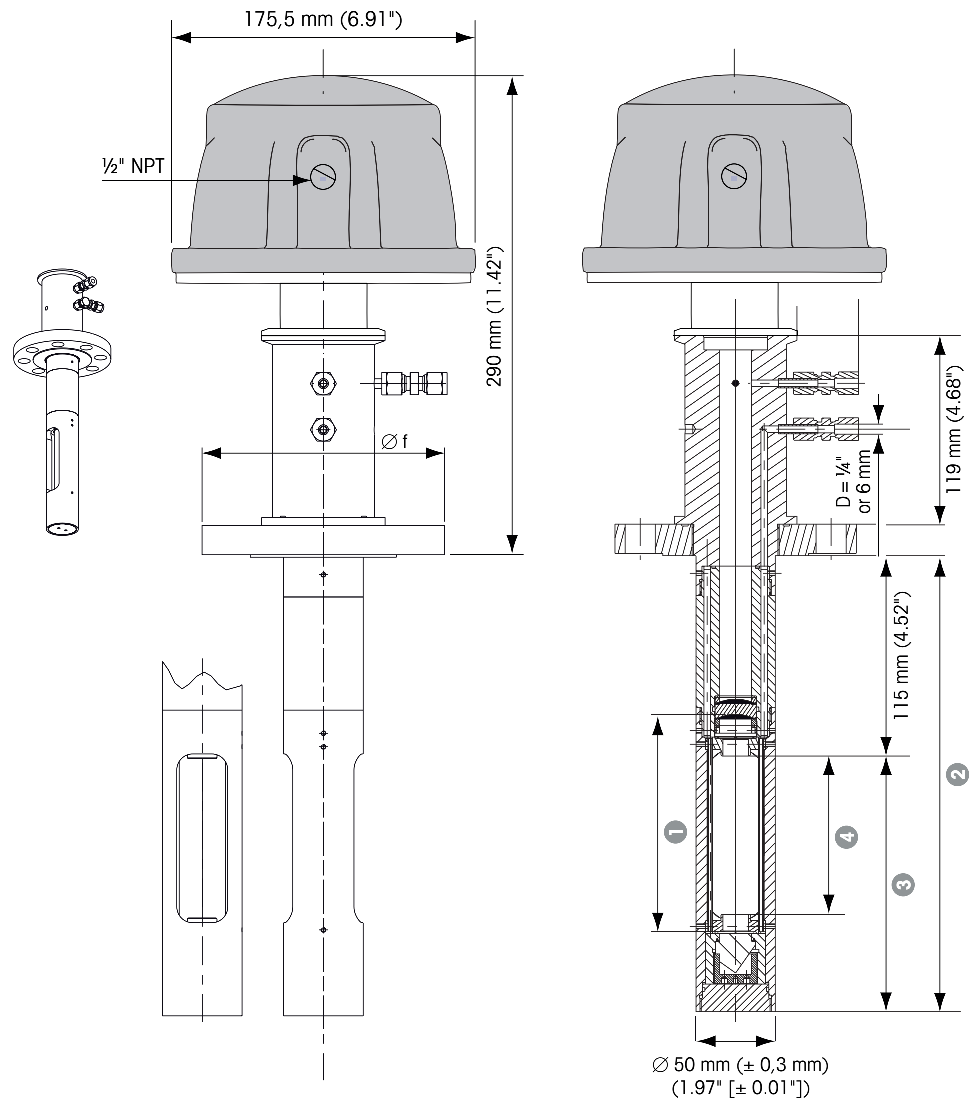


Figure 23 Dimensions of the standard probe (SP)

Definition of the lengths:

❶ **Nominal path length,** the default length when GPro 500 is delivered. It corresponds to the effective path length without purging.
❷ **Probe length,** the physical length of the probe.
❸ **Insertion length,** part of the probe that has to protrude into the pipe for effective purging.
❹ **Effective path length,** when configuring the GPro 500 with the M400, the double value of the effective path length must be keyed in (2x effective path length).

Note: • The exact dimensions may vary depending on the configuration.

Probes, wafer and cell dimensions					
Standard purged probe (SP)	**OPL**	**Dimension ❶**	**Dimension ❷**	**Dimension ❸**	**Dimension ❹**
Standard purged (SP)	200 mm (7.9")	138 mm (5.4")	288 mm (11.3")	161.5 mm (6.4")	138 mm (5.3")
Standard purged (SP)	400 mm (15.7")	238 mm (9.4")	388 mm (15.3")	261.5 mm (10.3")	238 mm (9.4")
Standard purged (SP)	800 mm (31.5")	438 mm (17.2")	588 mm (23.1")	461.5 mm (18.2")	438 mm (17.2")

Note: Dimension ❷ in above table applies for standard 100 mm (3.94") stand-off and for probes with 20 mm (0.79") flange thickness. For total probe length dimensions for other stand-off lengths, please refer to product configurator.

4.2 Non-purged probe (NP) with filter

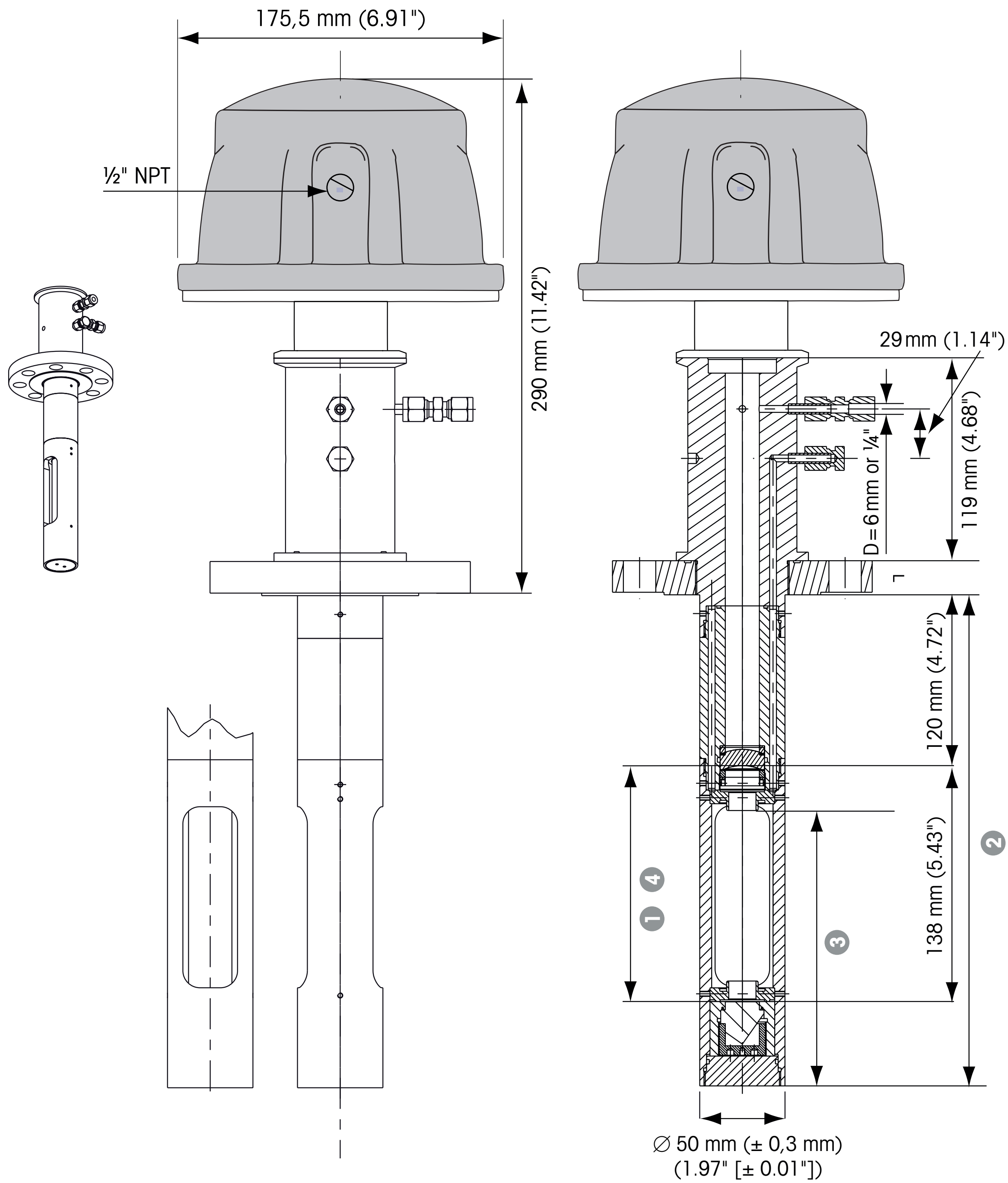


Figure 24 Dimensions of the non-purged probe (NP) with filter.

Definition of the lengths:

1. **Nominal path length,** the default length when GPro 500 is delivered. It corresponds to the effective path length without purging.
2. **Probe length,** the physical length of the probe.
3. **Insertion length,** part of the probe that has to protrude into the pipe for effective purging.
4. **Effective path length,** when configuring the GPro 500 with the M400, the double value of the effective path length must be keyed in (2x effective path length).

Note: • When using the PTFE filter, the maximum process gas temperature is 302 °F (150 °C).
• Metal filters available: 3 µm, 40 µm, 100 µm, 200 µm.

Probes, wafer and cell dimensions					
Non-purged probe (NP) with filter	**OPL**	**Dimension ❶**	**Dimension ❷**	**Dimension ❸**	**Dimension ❹**
Non-purged probe (NP)	200 mm (7.9")	138 mm (5.4")	288 mm (11.3")	161.5 mm (6.4")	138 mm (5.4")
Non-purged probe (NP)	400 mm (15.7")	238 mm (9.4")	388 mm (15.3")	261.5 mm (10.3")	238 mm (9.4")
Non-purged probe (NP)	800 mm (31.5")	438 mm (17.2")	588 mm (23.1")	461.5 mm (18.2")	438 mm (17.2")

Note: Dimension ❷ in above table applies for standard 100 mm (3.94") stand-off and for probes with 20 mm (0.79") flange thickness. For total probe length dimensions for other stand-off lengths, please refer to product configurator.

4.3 Non-purged probe (B) with Blow-Back

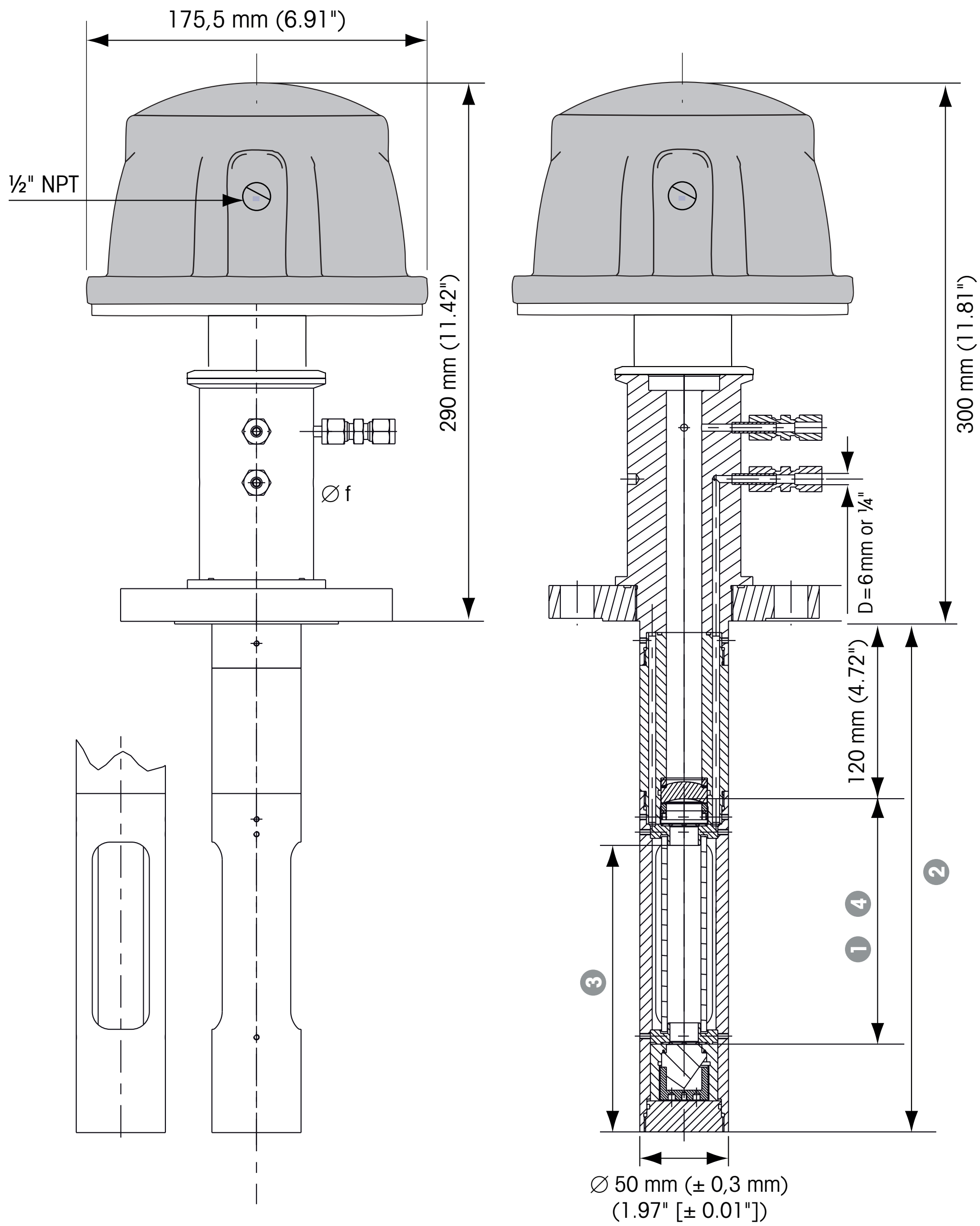


Figure 25 Dimensions of the non-purged probe (B) with Block-Back.

Definition of the lengths:

1. **Nominal path length,** the default length when GPro 500 is delivered.
   It corresponds to the effective path length without purging.
2. **Probe length,** the physical length of the probe.
3. **Insertion length,** part of the probe that has to protrude into the pipe for effective purging.
4. **Effective path length,** when configuring the GPro 500 with the M400, the double value of the effective path length must be keyed in (2x effective path length).

Note:
- When using the PTFE filter, the maximum process gas temperature is 302 °F (150 °C).
- Metal filters available: 3 µm, 40 µm, 100 µm, 200 µm.

Probes, wafer and cell dimensions					
Non-purged probe (NP) with blow-back	**OPL**	**Dimension ❶**	**Dimension ❷**	**Dimension ❸**	**Dimension ❹**
Non-purged filter probe with blow-back (NB)	200 mm (7.9")	138 mm (5.4")	288 mm (11.3")	161.5 mm (6.4")	100 mm (3.9")
Non-purged filter probe with blow-back (NB)	400 mm (15.7")	238 mm (9.4")	388 mm (15.3")	261.5 mm (10.3")	200 mm (7.9")
Non-purged filter probe with blow-back (NB)	800 mm (31.5")	438 mm (17.2")	588 mm (23.1")	461.5 mm (18.2")	400 mm (15.7")

Note: Dimension ❷ in above table applies for standard 100 mm (3.94") stand-off and for probes with 20 mm (0.79") flange thickness. For total probe length dimensions for other stand-off lengths, please refer to product configurator.

4.4 Configuring Blow-back function

When using the non-Purge probe with blow-back (NB), a suitable N2 or instrument air supply can be connected to the probe blow-back port. A suitable solenoid valve can then be connected to the M400 Transmitter, relay 1 connections (as detailed below) to initiate blow-back on a timed basis.

This is configured through the M400 interface:
Menu/Configure/Alarm/clean

Select clean and relay #1.
Press ENTER.
Select clean interval (period between cleaning cycles) and clean time (how long the solenoid valve is activated).
Press ENTER.
Select relay normal or inverted mode and finally save settings.

Blow-back will now be initiated automatically at the configured schedule.

4.5 Wafer (W)

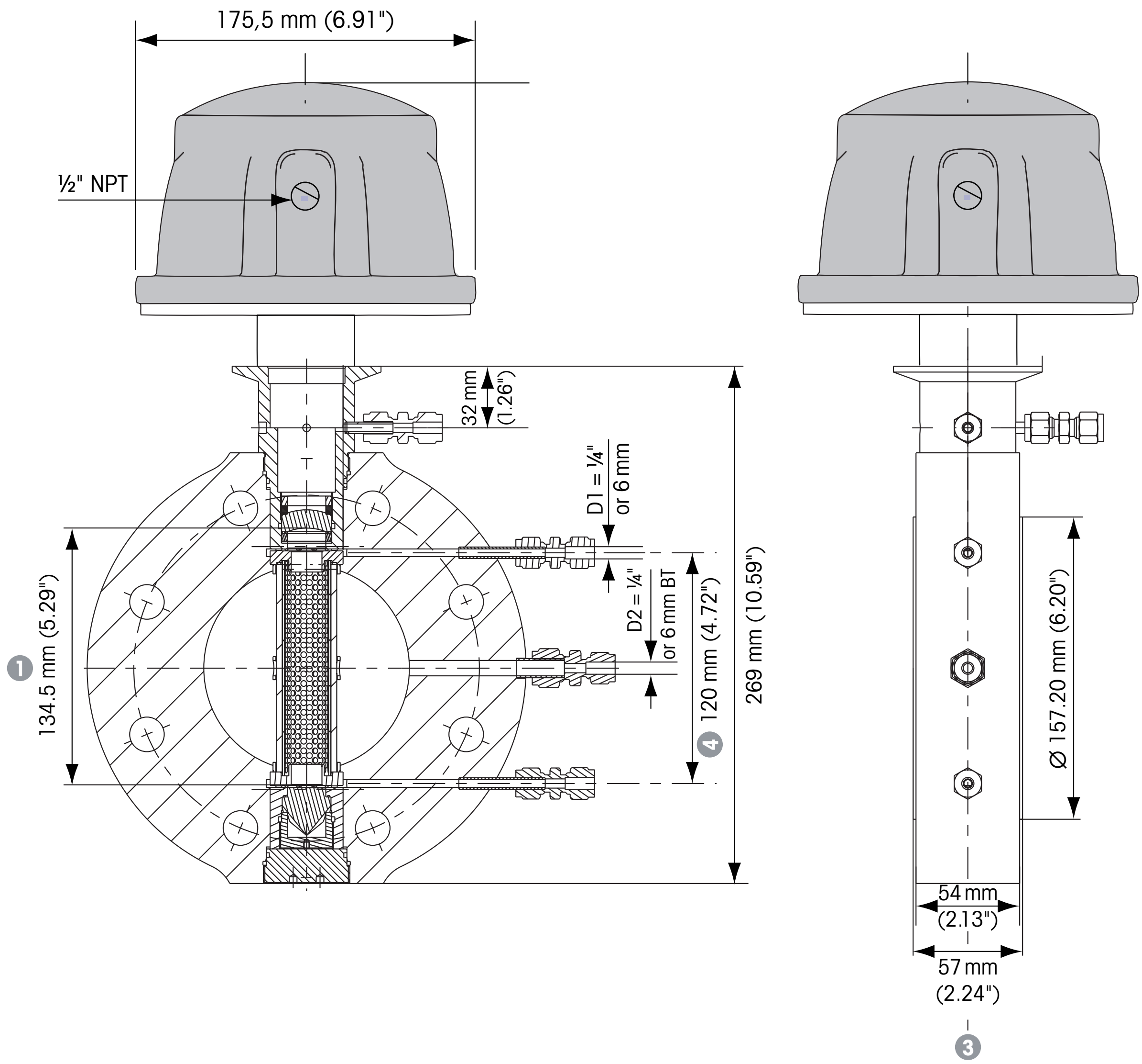


Figure 26 Dimensions of the wafer (W).

Definition of the lengths:

- ➊ **Nominal path length,** the default length when GPro 500 is delivered. It corresponds to the effective path length without purging.
- ➌ **Insertion length,** wafer thickness (distance between pipe flanges).
- ➍ **Effective path length,** when configuring the GPro 500 with the M400, the double value of the effective path length must be keyed in (2x effective path length).

Note:
- Filters only available on DN100/4" wafers.
- When using the PTFE filter, the maximum process gas temperature is 302 °F (150 °C).
- Metal filters available: 3 µm, 40 µm, 100 µm, 200 µm.

4.6 Wafer (W) Dual-Window

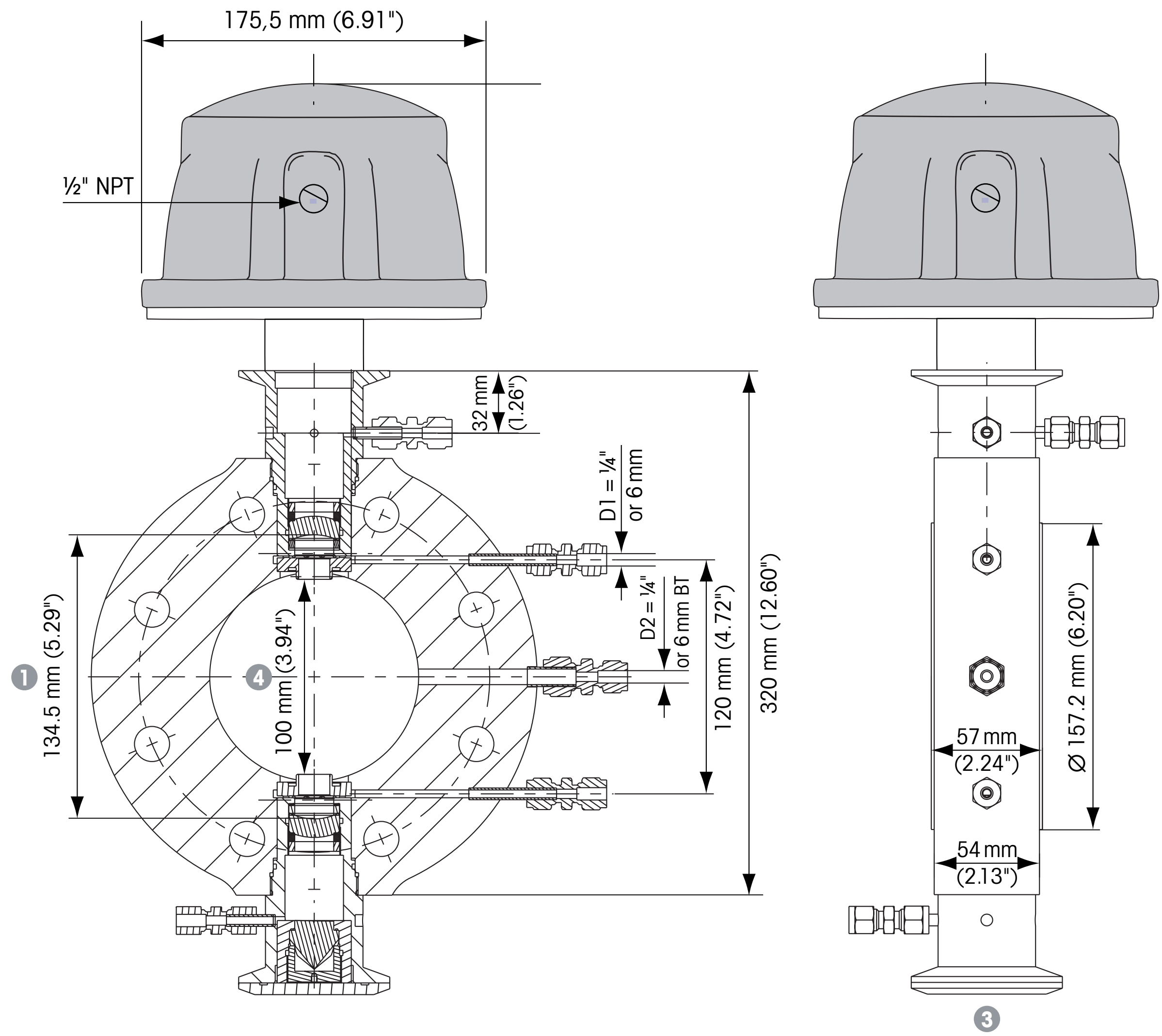


Figure 27 Dimensions of the wafer (W) dual-window.

Definition of the lengths:

1. **Nominal path length,** the default length when GPro 500 is delivered. It corresponds to the effective path length without purging.
3. **Insertion length,** wafer thickness (distance between pipe flanges).
4. **Effective path length,** when configuring the GPro 500 with the M400, the double value of the effective path length must be keyed in (2x effective path length).

Probes, wafer and cell dimensions					
Wafer (W) without filter	**OPL**	**Dimension ❶**	**Dimension ❷**	**Dimension ❸**	**Dimension ❹**
DN 50 wafer (W)	100 mm (3.94")	79 mm (3.11")	n.a.	54 mm (2.13")	55 mm (2.17")
DN 80 wafer (W)	154 mm (6.06")	121 mm (4.76")	n.a.	54 mm (2.13")	82 mm (3.29")
DN 100 wafer (W)	200 mm (7.87")	157 mm (6.18")	n.a.	54 mm (2.13")	107 mm (4.21")
ANSI 2" wafer (W)	100 mm (3.94")	77 mm (3.03")	n.a.	54 mm (2.13")	52 mm (2.05")
ANSI 3" wafer (W)	154 mm (6.06")	99 mm (3.90")	n.a.	54 mm (2.13")	77 mm (3.03")
ANSI 4" wafer (W)	200 mm (7.87")	157 mm (6.18")	n.a.	54 mm (2.13")	102 mm (4.06")

Note: For DN 80 (3") and DN 100 (4") wafer with filter, please use dimension ❶ as effective path length.

Probes, wafer and cell dimensions					
Wafer (W) with filter	**OPL**	**Dimension ❶**	**Dimension ❷**	**Dimension ❸**	**Dimension ❹**
DN 80 wafer (W)	222 mm (8.74")	111 mm (4.37")	n.a.	54 mm (2.13")	82 mm (3.29")
DN 100 wafer (W)	268 mm (10.55")	134 mm (5.27")	n.a.	54 mm (2.13")	107 mm (4.21")
ANSI 3" wafer (W)	222 mm (8.74")	111 mm (4.37")	n.a.	54 mm (2.13")	77 mm (3.03")
ANSI 4" wafer (W)	268 mm (10.55")	134 mm (5.27")	n.a.	54 mm (2.13")	107 mm (4.21")

Note: For DN 80 (3") and DN 100 (4") wafer with filter, please use dimension ❶ as effective path length.

Probes, wafer and cell dimensions					
Wafer Dual Window (DW) without filter	**OPL**	**Dimension ❶**	**Dimension ❷**	**Dimension ❸**	**Dimension ❹**
DN 50 wafer (W)	100 mm (3.94")	94 mm (3.70")	n.a.	54 mm (2.13")	55 mm (2.17")
DN 80 wafer (W)	154 mm (6.06")	121 mm (4.76")	n.a.	54 mm (2.13")	82 mm (3.29")
DN 100 wafer (W)	200 mm (7.87")	144 mm (5.67")	n.a.	54 mm (2.13")	107 mm (4.21")
ANSI 2" wafer (W)	100 mm (3.94")	94 mm (3.70")	n.a.	54 mm (2.13")	52 mm (2.05")
ANSI 3" wafer (W)	154 mm (6.06")	121 mm (4.76")	n.a.	54 mm (2.13")	77 mm (3.03")
ANSI 4" wafer (W)	200 mm (7.87")	144 mm (5.67")	n.a.	54 mm (2.13")	107 mm (4.21")

Note: For DN 80 (3") and DN 100 (4") wafer with filter, please use dimension ❶ as effective path length.

Probes, wafer and cell dimensions					
Wafer Dual Window (DW) with filter	**OPL**	**Dimension ❶**	**Dimension ❷**	**Dimension ❸**	**Dimension ❹**
DN 80 wafer (W)	242 mm (9.53")	121 mm (4.76")	n.a.	54 mm (2.13")	82 mm (3.29")
DN 100 wafer (W)	288 mm (11.34")	144 mm (5.67")	n.a.	54 mm (2.13")	107 mm (4.21")
ANSI 3" wafer (W)	242 mm (9.53")	121 mm (4.76")	n.a.	54 mm (2.13")	77 mm (3.03")
ANSI 4" wafer (W)	288 mm (11.34")	144 mm (5.67")	n.a.	54 mm (2.13")	107 mm (4.21")

Note: For DN 80 (3") and DN 100 (4") wafer with filter, please use dimension ❶ as effective path length.

4.7 Cross Pipe

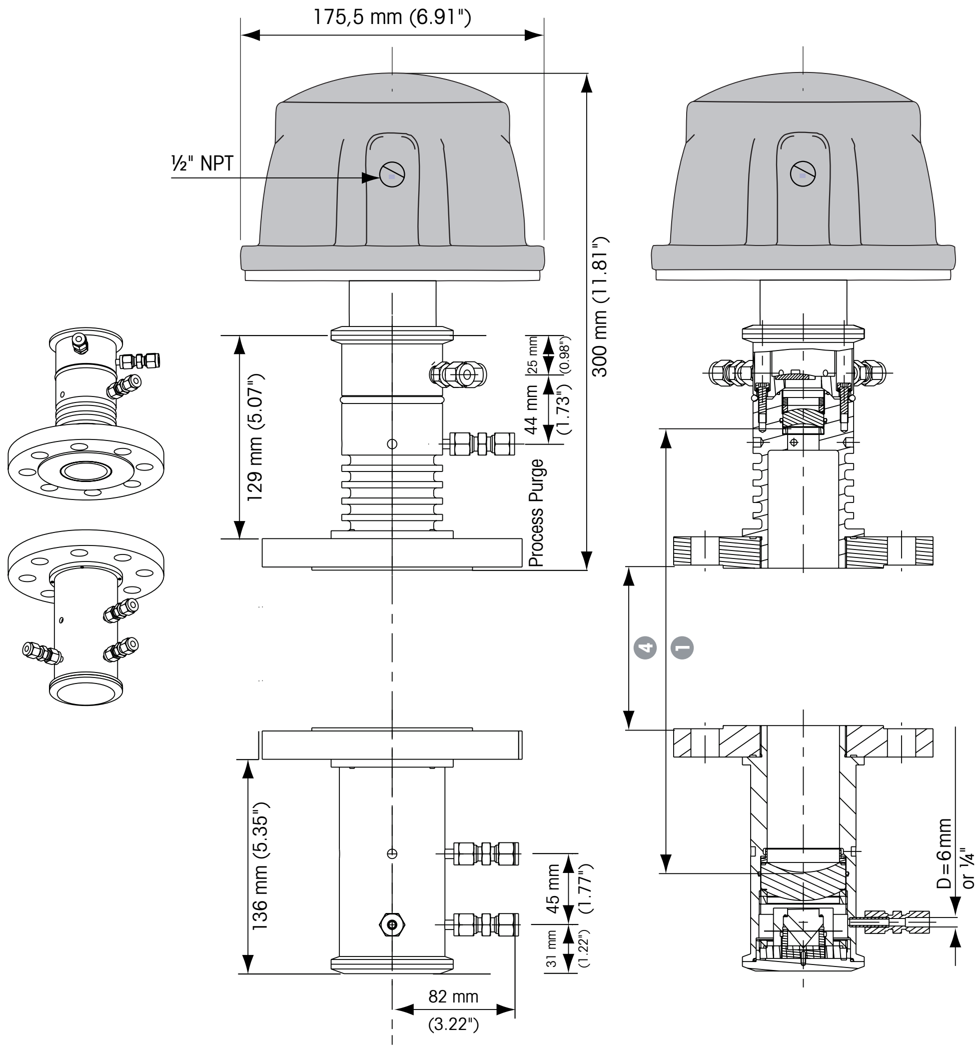


Figure 28 Dimensions of Cross Pipe.

Definition of the lengths:

- ❶ **Nominal path length,** the default length when GPro 500 is delivered. It corresponds to the effective path length without purging.
- ❹ **Effective path length,** when configuring the GPro 500 with the M400, the double value of the effective path length must be keyed in (2x effective path length).

Cross-Pipe Dimensions					
Cross-Pipe (C)	**OPL**	**Dimension ❶**	**Dimension ❷**	**Dimension ❸**	**Dimension ❹**
Cross-Pipe (C)	2000–6000 mm (78.74"–236.22")	2000–6000 mm (78.74"–236.22")	n/a	n/a	Dimension ❶–300 mm (11.81")

4.8 Extractive cell (E)

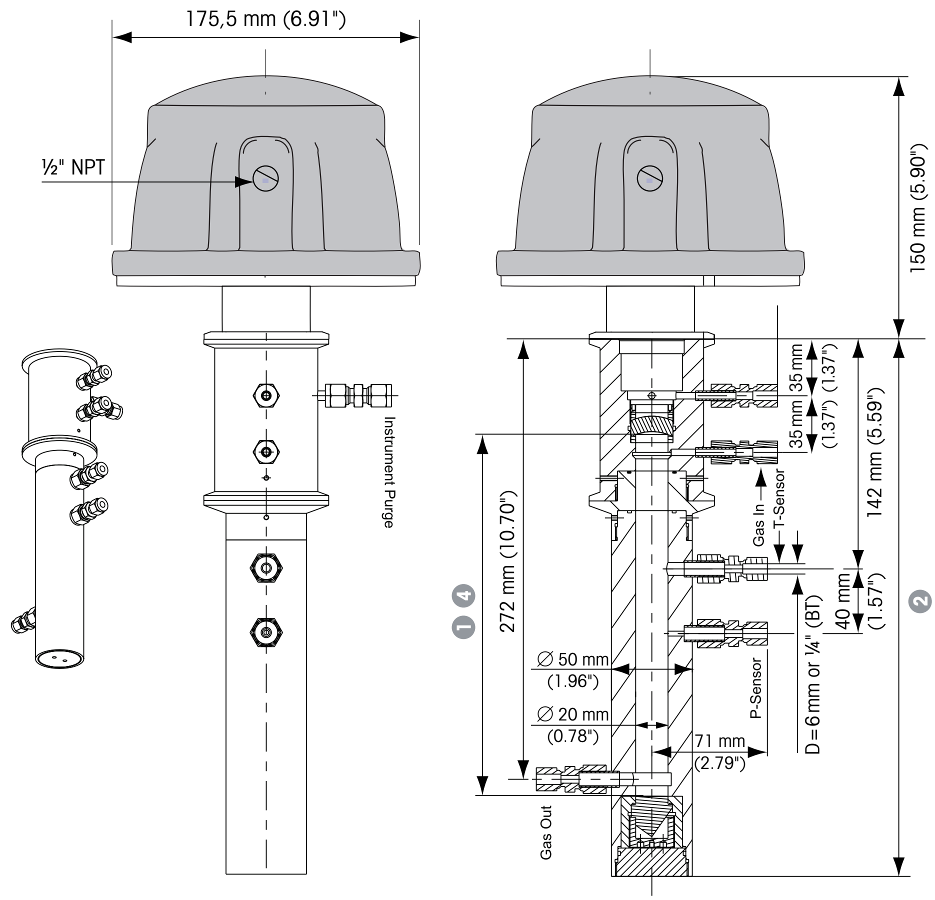


Figure 29 Dimensions of the extractive cell (E).

Definition of the lengths:

➊ **Nominal path length,** the default length when GPro 500 is delivered. It corresponds to the effective path length without purging.
➋ **Probe length,** the physical length of the probe.
➍ **Effective path length,** when configuring the GPro 500 with the M400, the double value of the effective path length must be keyed in (2x effective path length).

Probes, wafer and cell dimensions					
Extractive cell (E)	**OPL**	**Dimension ➊**	**Dimension ➋**	**Dimension ➌**	**Dimension ➍**
Extractive cell (E)	200 mm (7.9")	125 mm (4.92")	232 mm (9.13")	N.A N.A	125 mm (4.92")
Extractive cell (E)	400 mm (15.7")	225 mm (8.86")	332 mm (13.07")	N.A N.A	225 mm (8.86")
Extractive cell (E)	800 mm (31.5")	425 mm (16.73")	532 mm (20.94")	N.A N.A	425 mm (16.73")
Extractive cell (E)	1000 mm (39.4")	525 mm (20.67")	632 mm (24.88")	N.A N.A	525 mm (20.67")

4.9 Extractive Probe Dual Window

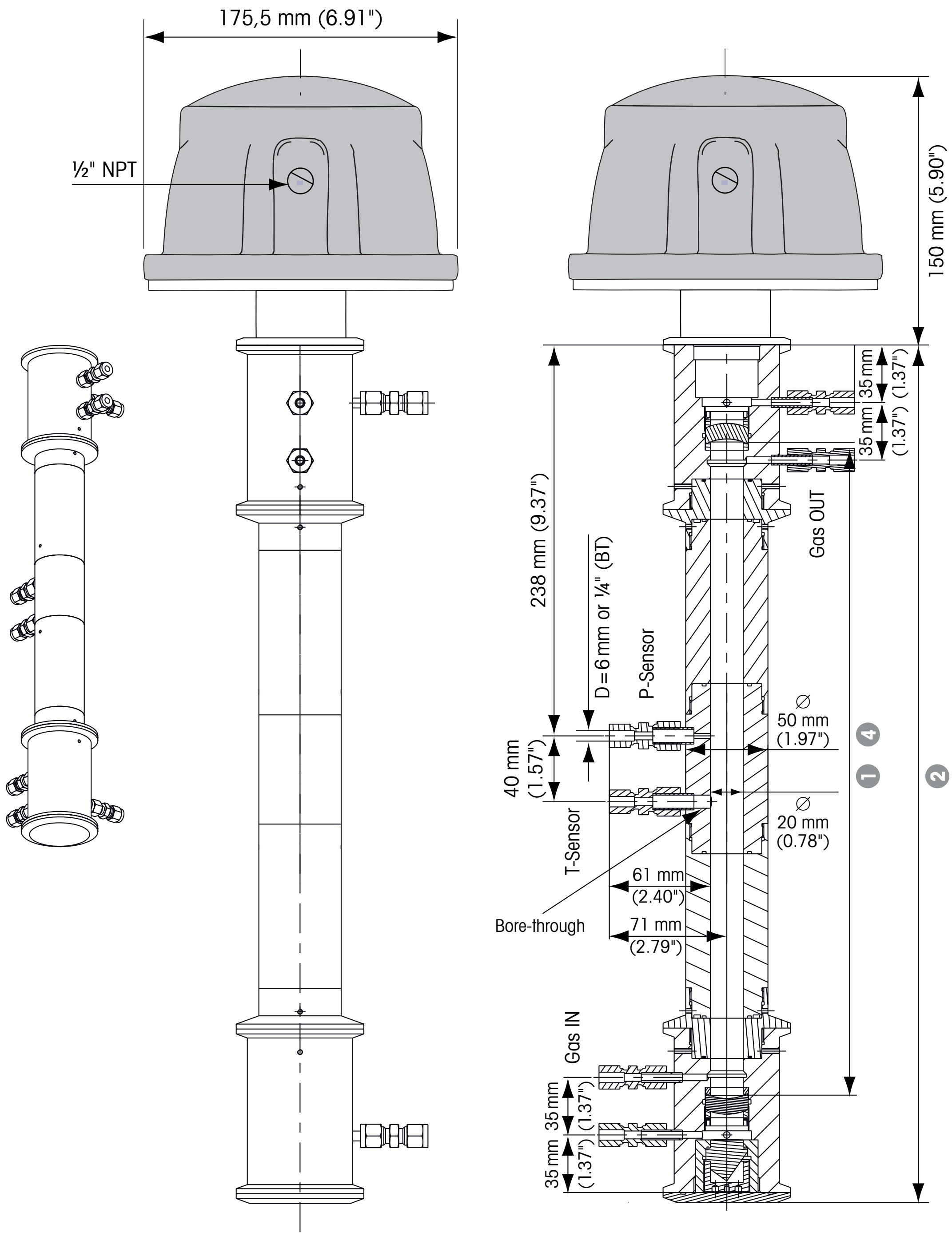


Figure 30 Dimensions of the extractive dual window.

Definition of the lengths:

❶ **Nominal path length,** the default length when GPro 500 is delivered.
It corresponds to the effective path length without purging.
❷ **Probe length,** the physical length of the probe.
❹ **Effective path length,** when configuring the GPro 500 with the M400, the double value of the effective path length must be keyed in (2x effective path length).

Probes, wafer and cell dimensions					
Extractive cell Dual Window (E)	**OPL**	**Dimension ❶**	**Dimension ❷**	**Dimension ❸**	**Dimension ❹**
Extractive cell Dual Window(E)	400 mm (15.7")	200 mm (7.9")	321 mm (12.6")	N.A N.A	200 mm (7.9")
Extractive cell Dual Window(E)	800 mm (31.5")	400 mm (15.7")	521 mm (20.5")	N.A N.A	400 mm (15.7")
Extractive cell Dual Window(E)	(1000 mm (39.4")	(500 mm (19.7")	(621 mm (24.4")	N.A N.A	(500 mm (19.7")

4.10 Extractive Cell PFA

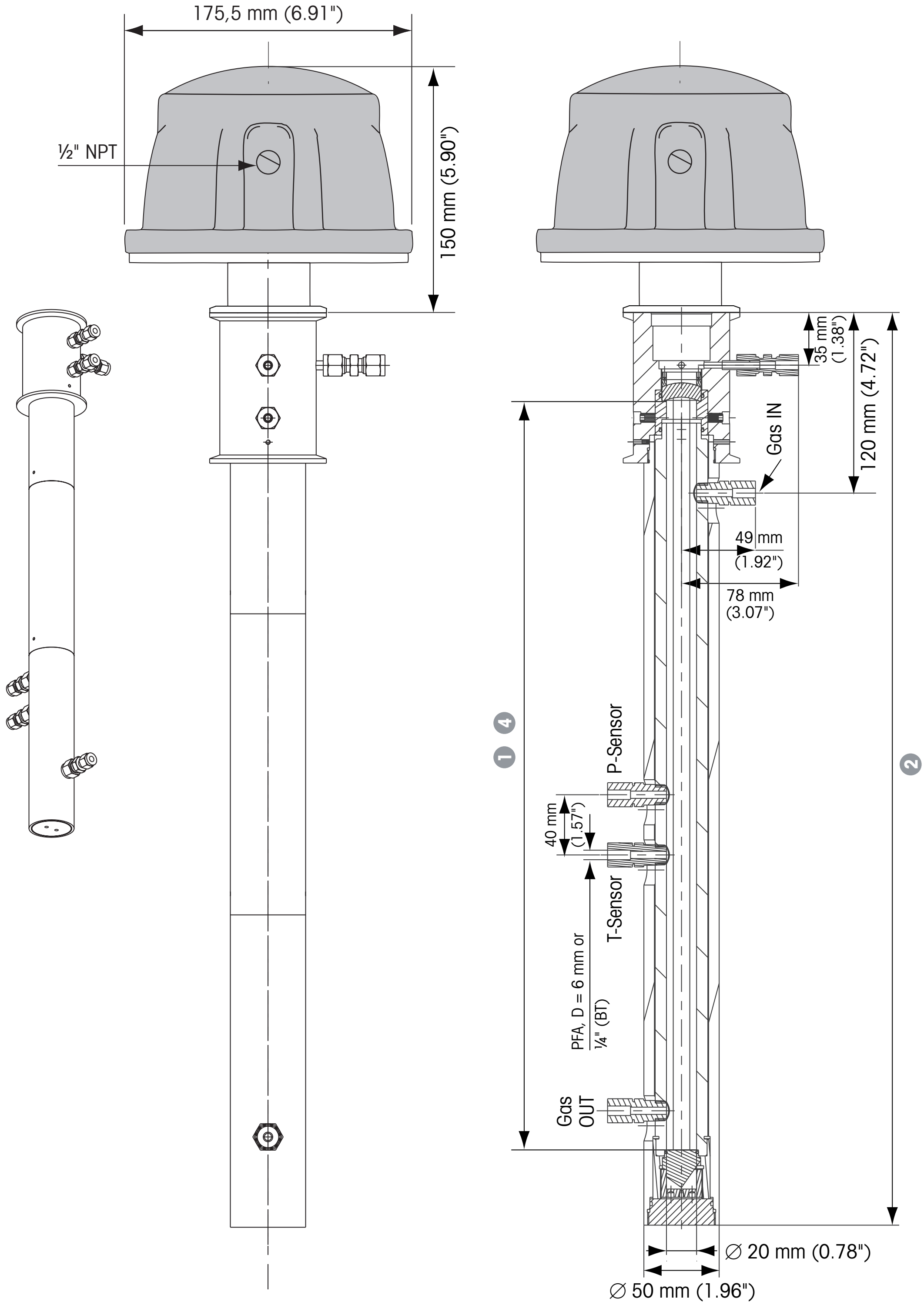


Figure 31 Dimensions of the extractive cell PFA.

Definition of the lengths:

❶ **Nominal path length,** the default length when GPro 500 is delivered. It corresponds to the effective path length without purging.
❷ **Probe length,** the physical length of the probe.
❹ **Effective path length,** when configuring the GPro 500 with the M400, the double value of the effective path length must be keyed in (2x effective path length).

Probes, wafer and cell dimensions					
Extractive Cell PFA	**OPL**	**Dimension ❶**	**Dimension ❷**	**Dimension ❸**	**Dimension ❹**
Extractive cell (E) PFA	1000 mm (39.4")	500 mm (19.7")	606.5 mm (23.9")	N.A N.A	500 mm (19.7")

4.11 Extractive White Cell

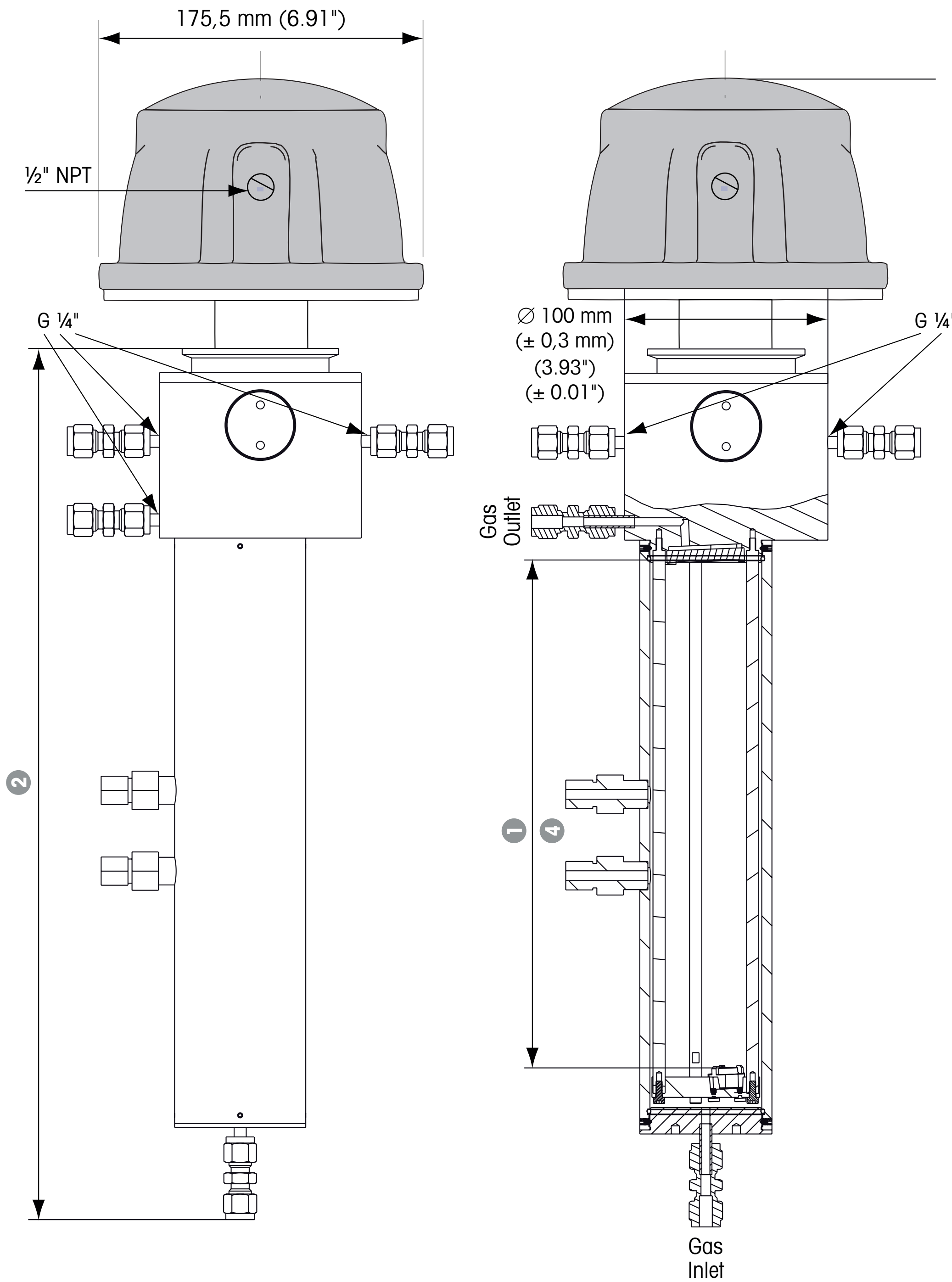


Figure 32 Dimensions of the extractive white cell.

Definition of the lengths:

- ➊ **Nominal path length,** the default length when GPro 500 is delivered. It corresponds to the effective path length without purging.
- ➋ **Probe length,** the physical length of the probe.
- ➍ **Effective path length,** when configuring the GPro 500 with the M400, the double value of the effective path length must be keyed in (2x effective path length).

Note: For oxygen measurement only.

Probes, wafer and cell dimensions					
Extractive White Cell	**OPL**	**Dimension ❶**	**Dimension ❷**	**Dimension ❸**	**Dimension ❹**
Extractive white cell (E)	10000 mm (393.7")	250 mm (9.8")	432 mm (17.0")	N.A N.A	250 mm (9.8")

Extractive Cell			
Internal Volume	**OPL**	**Diameter**	**Approx. Volume**
	200 mm (7.9")	20 mm (0.8")	39 ml
	400 mm (15.7")	20 mm (0.8")	71 ml
	800 mm (31.5")	20 mm (0.8")	134 ml
	1000 mm (39.4")	20 mm (0.8")	165 ml

Extractive DW			
Internal Volume	**OPL**	**Diameter**	**Approx. Volume**
	200 mm (7.9")	20 mm (0.8")	31 ml
	400 mm (15.7")	20 mm (0.8")	63 ml
	800 mm (31.5")	20 mm (0.8")	126 ml
	1000 mm (39.4")	20 mm (0.8")	157 ml

Extractive (PFA)			
Internal Volume	**OPL**	**Diameter**	**Approx. Volume**
	1000 mm (39.4")	20 mm (0.8")	157 ml

White Cell			
Internal Volume	**OPL**	**Diameter**	**Approx. Volume**
	260 mm (10.2")	55 mm (2.2")	618 ml

Table 4 Installation examples

Required flanges for some typical standard probe (SP) configurations (100 mm stand-off)					
❶ Nominal path length	❷ Probe length	❸ Insertion length	❹ Effective path length*	Pipe size DN/SPS	Number of flanges
138 mm (5.4")	288 mm (11.3")	161.5 mm (6.4")	100 mm (3.9")	100 mm (3.94")	2
138 mm (5.4")	288 mm (11.3")	161.5 mm (6.4")	100 mm (3.9")	150 mm (5.91")	2
138 mm (5.4")	288 mm (11.3")	161.5 mm (6.4")	100 mm (3.9")	200 mm (7.87")	1
238 mm (9.4")	388 mm (15.3")	261.5 mm (10.3")	200 mm (7.9")	200 mm (7.87")	2
238 mm (9.4")	388 mm (15.3")	261.5 mm (10.3")	200 mm (7.9")	250 mm (9.84")	2
238 mm (9.4")	388 mm (15.3")	261.5 mm (10.3")	200 mm (7.9")	300 mm (11.81")	1
438 mm (17.2")	588 mm (23.1")	461.5 mm (18.2")	400 mm (15.7")	300 mm (11.81")	2
438 mm (17.2")	588 mm (23.1")	461.5 mm (18.2")	400 mm (15.7")	400 mm (15.75")	2
438 mm (17.2")	588 mm (23.1")	461.5 mm (18.2")	400 mm (15.7")	500 mm (19.69")	1
438 mm (17.2")	588 mm (23.1")	461.5 mm (18.2")	400 mm (15.7")	600 mm (23.62")	1

* When configuring the GPro 500 with the M400, the double value of the effective path length must be keyed in (2 × effective path length).

4.12 Standard purged (SP) or non-purge (NP) and blow-back (B) probes configuration with single flange or dual flange.

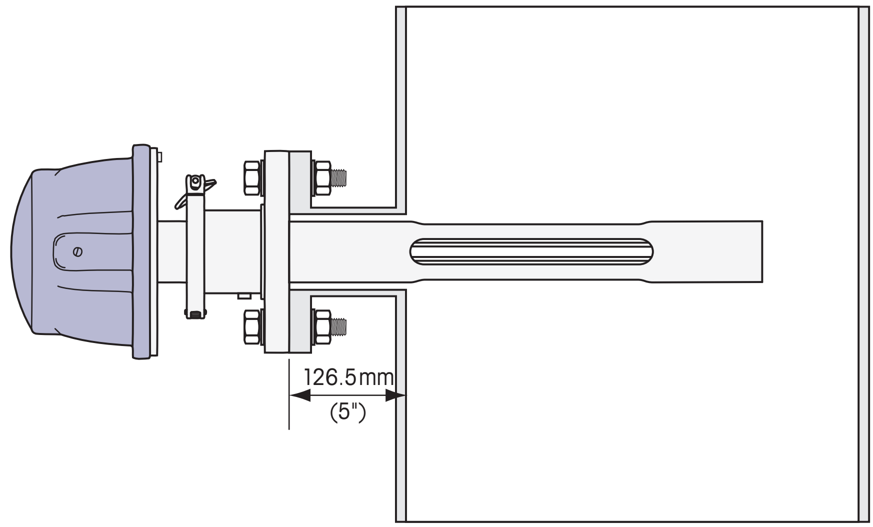


Figure 33 One flange configuration

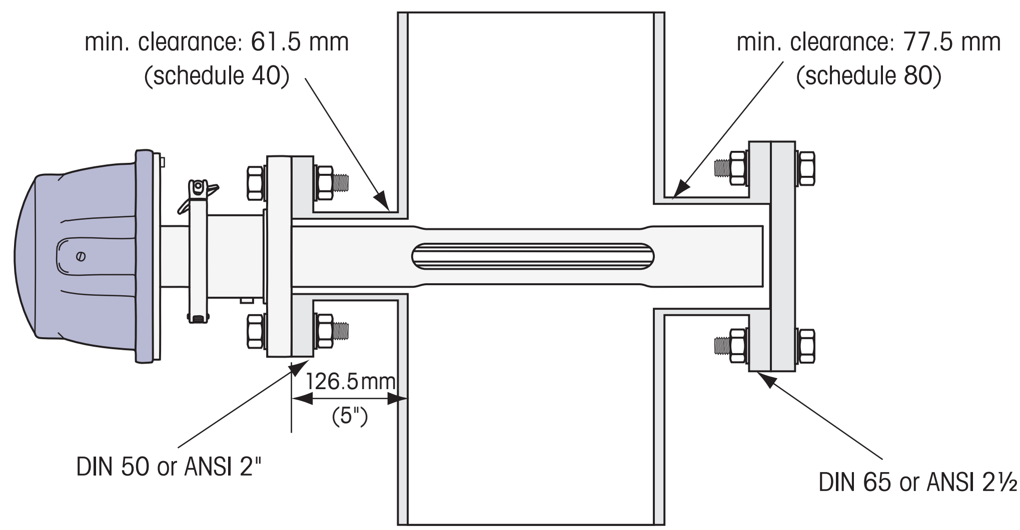


Figure 34 Two flange configuration (example: SP probe with 100 mm wall thickness).

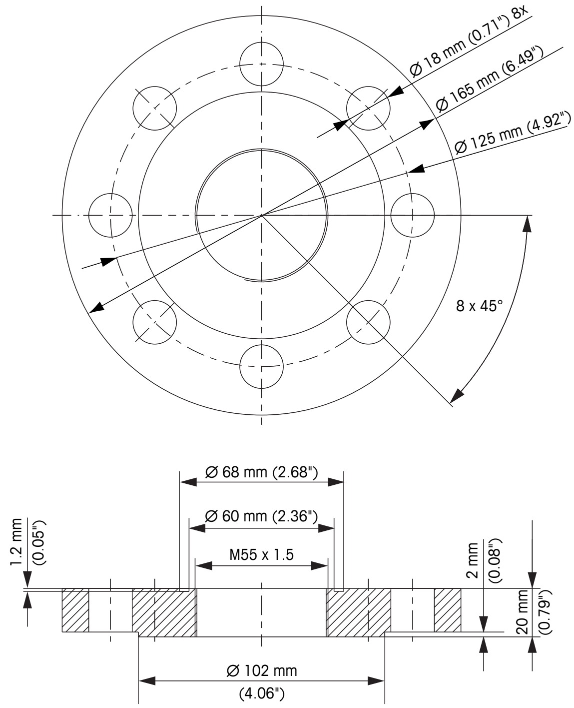


Figure 35 Dimensions of the RF DN50/PN40, PN25 and PN16 flange for standard purge (SP), non-purged (NP), cross-pipe (C), and blow-back (B) probe.

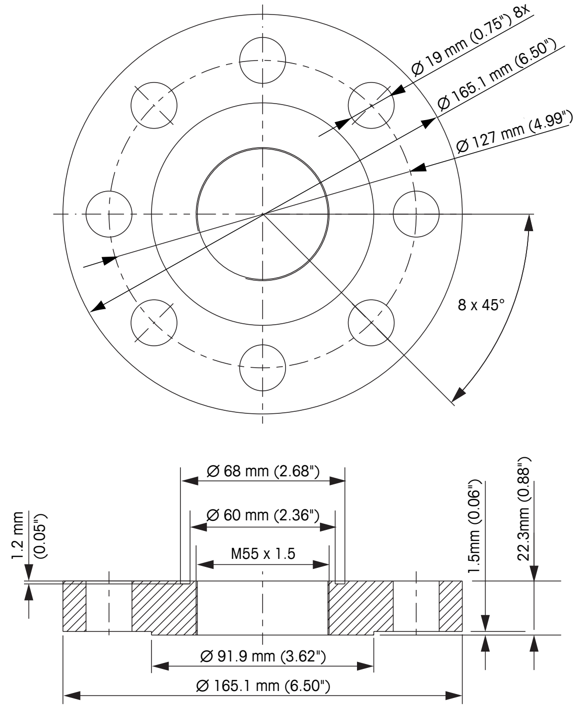


Figure 36 Dimensions of the RF ANSI 2"/300lb flange for standard purge (SP), non-purged (NP), cross-pipe (C), and blow-back (B) probe.

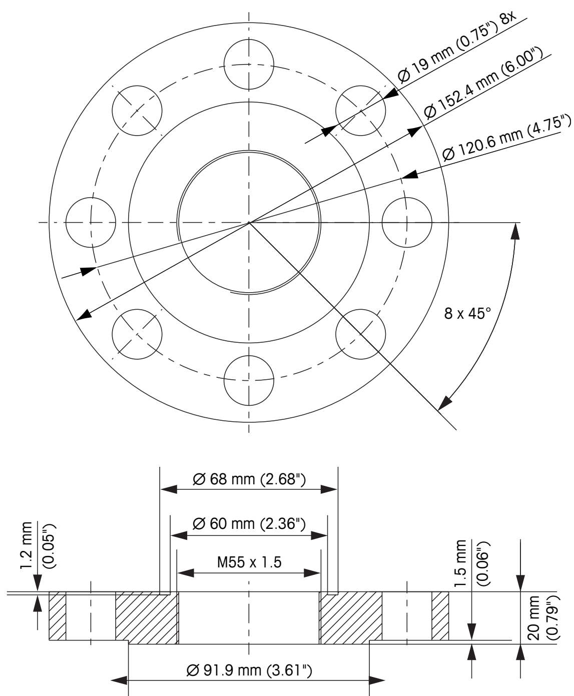


Figure 37 Dimensions of the ANSI 2"/150lb flange for standard purge (SP), non-purged (NP), cross-pipe (C), and blow-back (B) probe.

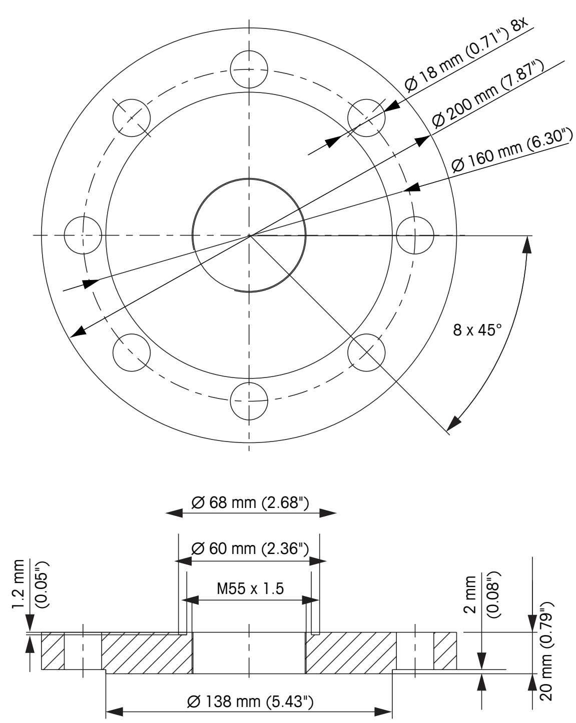


Figure 38 Dimensions of the RF DIN DN80/PN16 flange for standard purge (SP), non-purged (NP), cross-pipe (C), and blow-back (B) probe.

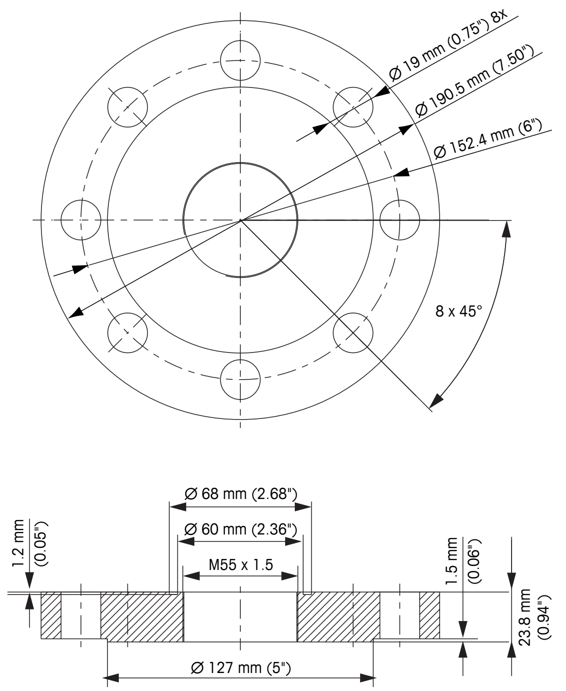


Figure 39 Dimensions of the ANSI 3"/150lb flange for standard purge (SP), non-purged (NP), cross-pipe (C), and blow-back (B) probe.

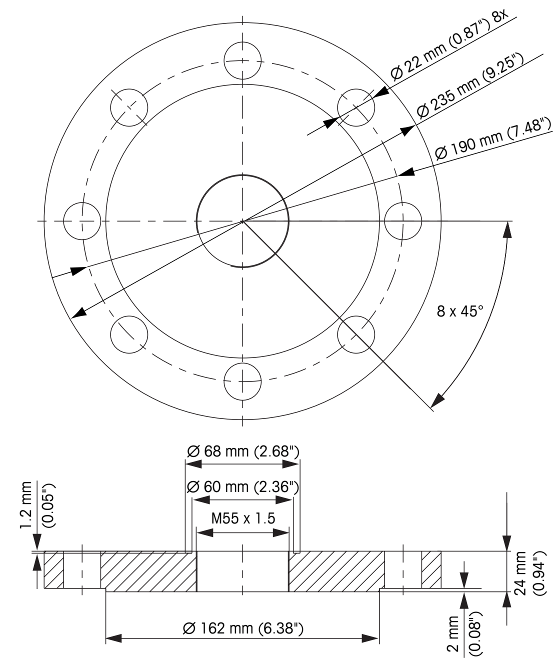


Figure 40 Dimensions of the RF DN100/PN25 flange for standard purge (SP), non-purged (NP), cross-pipe (C), and blow-back (B) probe.

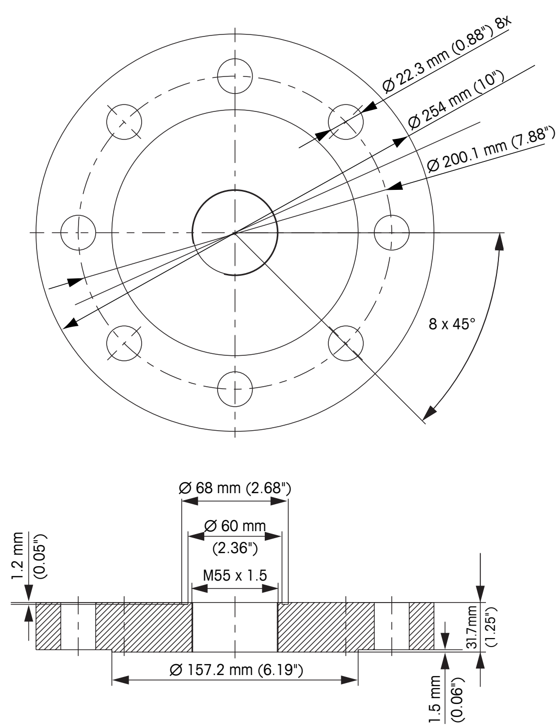
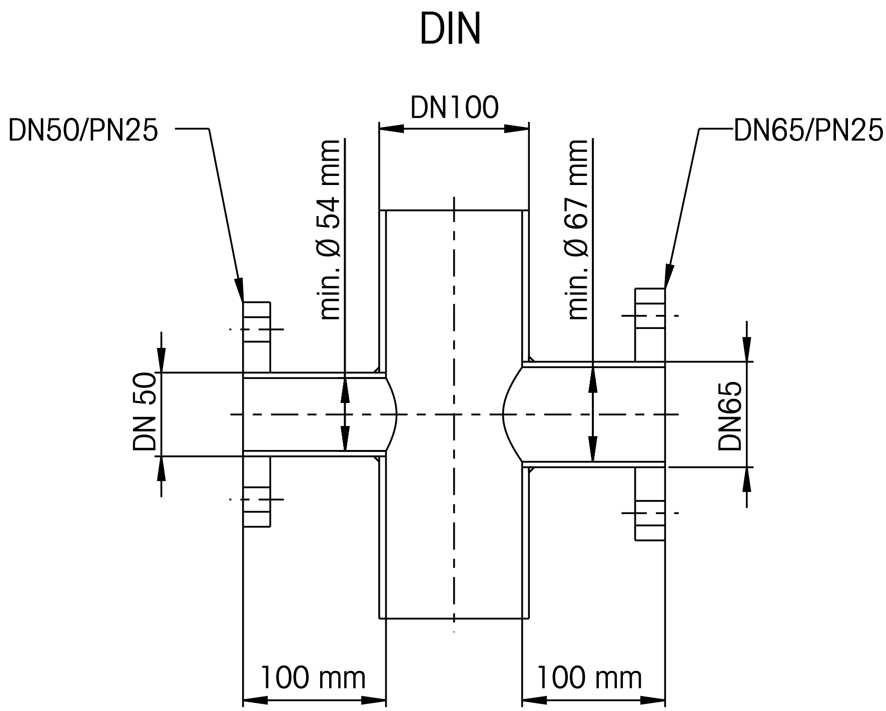


Figure 41 Dimensions of the RF ANSI 4"/300 lb flange for standard purge (SP), non-purged (NP), cross-pipe (C), and blow-back (B) probe.

4.13 Welded flange dimensions for standard purged (SP) and non-purged (NP) and blow-back (B) probes



For installations where the pipe diameter is not sufficient to accommodate the full probe length, a secondary "blind" flange is required 180° opposite to the entry flange. The figure shows typical dimensions for such a spool piece suitable for typical DIN 100 or 4" pipe diameters.

Note: It is important that the opposing "blind" flange has a larger diameter (as shown). This will accommodate any minor misalignment of the two flanges and allow the probe sufficient clearance across the pipe. Under no circumstances should the probe body be in contact with either flange internal wall or the welds. This could distort the probe body, affecting the laser beam integrity.

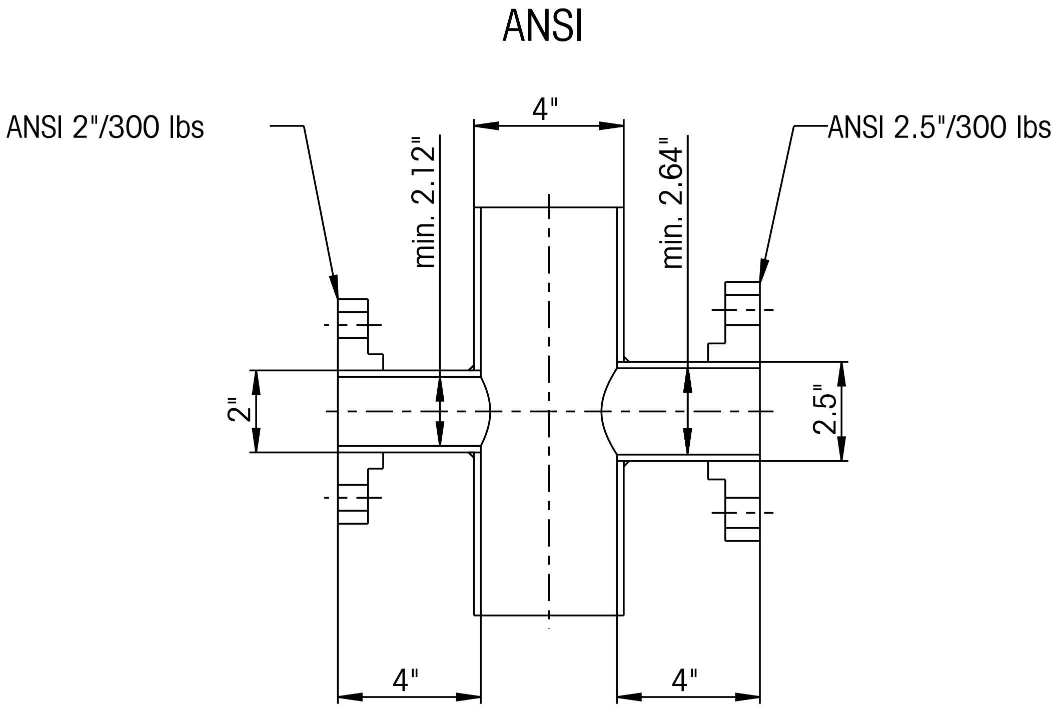


Figure 42 Recommended welded flange dimensions (for standard (SP) and non-purged (NP) and blow-back (B) probe installations)

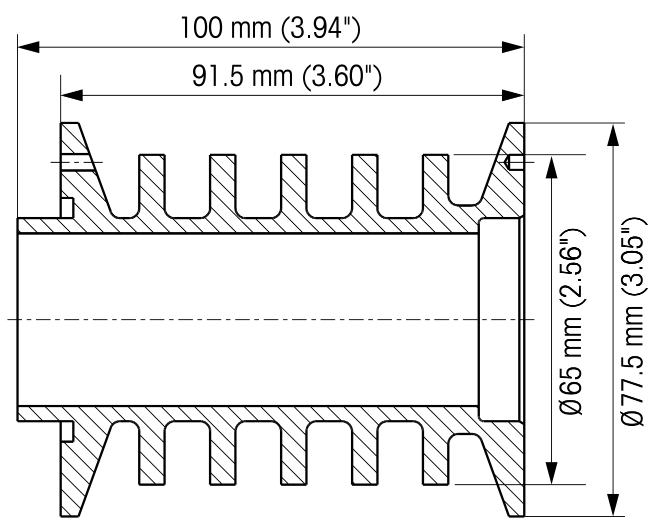


Figure 43 Dimensions of the thermal barrier.

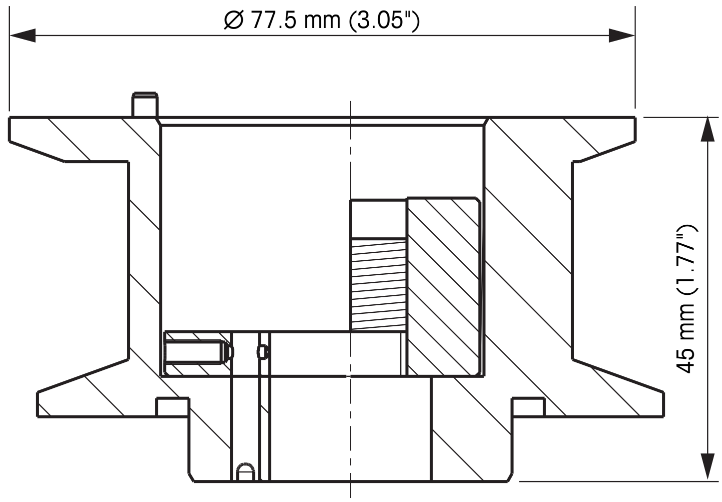


Figure 44 Dimensions of the multi-reflection cell (MR).

5 Electrical Connections

ATEX Version:

Most of the electrical connections are terminated at the junction box. All potentials are floating and none of them should be grounded to the box. This applies to all connection tables.

WARNING
Ensure that the electrical installation of the TDL conforms to all applicable local and national electrical safety requirements.

WARNING
Obey the safety instructions given below when you install the TDL; if you do not, the TDL certification may be invalidated, the TDL may not operate correctly, or it may be damaged.

WARNING
Isolate mains power before commencing installation.

WARNING
Make sure that power is disconnected or switched off before connecting any cable.

WARNING
When powering the TDL on, always wait minimum 5 minutes before powering down again.

US Version:

The US version must be installed using a suitable cabling conduit system in accordance with local codes and regulations. To aid installation, the unit is supplied without an attached cable.

The terminals are suitable for single wires/flexible leads 0.2 mm^2 to 1.5 mm^2 (AWG 16–24).

WARNING
The electrical installation must be performed in accordance with National Electrical Codes of practice and/or any other applicable national or local codes.

WARNING
Wait 2 minutes before opening the enclosure after de-energizing the system.

WARNING
When powering the TDL on,
always wait minimum 5 minutes before powering down again.

WARNING
When fitting the enclosure cover onto the sensor head,
the 8 x M5 fixing screws must be tightened to 8 Nm torque.

WARNING
For gas group A, sealing of the conduit is required at the enclosure entry.
For gas groups B, C and D, no conduit sealing is required.

Power supply of the GPro 500 and M400

- GPro 500: 24 VDC, 5–60 W range
  (The GPro 500 and the M400 don't have to be powered separately)
- M400 transmitter: 20–30 V DC or 100–240 V AC

WARNING
Always check the complete wiring between the M400 transmitter,
the GPro 500 sensor head, junction box (if applicable) and external
temperature and pressure sensors before switching on the sensor.

WARNING
Always check all the electrical and grounding
connections before switching on the power.

5.1 Electrical Safety and Grounding

The GPro 500 does not incorporate an integral on/off switch. You must provide a means of externally isolating the electrical supply from the GPro 500: use a suitable switch or circuit breaker located close to the GPro 500, clearly marked as the disconnecting device for the GPro 500.

- The electrical supply circuit must incorporate a suitable fuse or over-current protection device, set to or rated at no more than 10 A.
- The GPro 500 must be connected to an external protective earthing system via one of the screws for the lid to the sensor head (see Figure 45 on page 84).
- Ensure that your electrical supply can provide the necessary maximum power consumption. Refer to "Product data" on page 24.
- Equipment connected to the mA input, mA output, RS 485 and Ethernet must be separated from mains voltages by at least reinforced insulation.

- Ensure that the cables that you connect to the GPro 500 are routed so that they do not present a trip hazard.
- All signal and electrical supply cables must be rated for temperatures of 70 °C or higher. When you carry out insulation testing, disconnect all cables from the GPro 500.

Power supply of the GPro 500 and M400

- GPro 500: 24 VDC, 5 – 60 W range
  (The GPro 500 and the M400 don't have to be powered separately)
- M400 transmitter: 20–30 V DC or 100–240 V AC

WARNING
Always check all the electrical and grounding connections before switching on the power.

Instrument Protective Grounding

WARNING
It is important that the protective ground connection provided at the analyzer enclosure is connected to a suitable instrument grounding (earthing) point at the site of installation.

The GPro 500 is supplied with both internal and external protective grounding (earth) connections. The external protective grounding connection is clearly labelled and consists of an M6 x12mm screw located on the flange of the instrument cover. The internal protective grounding connections are located inside the instrument enclosure and are used for connection of the cable outer screen. See drawing "Protective Grounding." on page 84 for location of protective ground connections.

ATEX Protective Grounding

Note: The European ATEX certified version is supplied pre-wired with the internal grounding connection already terminated to the cable outer screen.

IMPORTANT: The instrument cover MUST NOT be opened under any circumstances, as this will invalidate the safety certification.

For the external protective grounding a suitable grounding cable should be appropriately terminated and attached to the M6 x12mm protective ground connection. The other end of the cable should be terminated at a suitable instrumentation grounding point at the installation site.

FM Protective Grounding

The FM certified version is supplied without an attached cable. When installing the multicore cable, the cable screen should be appropriately terminated at one of the two internal protective grounding points, using the supplied M4 x 6mm screw.

For the external protective grounding a suitable grounding cable should be appropriately terminated and attached to the M6 x12mm protective ground connection. The other end of the cable should be terminated at a suitable instrumentation grounding point at the installation site.

Grounding cable needs to be in accordance with the NEC regulations.

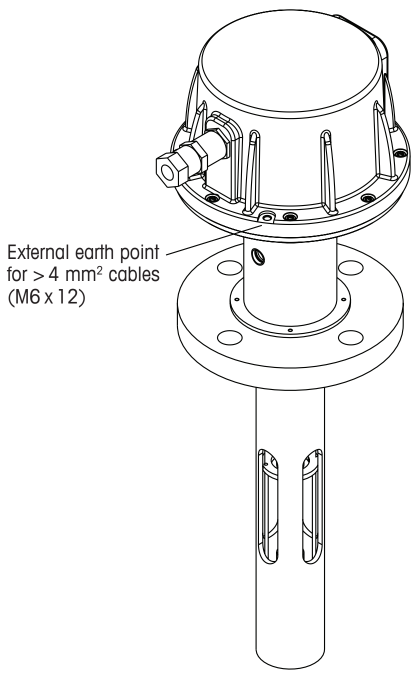


Figure 45 External earth point. Standard probe (SP) process adaption shown.

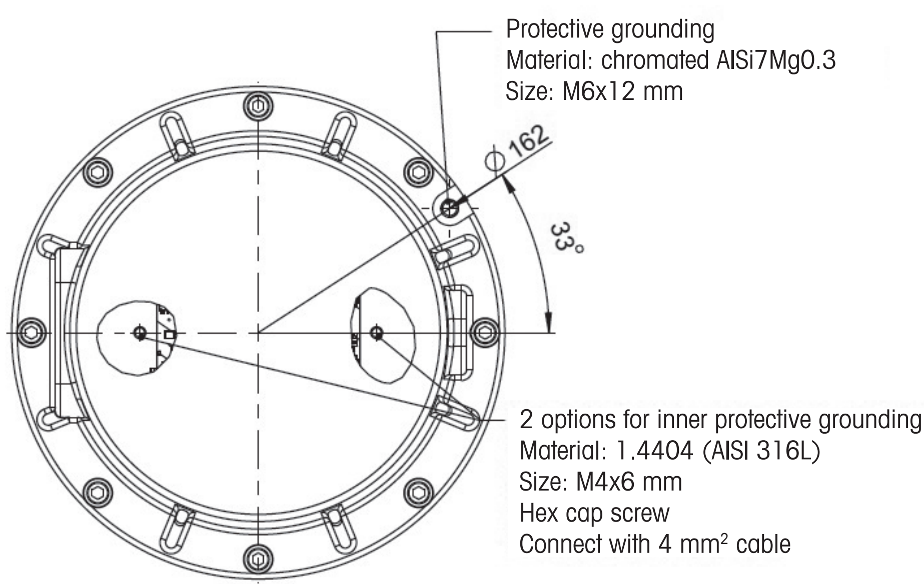


Figure 46 Protective Grounding.

5.2 Sensor head connections

ATEX Version:

In the ATEX Version, the sensor head is supplied with a pre-configured cable already installed. Do not open the sensor head for removing, altering, or replacing the cable.

The junction box is the interface between the GPro 500 and the M400 and also the Ethernet. Any suitable junction box approved for the hazardous area can be used. The GPro 500 can be supplied with the optional accessory GHG 731.11 which is a suitable junction box supplied by Malux.

	WARNING Opening the sensor head voids the warranty and violates the ATEX certification.

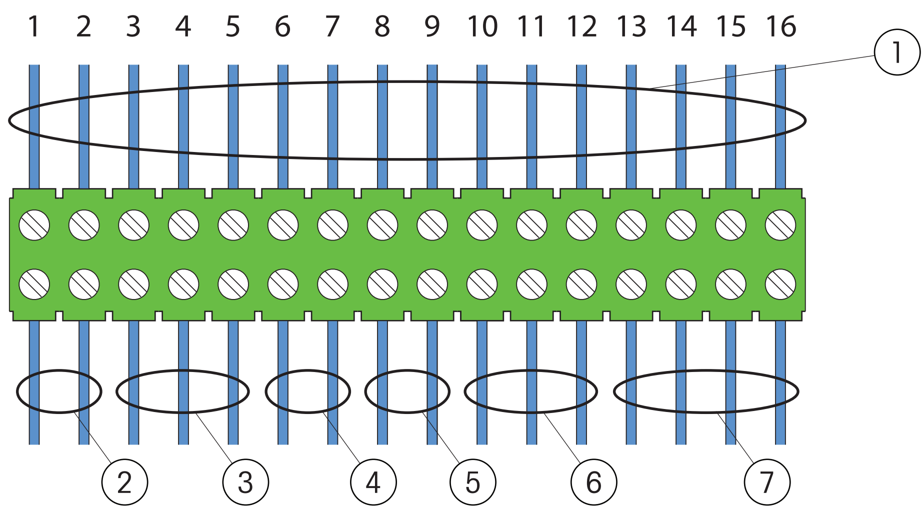
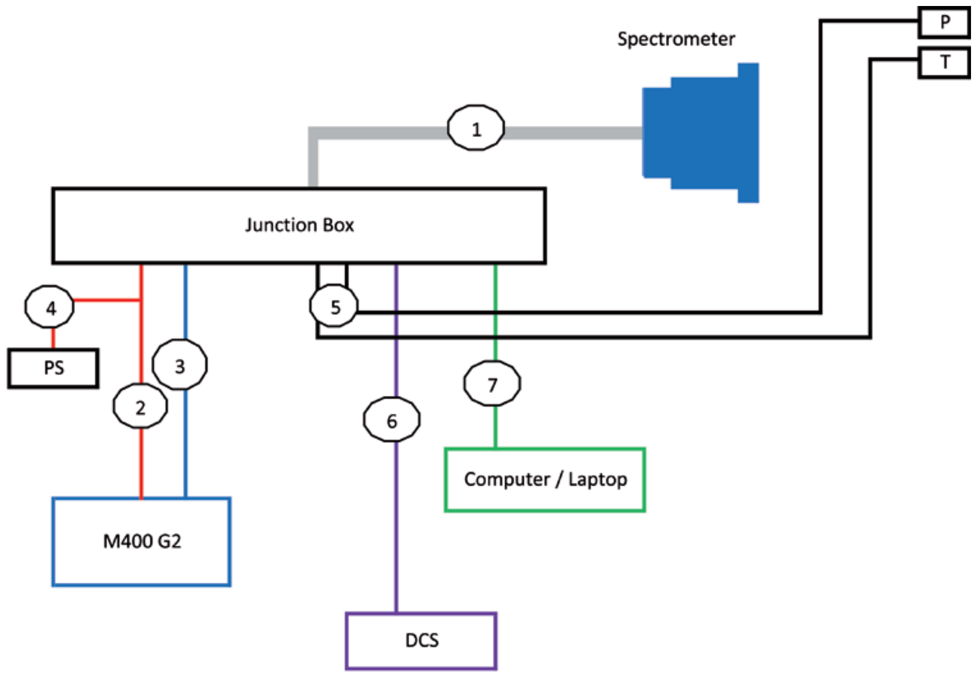


Figure 47 Connections in the junction box

1 Connections to the GPro 500 – Cable numbers below.
2 Power to the GPro 500 from an external 24 V, 5 – 60 W
3 RS 485 from the M400
4 4...20 mA from temperature sensor
5 4...20 mA from pressure sensor
6 Direct passive analog output (2x 4…20 mA) (optional)
7 Ethernet



Configuration		Connection	Drawing
GPro500		1	D1
Power Supply	external	4	D1
M400 G1	RS 485	3	D1
Pressure and temp. sensors	with passive AOs	5	D4
GPro500		1	D1
Power Supply	external	4	D1
M400 G1	RS 485	3	D1
Pressure and temp. sensors	with active AOs	5	D6
GPro500		1	D2
Power Supply	external	4	D2
M400 G2	RS 485	3	D2
Pressure and temp. sensors	with passive AOs	5	D4
GPro500		1	D2
Power Supply	external	4	D2
M400 G2	RS 485	3	D2
Pressure and temp. sensors	with active AOs	5	D5 or D6
GPro500		1	D3
Power Supply	M400 G2	2	D3
M400 G2	RS 485	3	D3
Pressure and temp. sensors	with passive AOs	5	D4
GPro500		1	D3
Power Supply	M400 G2	2	D3
M400 G2	RS 485	3	D3
Pressure and temp. sensors	with active AOs	5	D5 or D6
GPro500		1	D1 or D2
Power Supply	external	4	D1 or D2
Pressure and temp. sensors	with passive AOs	5	D4
SIL unit with 2direct (pass.) AOs	Aos	6	D7
GPro500		1	D1 or D2
Power Supply	external	4	D1 or D2
Pressure and temp. sensors	with act. AOs	5	D6
SIL unit with 2direct (pass.) AOs	AOs	6	D7
All configurations: Connection with MT-TDL Suite	Ethernet	7	D8
All configurations: Connection switch amplifier resp. solenoid valve for blow-back operated via M400 G2		not shown	D9

Figure 48 Wiring diagram overview.

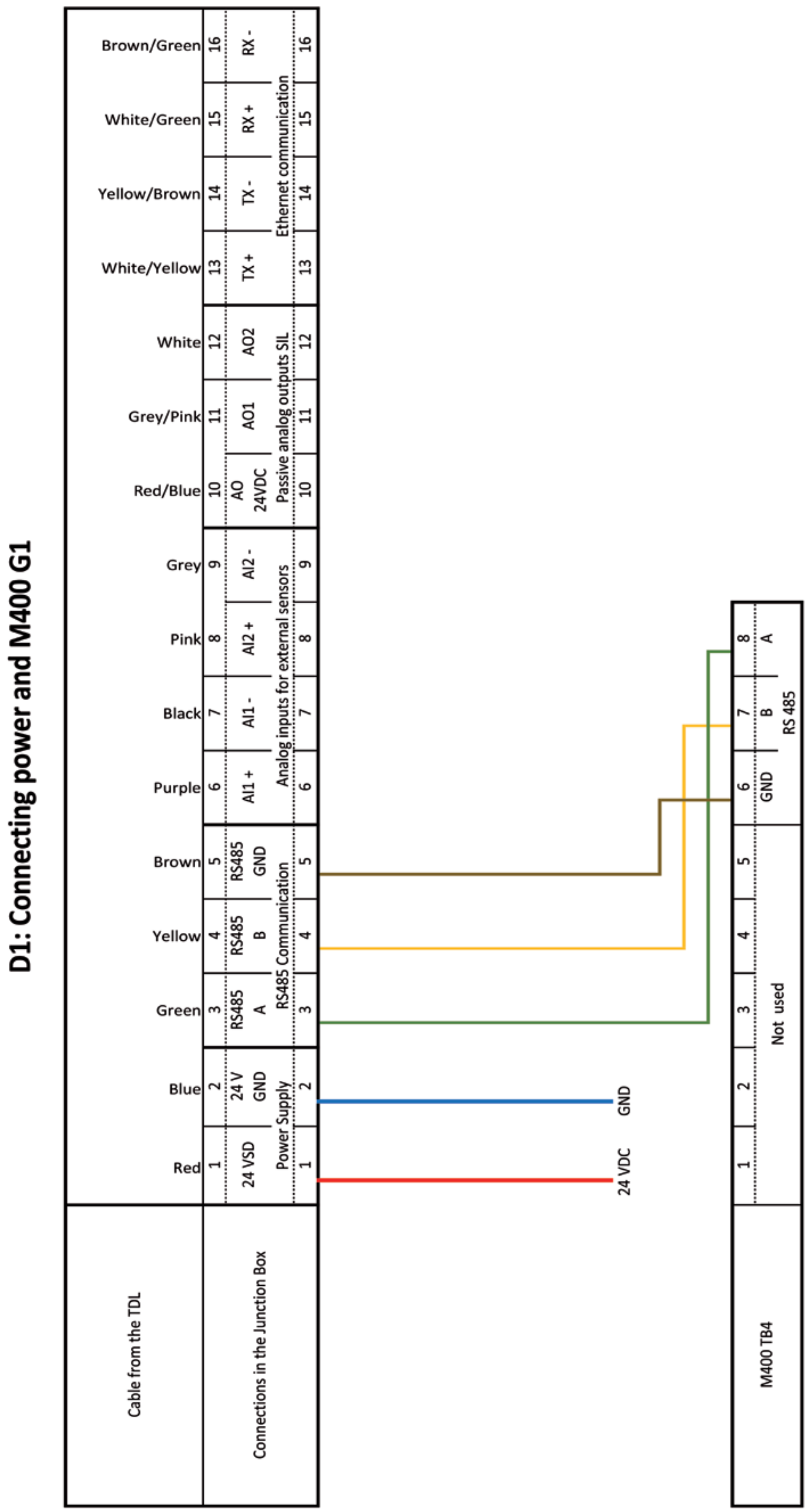


Figure 49 D1: Connecting power and M400 G1.

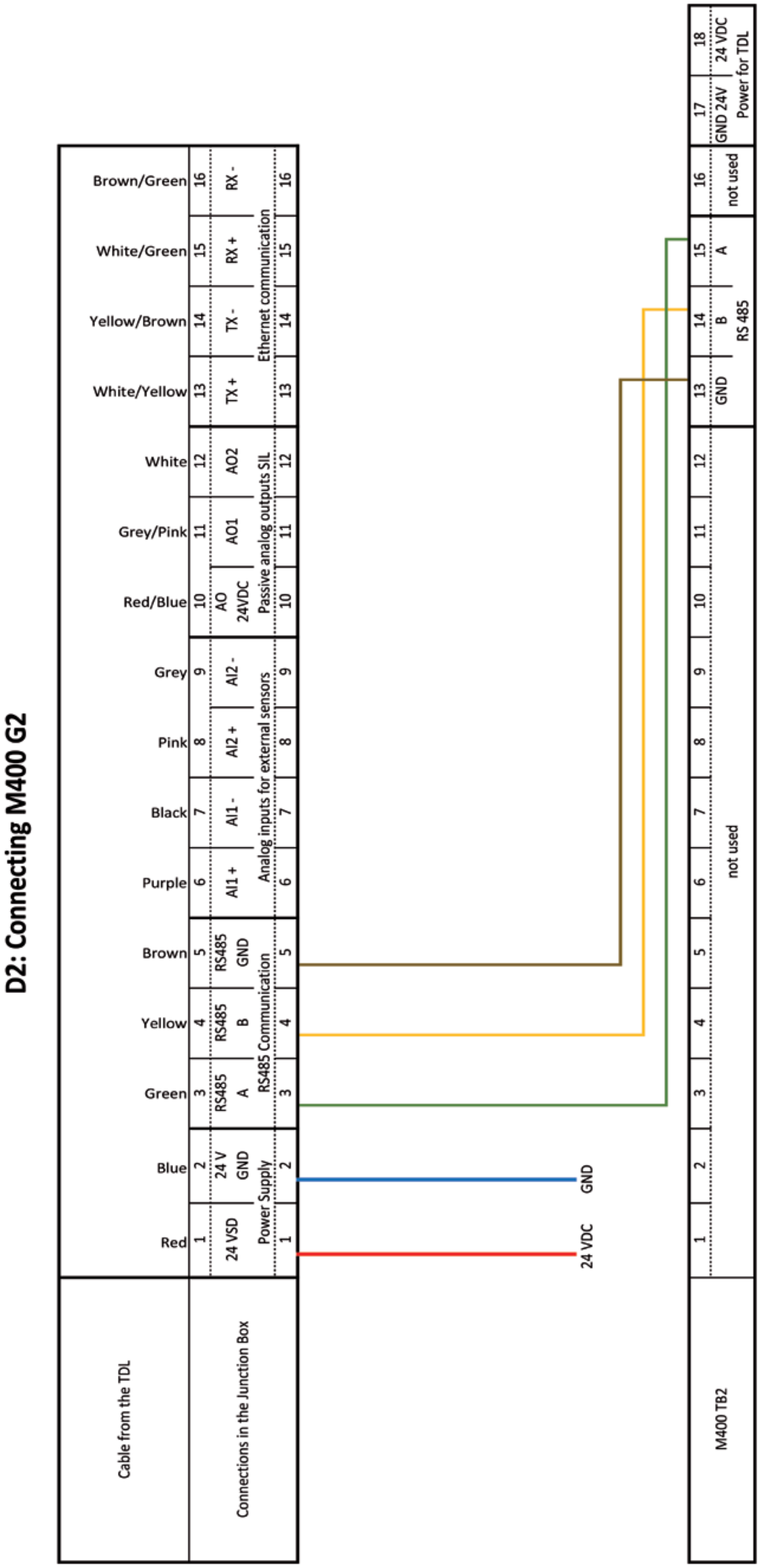


Figure 50 D2: Connecting M400 G2.

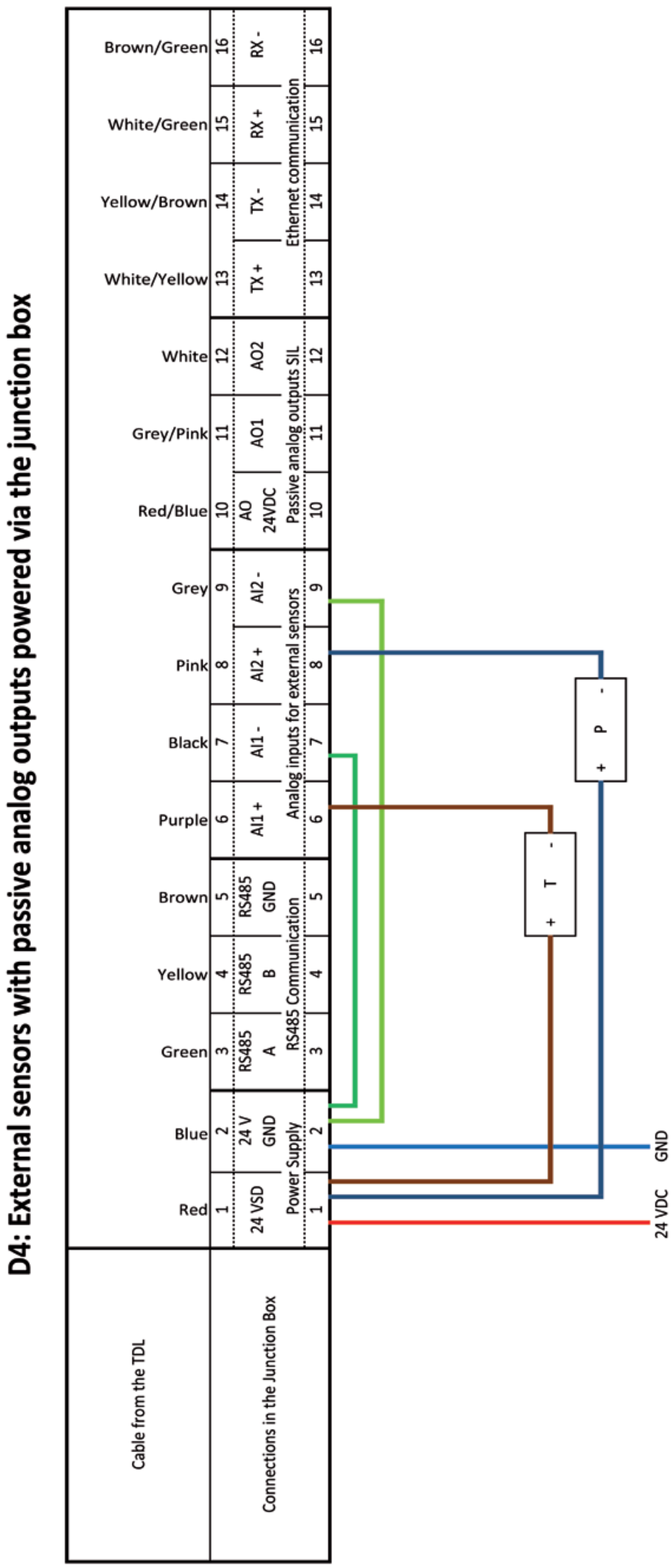


Figure 51 D4: External sensors with passsive analog outputs powered via the junction box.

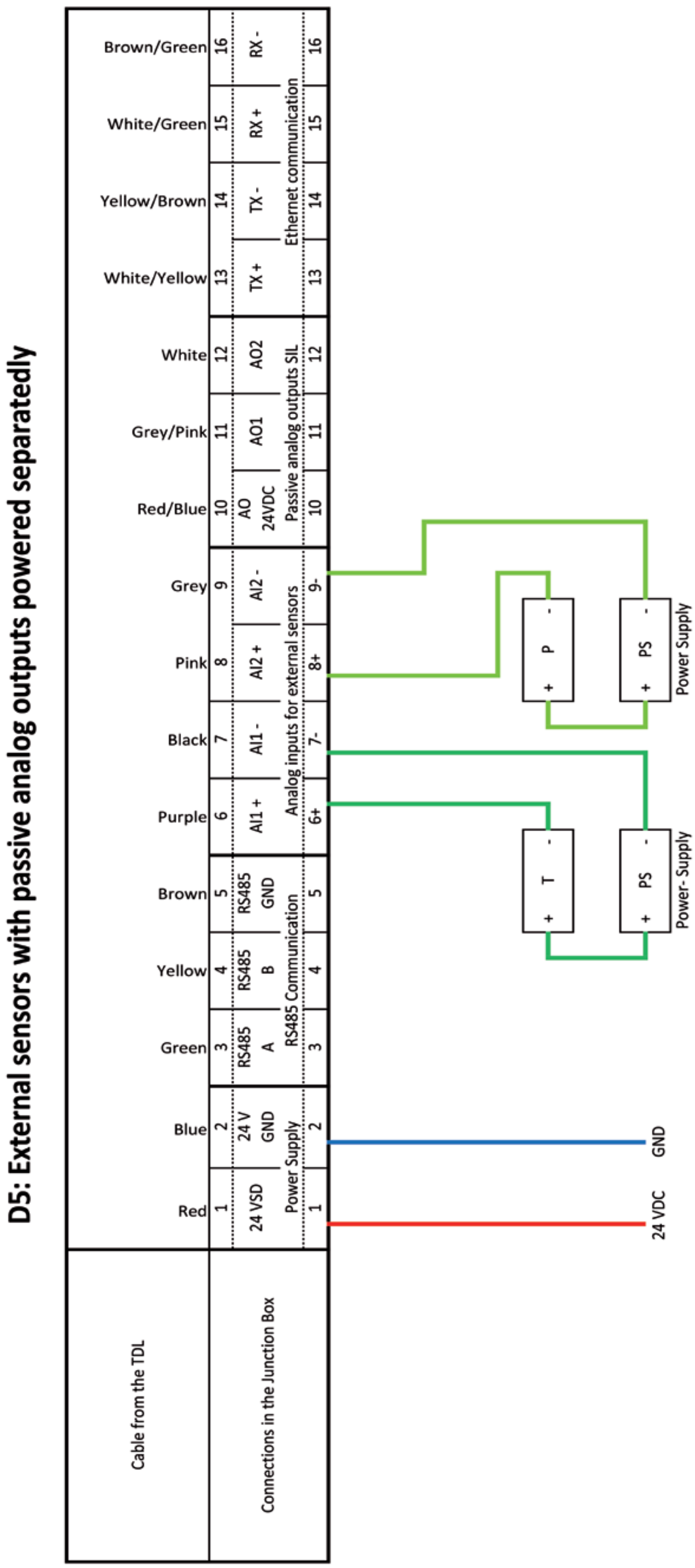


Figure 52 D5: External sensors with passive analog outputs powered separately.

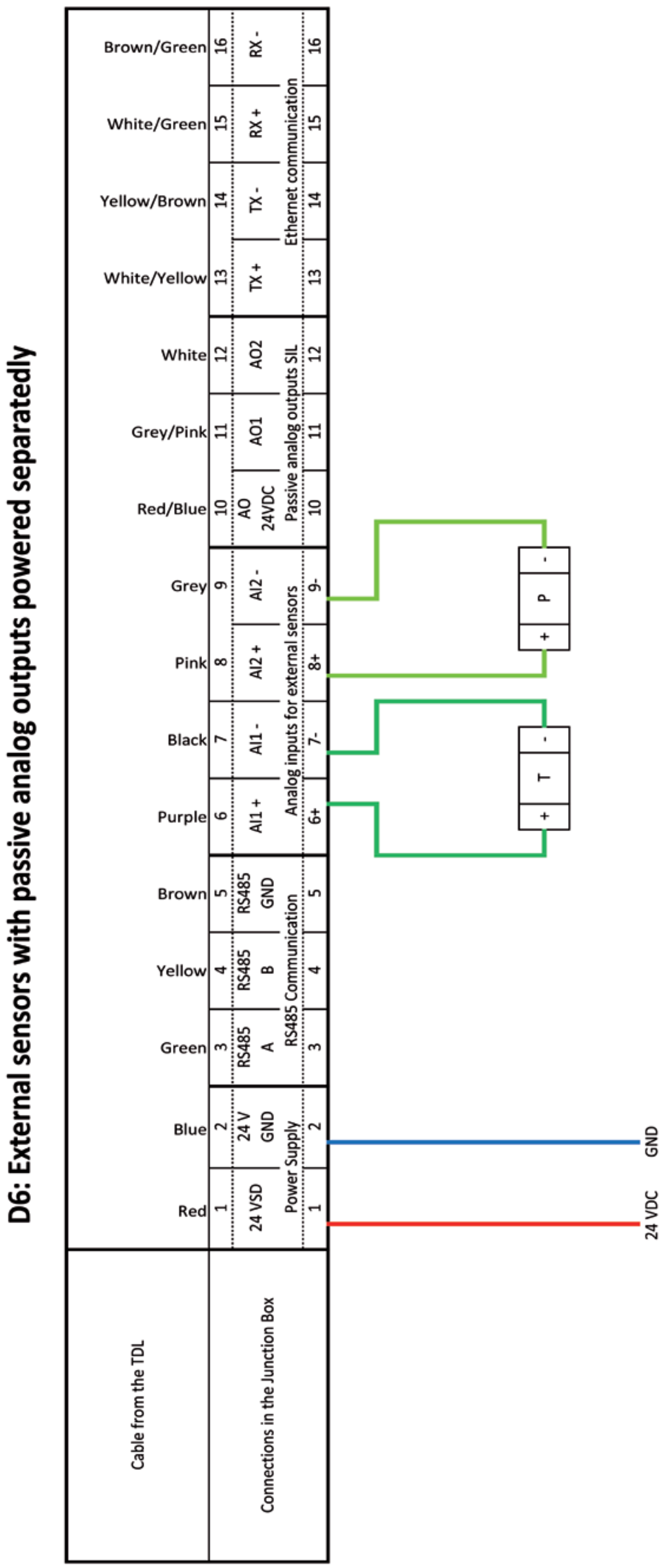


Figure 53 D6: External sensors with passive analog outputs powered separately.

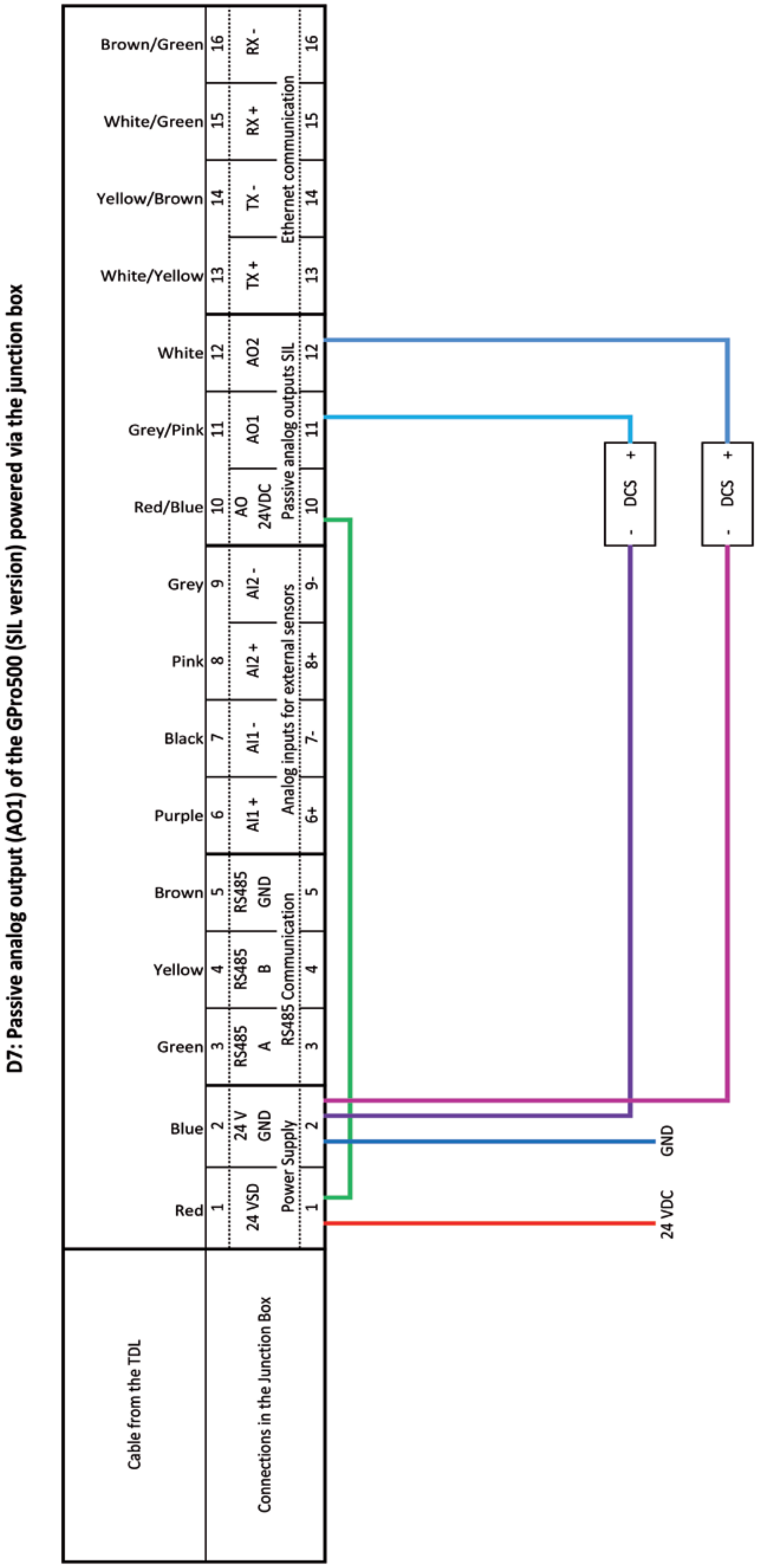


Figure 54 D7: Passive analog output (AO1) of the GPro 500 (SIL version) powered via the junction box.

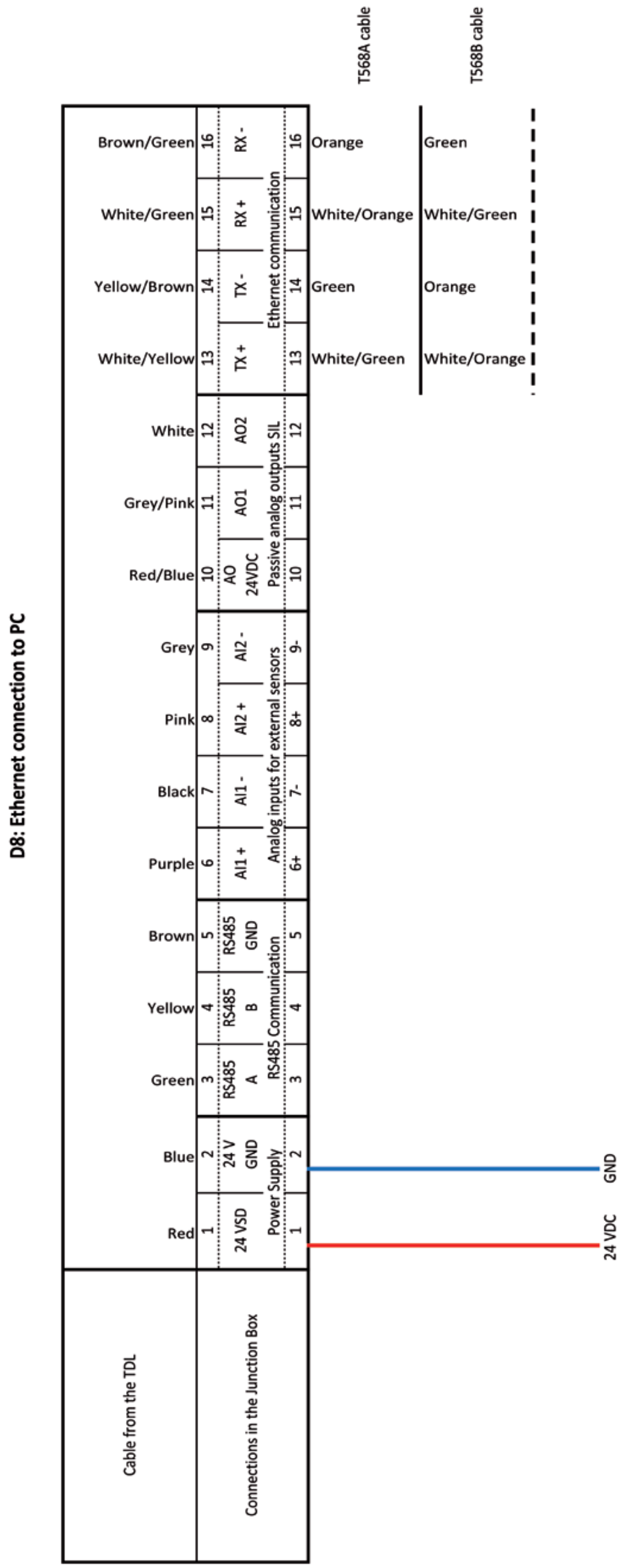


Figure 55 D8: Ethernet connection to PC.

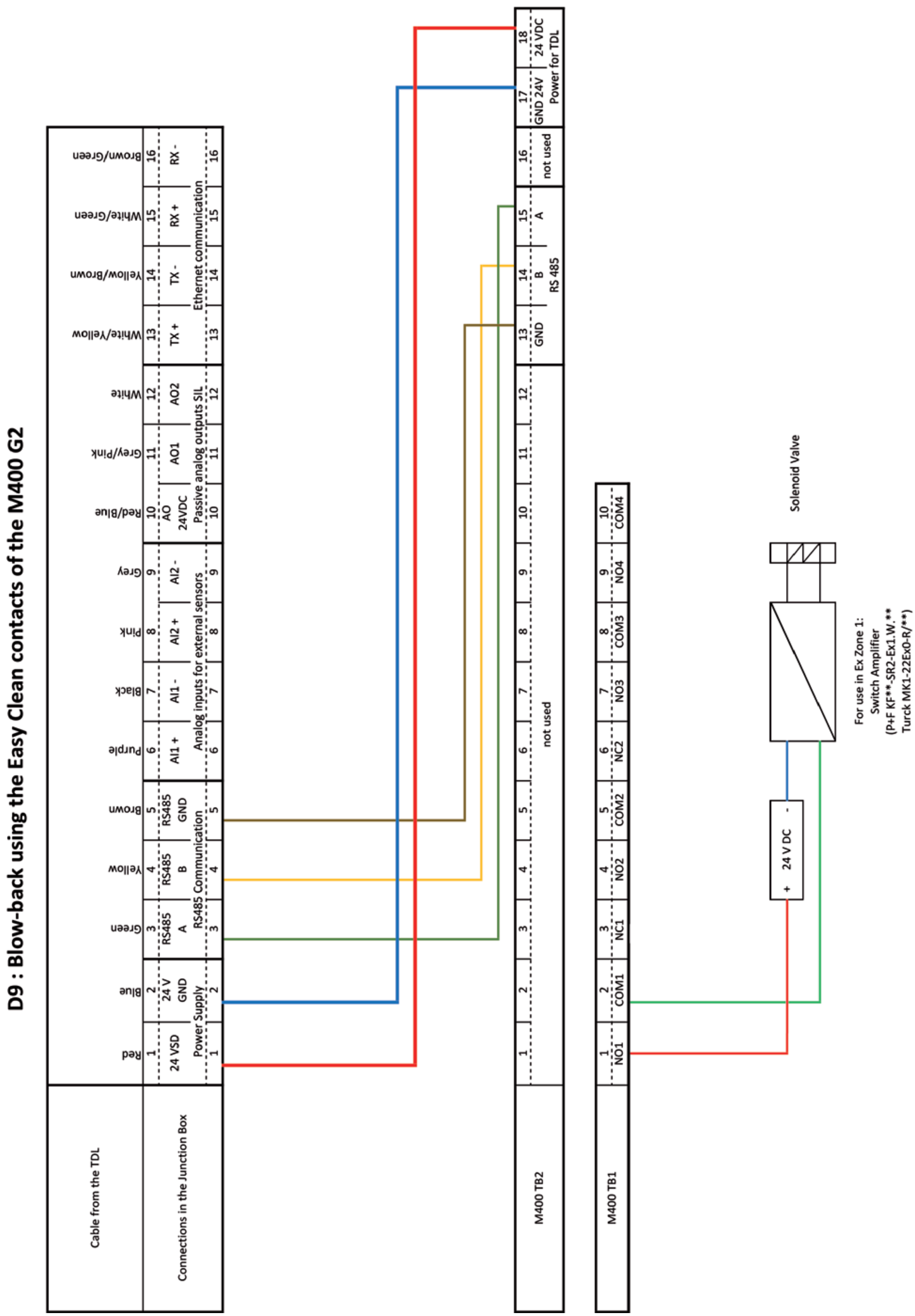


Figure 56 D9: Blow-back using the Easy Clean contacts of the M400 G2.

Table 5 GPro 500 cables for US versions (non ATEX)

Signal	Description	Cable no.	Color
Power + 24 V	Power 24V, 5W	1	Red
GND (Power)		2	Blue
RS 485 A	Interface M400 (RS 485)	3	Green
RS 485 B		4	Yellow
RS 485 GND		5	Brown
4...20 mA pos	Current input temperature	6	Purple
4...20 mA neg		7	Black
4...20 mA pos	Current input pressure	8	Pink
4...20 mA neg		9	Grey
+ 24 V	Direct passive analog output (2 x 4…20 mA) (optional)	10	Red/Blue
Out 1		11	Grey/Pink
Out 2		12	White
TX+	Ethernet interface for communication with PC	13	White/Yellow
TX–		14	Yellow/Brown
RX+		15	White/Green
RX–		16	Brown/Green

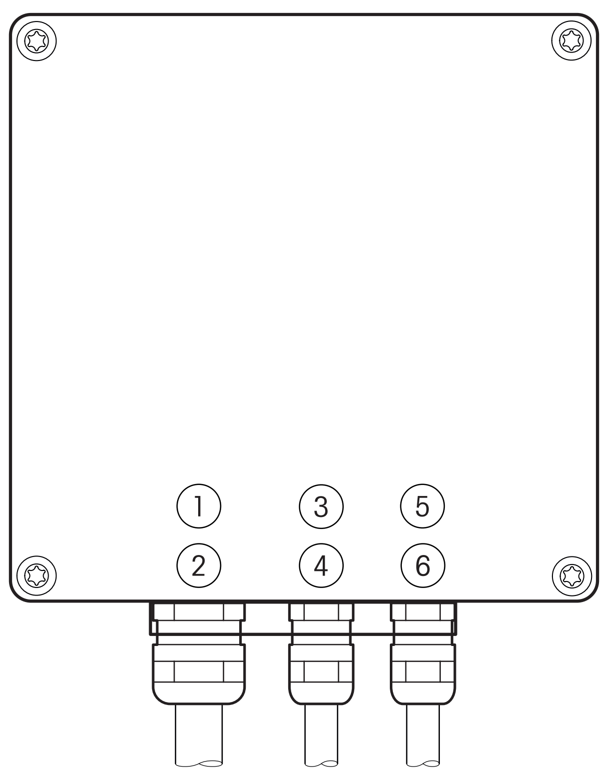


Figure 57 The junction box (EX-e)

1 Connection for the TDL
2 Connection for external power supply
3 Ethernet connection
4 Connection for temperature sensor (4...20 mA)
5 Connection for pressure sensor (4...20 mA)
6 Connection for M400 (RS 485)

The connection are done to the same number in the GPro 500 and in the junction box except for the Ethernet cable. This cable has to be equipped with an Ethernet connector in the GPro 500 side and screwed to the appropriate screw connectors in the junction box. The connection diagram is shown below.

US Version:

FM APPROVED

The US version must be installed using a suitable cabling conduit system in accordance with local codes and regulations. To aid installation, the unit is supplied without an attached cable. For suitable cables (for example Lapp UNITRONIC FD CP [TP] plus) please see Appendix 2, chapter 2.3 "Accessories" on page 139.

The terminals are suitable for single wires/flexible leads 0.2 mm² to 1.5 mm² (AWG 24–16).

	WARNING The electrical installation must be performed in accordance with National Electrical Codes of practice and/or any other applicable national or local codes

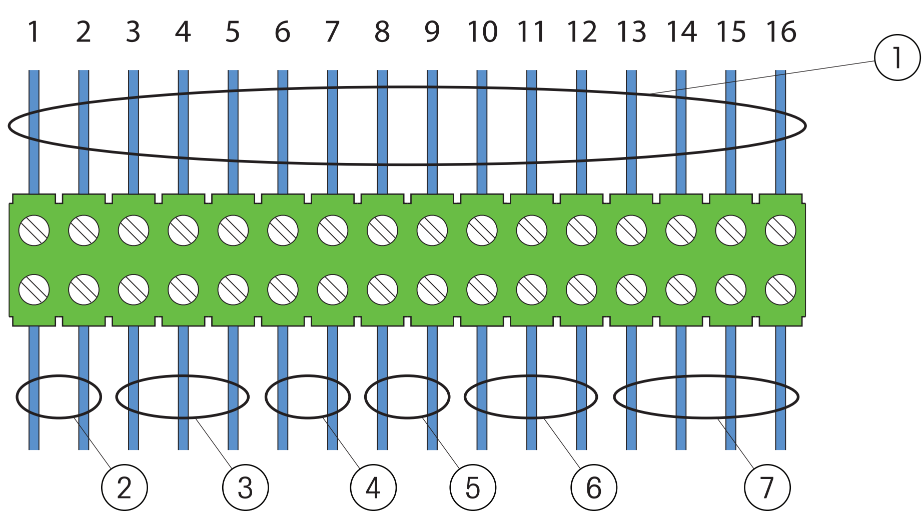


Figure 58 Connections in the junction box

1 Connections to the GPro 500 – Cable numbers below.
2 Power to the GPro 500 from an external 24 V, 5 W minimum source
3 RS 485 from the M400
4 4...20 mA from temperature sensor
5 4...20 mA from pressure sensor
6 Direct passive analog output (2 x 4…20 mA) (optional)
7 Ethernet

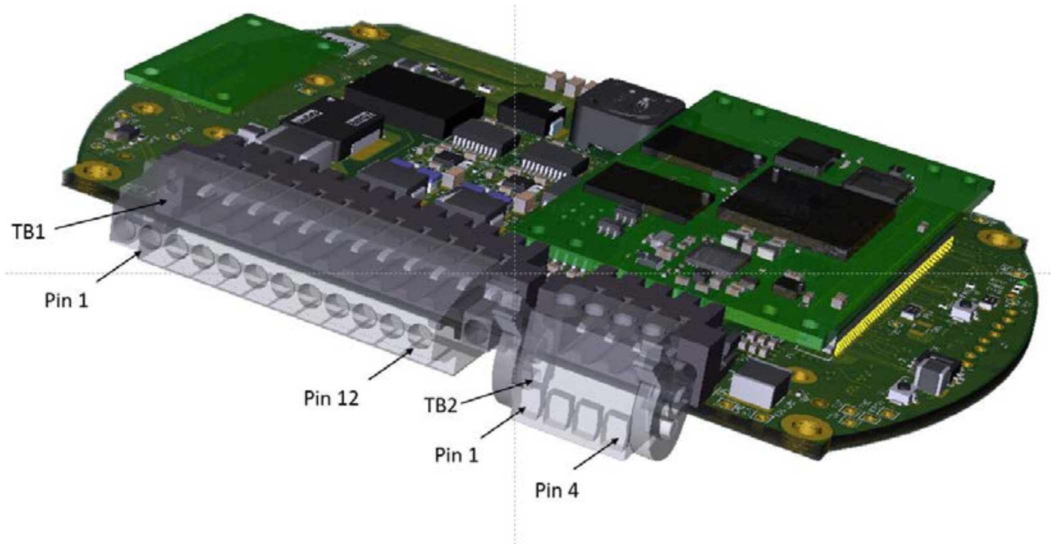


Figure 59 Connections on IO board in the sensor head

Table 6 GPro 500 cables

Signal	Description	Cable no. Junction Box	Color	TB1 Pin no	TB2 Pin no
Power + 24 V	Power 24 V, 5 W	1	Red		1
GND (Power)		2	Blue		2
RS 485 A	Interface M400 (RS 485)	3	Green		3
RS 485 B		4	Yellow		4
RS 485 GND		5	Brown		5
4...20 mA pos	Current input temperature	6	Purple		6
4...20 mA neg		7	Black		7
4...20 mA pos	Current input pressure	8	Pink		8
4...20 mA neg		9	Grey		9
+ 24 V	Direct passive analog output (2x 4…20 mA) (optional)	10	Red/Blue		10
Out 1		11	Grey/Pink		11
Out 2		12	White		12
TX+	Ethernet interface for communication with PC	13	White/Yellow	1	
TX–		14	Yellow/Brown	2	
RX+		15	White/Green	3	
RX–		16	Brown/Green	4	

For all versions.

WARNING
All openings have to be closed with certified cable glands or blocking plugs of the same degree of certification as the GPro 500.

WARNING
It is essential that you observe all provided information and warnings. The system must be closed and grounded before switching on the system.

For version with optional direct analog outputs.

WARNING
Do not connect the M400 and the direct passive analog outputs at the same time.

5.3 M400 connections

	WARNING AC Power for Ex versions may only be connect- ed via a suitably certified Purge Control Unit.

The power cable is attached inside the M400. It shall be a two core cable with Line/Live (L), Neutral (N) conductors.

The power cable connection terminals are suitable for solid or stranded conductors 0.205 to 2.5 mm^2 (24 to 13 AWG).

Connect your mains electrical supply cable as follows:

1. Pass your mains electrical supply cable through a suitable cable-gland fitted to the base of the power/interface compartment.
2. Connect the wires in the supply cable to the appropriate electrical supply terminals in the M400 as follows and as shown in Table 10 "Mains power supply terminals" on page 100.

Table 7 Connecting the GPro 500 TDL and the M400 – Terminal Block 3

		GPro 500 TDL
Terminal	**Function**	**Color**
1 to 12	Not used	
13	GND	Brown
14	RS 485-B	Yellow
15	RS 485-A	Green
16	5 V	–
17	GND (24 V)	Blue
18	24 V	Red

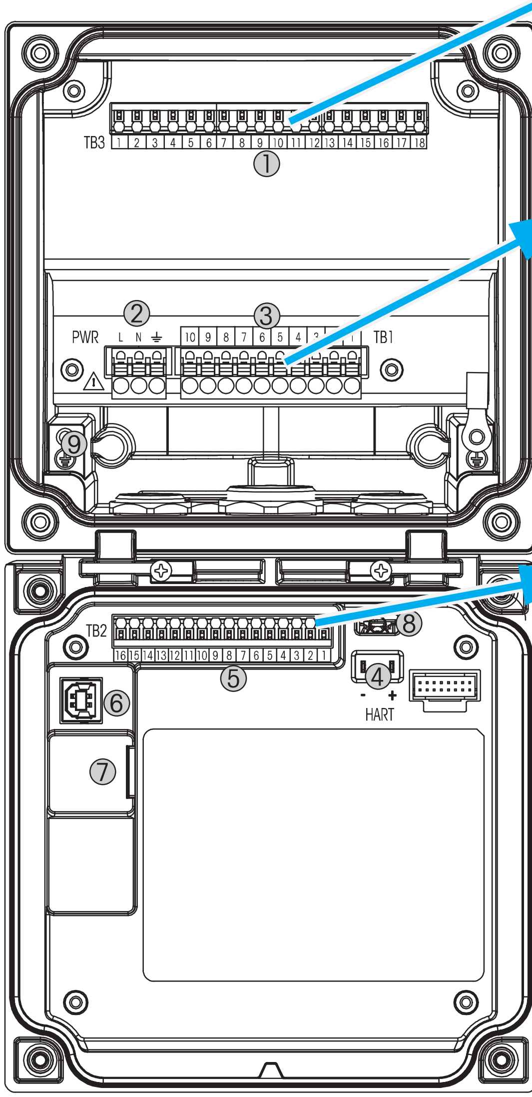


Table 8 Terminal Block TB1

Terminal	Description	Contact rating
1	NO 1	250 VAC or 30 VDC, 3 A
2	COM 1	
3	NC 1	
4	NO 2	250 VAC or 30 VDC, 3 A
5	COM 2	
6	NC 2	
7	NO 3	250 VAC or 30 VDC, 0.5 A, 10 W
8	COM 3	
9	NO 4	250 VAC or 30 VDC, 0.5 A, 10 W
10	COM 4	

Table 9 Terminal Block TB2

Terminal	Description
1	AO 1 +/HART +
2	AO 1 –/HART –
3	AO 2 +
4	AO 2 –
5	AO 3 +
6	AO 3 –
7	AO 4+
8	AO 4 –
9	DI 1+
10	DI 1–/DI 2 –
11	DI 2+
12	AI +
13	AI –
14 to 16	Not used

Table 10 Mains power supply terminals

Signal	Terminal on mains power supply
Live	L
Neutral	N

6 Service

6.1 Connecting a PC

The MT-TDL software is the GPro 500 service tool. With this software all parameters can be access and all possible settings can be modified. To run it you need to connect a PC, with the software installed, to the Ethernet port in the junction box as illustrated below.

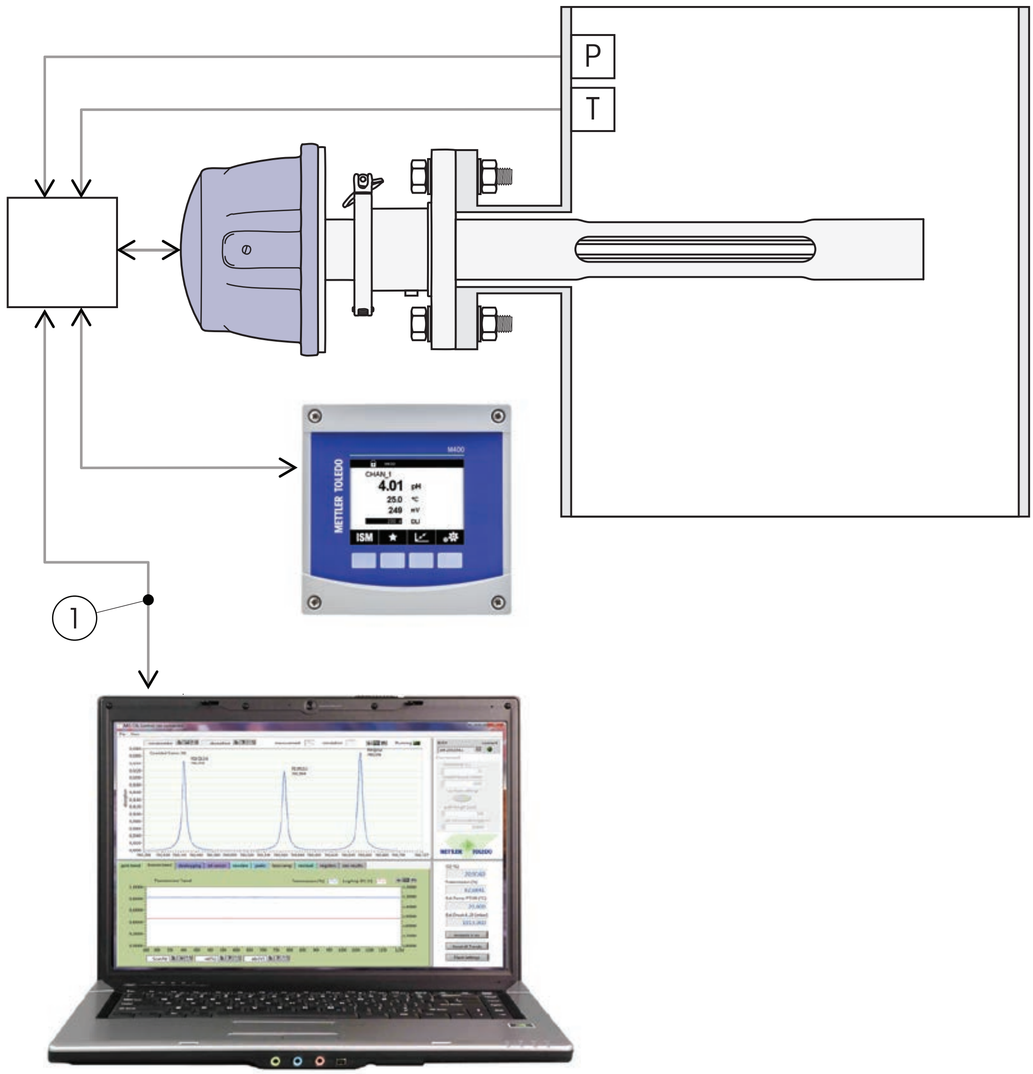


Figure 60 Connecting a PC. Standard probe (SP) process adaption shown

1 Ethernet connection

When accessing the MT-TDL with a PC it is important to make sure that no work is performed at the same time via the M400.

> **WARNING**
> When accessing the GPro 500 using the MT-TDL software, work using the laptop or PC must comply with the restrictions in place for working in hazardous areas.

6.2 The MT-TDL software

The most important function of the MT-TDL software from a service view is the log capabilities. SPC files are continuously saved on the SD-Card and can be accessed at any time. A log folder is created on the SD-card and the files within this folder can either be sent to trained staff at METTLER TOLEDO for further investigation or it can be viewed locally on your PC with the MT TDL log viewer. Files are stored in date stamped folders, one folder for each day.

The software has three access levels but the normal user will only use the first one (Normal). The remaining two access levels are restricted for use by METTLER TOLEDO personnel. You can perform the following tasks under the Normal access level:

1. Concentration trend – Here you can follow the concentration value in the lower plot.
2. Transmission trend – Here you can follow the optical transmission value in the lower plot.
3. Data logging
4. Ext sensor
5. Analog output (Note: only available if connected to a TDL with this option)
6. TDL configuration (opl, mapping of the external sensors)

Through different menus the necessary installation parameters may be set. After setting and transmitting the necessary parameters the PC is no longer needed. The GPro 500 has all the parameters stored in the internal memory. The PC can therefore be disconnected and the GPro 500 can be turned off and on without resetting the parameters.

Once the program starts the user is presented with a screen like the one in Figure 61 "The ppm trend" on page 103. It consists of an upper part and a lower part. In the upper screen a plot of the signal processed absorption lines and the model absorption lines are shown. The version of the service program is shown in Figure 61 as is also the IP number of the GPro 500.

The content in the lower part is specific to the function the user chooses – concentration trend, transmission trend, etc. The following paragraphs will discuss their content.

6.2.1 The ppm trend

In this screen the user can monitor the measured concentration value over time: The present values of concentration, transmission, temperature and pressure in the process are shown to the right.

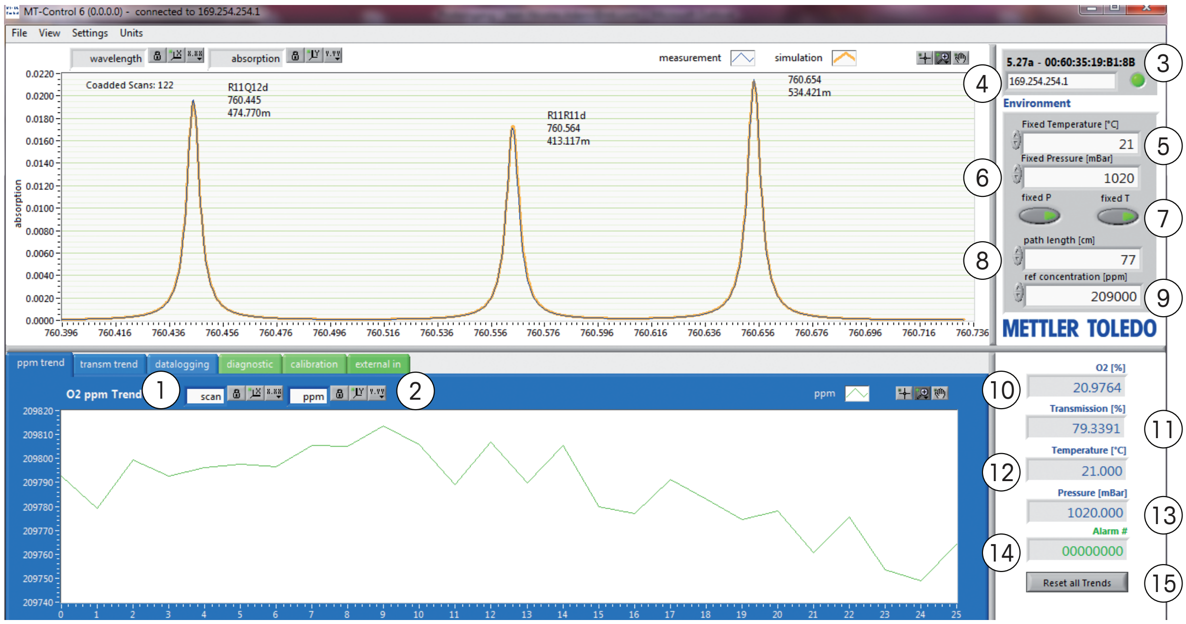


Figure 61 The ppm trend

Here follows a descriptions of some of the settings for this screen. Note that settings 3 through 16 are visible on all the different screens.

1 Scan no
2 Unit for the concentration
3 Version of the software
4 IP number of the GPro 500
5 The fixed value for the temperature
6 The fixed value for the pressure
7 Toggle between fixed and measured values for temperature and pressure
8 The effective path length
9 Concentration for simulated curve in the upper half of the window
10 Actual O_2 concentration
11 Actual transmission
12 External temperature reading
13 External pressure reading
14 Alarm
15 Reset all trends

6.2.2 The transmission trend

In this screen the user can monitor the optical transmission level in the measurement path over time: The present values of concentration, transmission, temperature and pressure in the process are shown to the right.

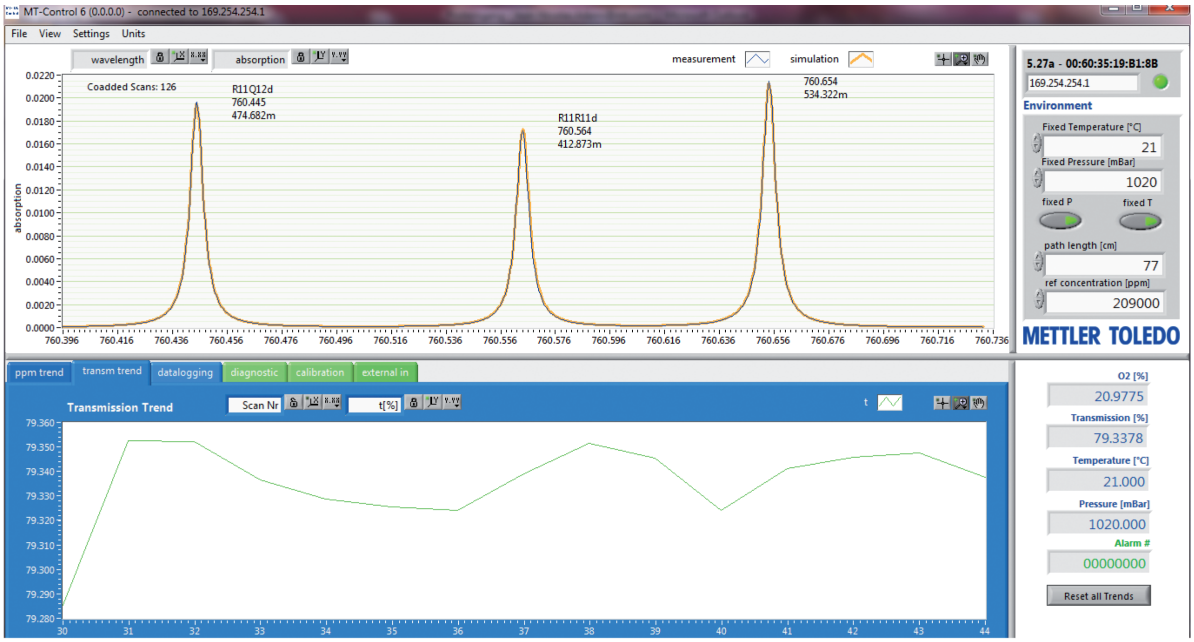


Figure 62 The transmission trend

6.2.3 Data logging

This screen is used to administer the data logging capabilities of the software.

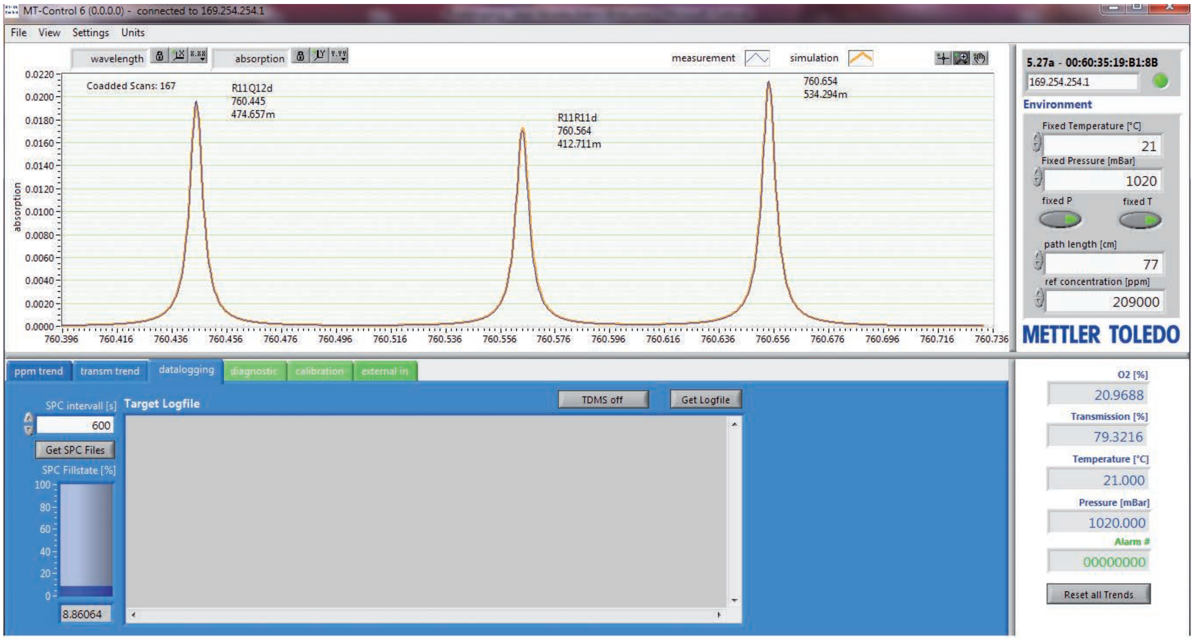


Figure 63 Data logging

The logging starts automatically when the unit is powered. By setting the log interval to 1 sec. the system will store a log record every one second. Each log record is 8 kb, the total space available is 80% of 4GB (3.2GB). When the available space is used up the system will automatically replace the oldest log record. By changing the "SPC Interval(s)" back to 0 sec. the log will stop. By pushing the button "Get Files" you will download the entire log file to your PC. The log can later be viewed/analyzed by using the MT-TDL Viewer.

6.2.4 External sensors

When using external inputs for Temperature and Pressure, the inputs have to be configured according to the customer specifications. This is done in this screen.

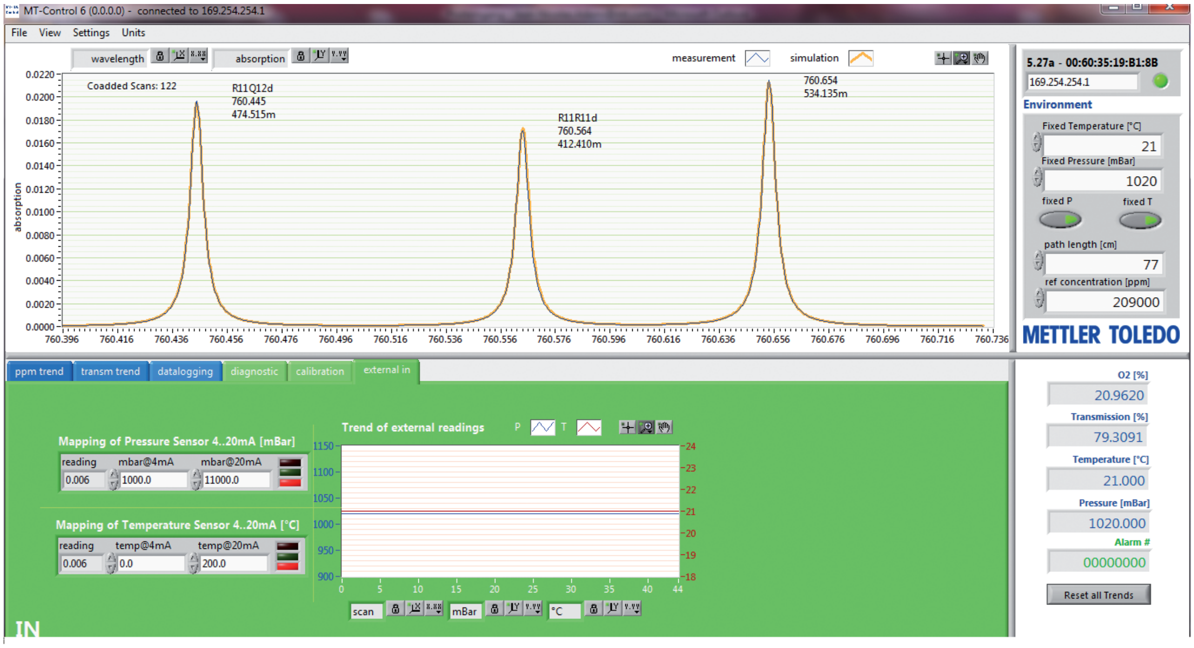


Figure 64 External sensors

6.2.5 Diagnostic

On this tab, several ISM related data is available. ISM (Intelligent Sensor Management) is METTLER TOLEDO's concept for proactive, real-time sensor health monitoring. The ISM relevant data for the GPro 500 contain the following:

– DLI (Dynamic Lifetime Indicator): The DLI indicates in days the expected laser diode remaining lifetime, based on current usage. This value is read-only and is a general indication of the analyzer's recommended duration until complete replacement. When the DLI reaches zero, the analyzer will continue to measure but the alarm will appear in the M400 transmitter.

– TTM (Time to Maintenance): The TTM is evaluating in real-time the remaining time until the minimum recommended transmission value of 10% is reached. This evaluation is based on the current rate of transmission loss under the present process conditions. When the TTM reached zero, cleaning of the optics or even replacement of optics parts is recommended.

– T-max extern: this is the maximum temperature at which the GPro 500 process adaption has been exposed to from the process gas stream.

– Operating hours: the service time of the GPro 500 in hours.

– Create Diagnostic file: use this button for troubleshooting the unit. When the button "Create diagnostic file" is pressed, a ZIP compressed file is created after 15 seconds on the desktop. The ZIP file contains:

  – the log file (equivalent to clicking on the "Get logfile" button).
  – 10 spc files containing the full spectral data of the last 10 seconds in service.
  – the ppm trend values
  – the % trend values
  – the calibration history file

Please send the ZIP file to your METTLER TOLEDO representative for further analysis.

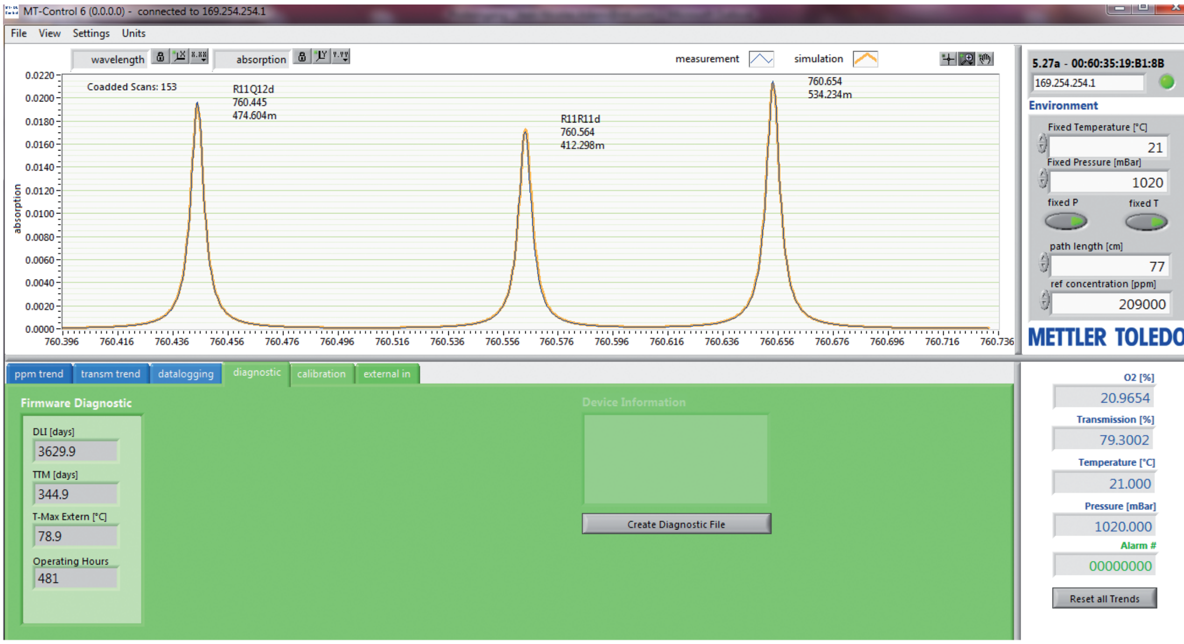


Figure 65 Diagnostic

6.2.6 Calibration data

The calibration tab shows a summary of all successfully executed calibrations on the unit.

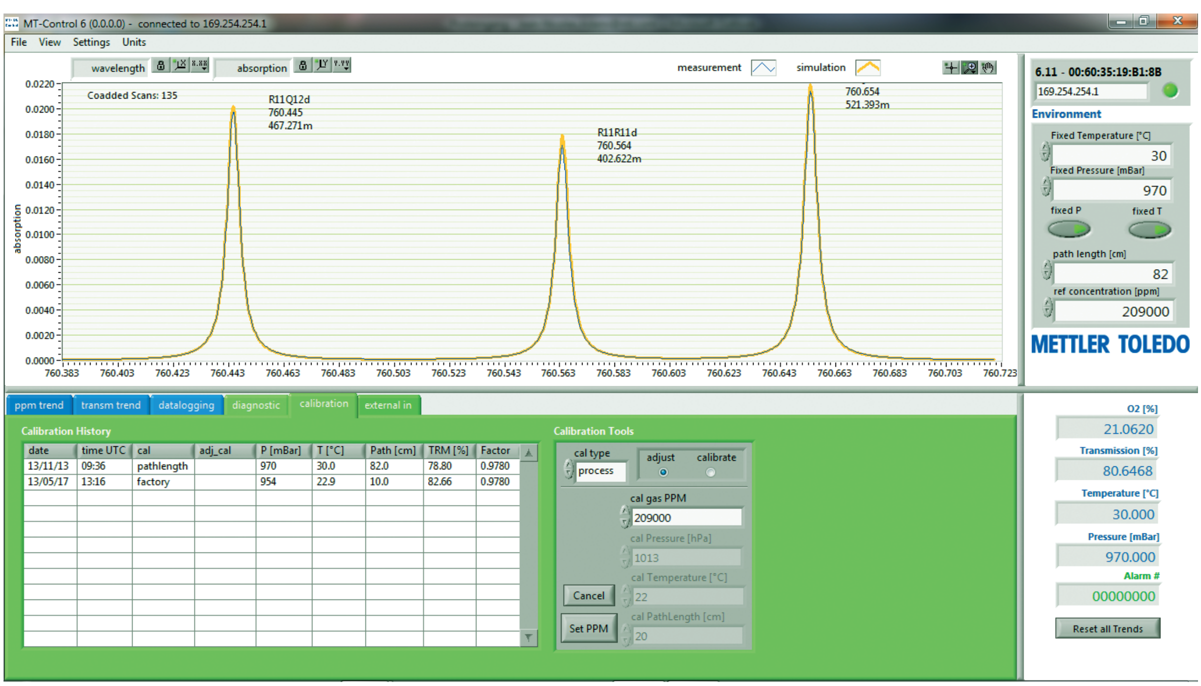


Figure 66 Calibration

6.2.7 Analog Outputs (optional)

When an Ethernet connection is established to a GPro 500 with the option Direct Analog Outputs, the tab "external out" appears. This screen is used to configure the 4…20 mA passive analog outputs (for correct wiring please refer to chapter5 "Electrical Connections" on page 81). Please note that there is no configuration menu in the M400 in order to set up the direct analog outputs.

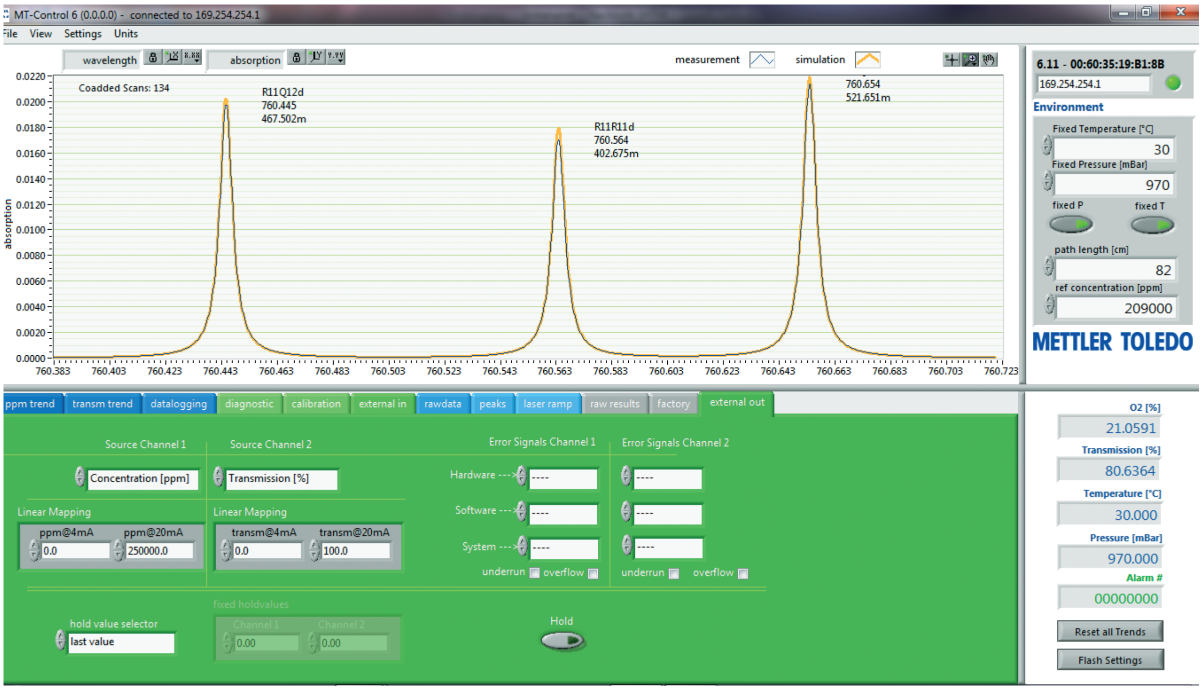


Figure 67 Analog outputs (optional)

For each channel to be used, select the parameter to be mapped to the channel using the pull down menu. The following measured values can be mapped on each channel:

- Concentration (ppm)
- Concentration (%v)
- Pressure (mbar and psi)
- Temperature (°C and °F)
- Transmission (%)
- DLI (days)
- TTM (days)

When the parameter is selected, key in the range that has to be linearly mapped to the 4…20 mA values. Units must be the same as those of the parameter selector above.

WARNING

For SIL2 installations the direct analog output version must be used and only these outputs should be connected to external systems.

An M400 transmitter can be added if desired, but note that the M400 is not SIL certified and its 4-20mA outputs MUST NOT be used.

Figure 68 Selecting a parameter

To assign the high-level error signals to each channel (hardware, software and system) to be relayed to the control system, use the corresponding pull-down menu, see picture below. The following choices can be selected:

– No alarm: when the error occurs, no action is taken to set the analog outputs in alarm condition.
– Alarm condition low (3.6 mA)
– Alarm condition high (22 mA)

Additionally, when the analog outputs can be set to the 3.8 mA or 21 mA state when an out-of-range condition has to be detected by the system. To do this, check the corresponding box (underrun/overflow).

Figure 69 Selecting alarms

Hold mode: during operations such as calibration as well as when in alarm state, the reading when in hold mode can be set to the following values:

– Last value
– Fixed value

The fixed readings for the analog outputs can be set using the corresponding fields.

Figure 70 Selecting hold mode

7 Operation, Maintenance and Calibration

7.1 M400

Key features of the M400 are the Integration of ISM functionality and the unique mixed-mode input feature (accepting conventional or ISM sensors).

Figure 71 M400 G2 front

1 8 languages
English, Spanish, French, German, Italian, Portuguese, Russian and Japanese
2 Large backlit display (4 text lines)
3 Password protection (5 digit, numeric)
4 Multi parameter unit
5 ISM (the availability of specific ISM functions is dependent of the measured parameter)
– Plug and Measure
– Dynamic Lifetime Indicator (DLI)
– Adaptive Calibration Timer (ACT)
– Time to Maintenance Indicator (TTM)
– CIP/SIP/Autoclaving counter
– Calibration history
6 FM Cl1 Div 2, Atex Zone 2, IP 65 /NEMA 4X protection
7 Quick Setup Mode

WARNING
Make sure the time and date settings are correct all the time. If date and times are wrong on the M400, the log files will also be wrong on the analyzer.

7.1.1 Instrument Start-up

Assuming that the TDL is connected to the M400 Transmitter, the TDL will power-up automatically when power is switched on to the M400. The start-up time is approximately 1 min.

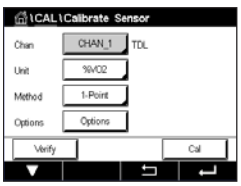
7.1.2 Instrument Shut-down

To shut down the instrument simply disconnect it. No other measures needs to be taken.

7.2 Calibration of the GPro 500 analyzer

PATH: ⌂\Cal\Calibrate Sensor

Calibration for a GPro 500 is performed as a one-point or process calibration.



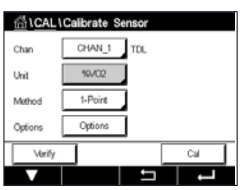
The following menus can be called up:

Unit: One of several units can be chosen. The units are displayed during the calibration.

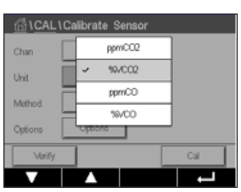
Method: Select the desired calibration procedure, 1-point or process calibration.

Options: If the 1-point method has been chosen the calibration pressure, temperature and the path length for the sensor signal during the calibration can be edited.

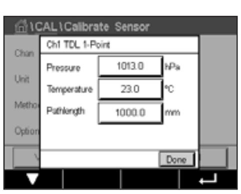
7.2.1 One-point calibration for GPro 500



A one-point calibration of gas sensors is always a slope (i.e. with air) calibration. A one-point slope calibration is done in air or any other calibration gas with defined gas concentration.

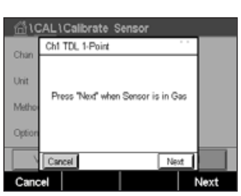


In the case of a dual gas (for example CO and CO_2) the GPro 500 selects the gas to be calibrated.



Adjust calibration pressure and temperature, which are applied during calibration.

Adjust the optical path length for your individual system.



Press the Cal button to start the calibration

Place the sensor in the calibration gas (e.g. air). Press Next.

Enter the value for the calibration point then press Next to start the calculation.

The M400 checks the deviation of the measuring signal and proceeds as soon as the signal is sufficiently stable.

The display shows the value of the sensor as the result of calibration.

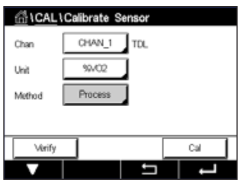
Press the adjust button to perform the calibration and store the calculated values in the sensor.

Press the Calibrate button to store the calculated values in the sensor. Calibration is not performed. Press the Cancel button to terminate the calibration.

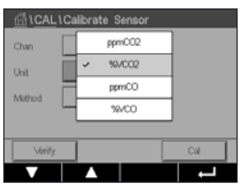
If "Adjust" or "Calibrate" are chosen, the message "Adjustment Saved Successfully!" or "Calibration Saved Successfully!" is displayed. In either case you will see the message "Please re-install sensor".

The GPro 500 measurement value doesn't drift, therefore we do not recommend to use the Adjust function. The Calibrate function allows you to verify correct measurement without adjusting the measurement value.

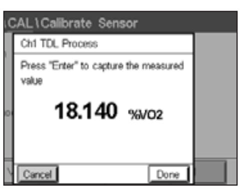
7.2.2 Process calibration for GPro 500 gas sensors



A process calibration of gas sensors is always a slope calibration.

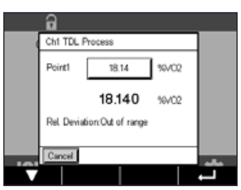


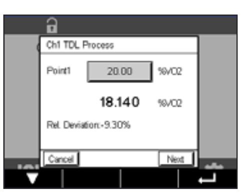
In the case of a dual gas (for example CO and CO2) the GPro 500 selects the gas to be calibrated.
Press the Cal button to start calibration.



Take a sample and press the [ENTER] key to store the current measuring value. To show the ongoing calibration process, P blinks in the start and menu screen.

After determining the concentration value of the sample, press the calibration icon in the menu screen to proceed with the calibration.





Enter the value for the calibration point then press Next to start the calculation.

The M400 checks the deviation of the measuring signal and proceeds as soon as the signal is sufficiently stable.

The display shows the value of the sensor as the result of calibration.

Press the Adjust button to perform the calibration and store the calculated values in the sensor.

Press the Calibrate button to store the calculated values in the sensor. Calibration is not performed. Press the Cancel button to terminate the calibration.

If "Adjust" or "Calibrate" are chosen, the message "Adjustment Saved Successfully!" or "Calibration Saved Successfully!" is displayed. In either case you will see the message "Please re-install sensor."

Calibration using a calibration cell (for O_2 measurements only)

For a more accurate calibration the calibration cell can be used. To do this the TDL (the blue head) needs to be removed from the probe. Then it has to be mounted on the calibration cell according to the illustration below. Before calibration is started new values for path length, temperature and pressure have to be entered on M400. Then the calibration gas is flowed through the calibration cell and the calibration is done in the calibration menu of M400.

During calibration with the calibration cell the process is still sealed and no extra precautions need to be taken.

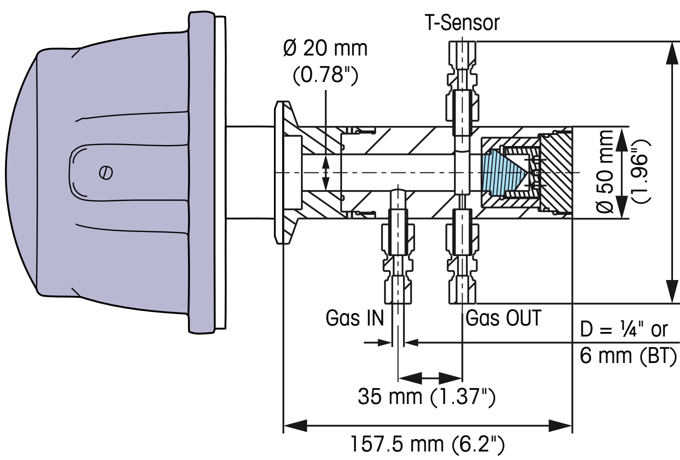


Figure 72 Calibration cell

7.3 Maintenance

The GPro 500 TDL is designed to reduce maintenance to a minimum. Experience has shown that a maintenance interval of more than 12 months is acceptable for most applications. The maintenance operations described in this section will secure continuous and safe operation of the GPro 500.

7.3.1 Routine maintenance

GPro 500 has no moving parts and requires very few consumables (filters). TTM and DLI in M400 can generate maintenance requests - for instance if the transmission drops. For best performance, however, we recommend to routinely carry out the following steps:

- Check optical transmission regularly (daily).
- Clean windows when necessary (see below).
- For applications where the concentration of the measured gas is normally zero (zero gas application): Check instrument response by applying some gas at least once every 12 months. Apply sufficiently high gas concentrations to obtain a strong instrument response for at least 10 minutes (at least 70 minutes after power on). No warnings or errors should be displayed during the test. Contact your supplier if you are in doubt about your instrument.
- Check calibration every 12 months (depending on the required accuracy). Recalibrate if necessary, see "Calibration" on page 119.

7.3.2 Remove the probe or wafer cell from the process

The GPro 500 is removed from the process by loosening the four bolts on the flange and carefully extracting it. If necessary the purging connection may have to be removed as well. For wafer cell removal, the process must first be stopped, or the pipe section isolated via closure of isolation valves. The flange mounting bolts can then loosened and removed and the wafer cell carefully extracted from the pipe flanges.

	WARNING Before removing the probe or wafer cell from the process it is very important to verify with the plant manager that it is safe. The process must be shut down or in a state so it is safe to expose the ambient environment to it.

	WARNING Do not turn off the purging before removing the probe. This will prevent the optical surfaces from being contaminated

7.3.3 Removing & cleaning the corner cube

To remove the corner cube you need to unscrew the end cap of the probe with a pin spanner. Thereafter the unit containing the corner cube can be taken out. Carefully clean the surface of the corner cube and remount it. The optical surface can be cleaned with non-hazardous, non-abrasive detergents or solvents. Iso-propyl alcohol (IPA) is the recommended solvent for optical component cleaning.

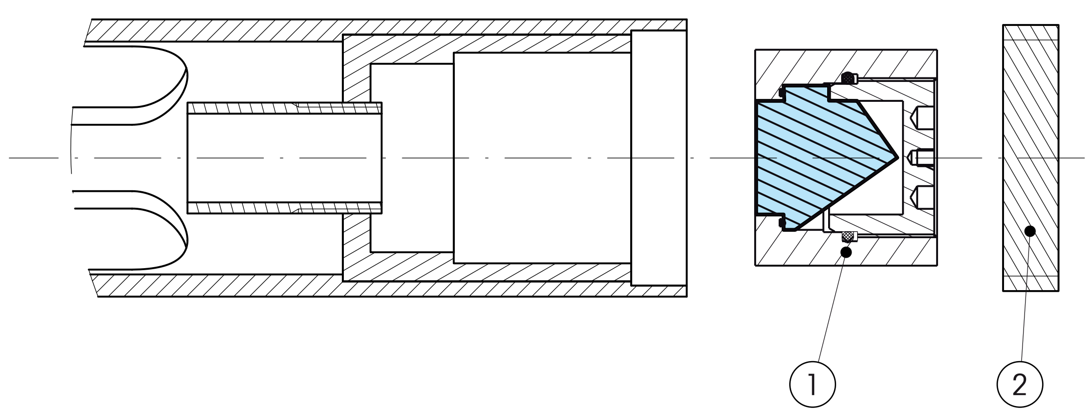


Figure 73 Cleaning/Replacing the corner cube on standard probe (SP) and non-purged probe (NP).

1 Corner cube module
2 Probe end cap

In cases of condensation within the corner cube module, use the pin spanner (part number 30 129 726) to carefully open the back side of the module to access the corner cube for cleaning. For spare O-ring set, please see Appendix 2, chapter 2.2 "Spare parts" on page 139.

	WARNING As the in-line wafer cells (single-window version) is integral of the process and in order to maintain the integrity of the PED (Pressure Equipment Directive) certification, the corner cube should not be removed.

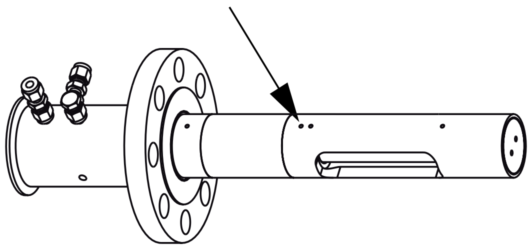


Figure 74 Arrow indicates sunk-in screws for process window cleaning.

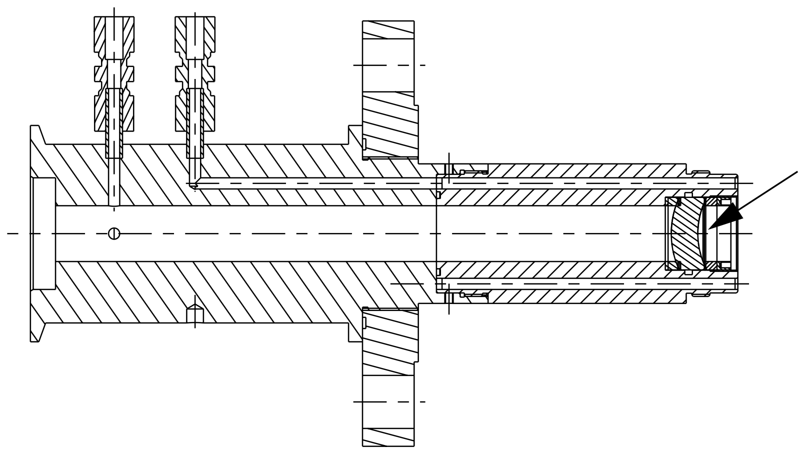


Figure 75 Probe without tip assembly. Arrow indicates process window.

7.3.4 Cleaning the probe process window

To clean the process window you need to remove the probe from the process, see 7.3.2 on page 115. Remove the sensor head, unscrew the probe and then unscrew the sunk-in screws (see Figure 74 on page 116) carefully. With care, unscrew at the probe tip assembly to access the window (see Figure 75 on page 116). Carefully clean the surface of the process window. The optical surface can be cleaned with non-hazardous, non-abrasive detergents or solvents. Iso-propyl alcohol (IPA) is the recommended solvent for optical component cleaning.

> **WARNING**
> Do not remove the process window from the window module since that will void the PED pressure certificate.

The process side purge connection is fitted with a seal between the fitting and the purge housing to conform to the pressurized equipment directive (PED). To ensure the integrity of this seal and to prevent damage when connecting or disconnecting the purge tube to the fitting, a back spanner (wrench) must be used to securely hold the fitting body as the purge pipe nut is tightened, as illustrated in Figure 76 below.

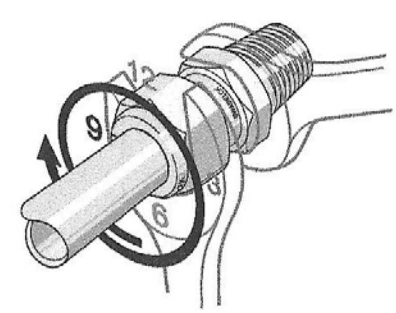


Figure 76 Connecting purge pipe to process side purge fitting.

WARNING
Do not remove and/or disassemble the purge gas inlet for process.
If disassembled, the PED pressure certificate is void.

WARNING
The high pressure glass in the probe must not be subject to any mechanical impact which might cause damage to the glass (scratch, gash etc.). When cleaning the glass it must be done with a soft cloth.
Make sure that it is safe to dismount the probe before cleaning.

If the process window cannot be cleaned correctly, the whole window module and flange assembly need to be replaced.

WARNING
The window module is securely attached to the flange using sunk-in screws.
Do not attempt to remove or untighten the screws,
as this will void the PED pressure certificate.

WARNING
When reassembling the probe, carefully slide the purging tube inside and screw the probe into the flange until the thread is fully seated.
This is to ensure the tightness of the purging system inside the probe.

WARNING
After probe reassembly,
check the integrity of the process purge circuit to avoid any leaks.

7.3.5 Removing and cleaning the filter

For process adaptions that require a filter (NP and B probes, W wafers), the filter may be removed for maintenance or replacement. First, unscrew the end cap (see Figure 73 on page 115) and carefully remove the corner cube for accessing the filter. Then unscrew the sunk-in screws (see Figure 77 on page 118) to loosen the filter from the probe. Remove the filter by lifting the probe slightly pointing downwards and the filter will glide out (on sinter filters carefully clean the O-rings (see Figure 77 on page 118 and Figure 78 on page 118). Use a bath filled with non-hazardous detergent or solvent that is compatible with the process composition to clean the filter pores (typically overnight); an ultraconic bath can be used as well. For spare O-ring set, please see Appendix 2, chapter 2.2 "Spare parts" on page 139. Finally, reassemble the filter using the reverse of the above procedure.

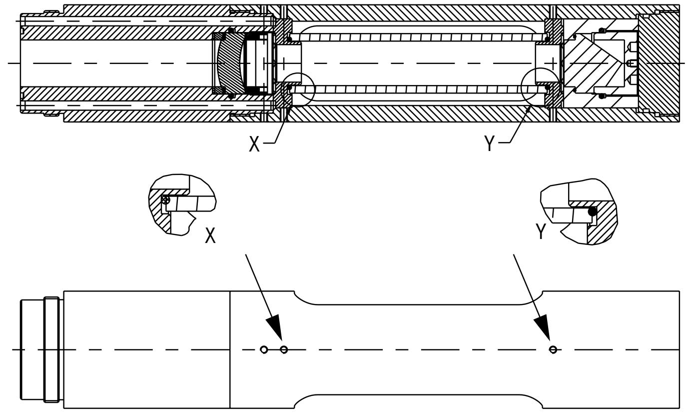


Figure 77 Cleaning / replacing the sinter filter (for NP probes with filter, B probes and W wafers). Arrows indicate the sunk-in screws to uninstall the filter.

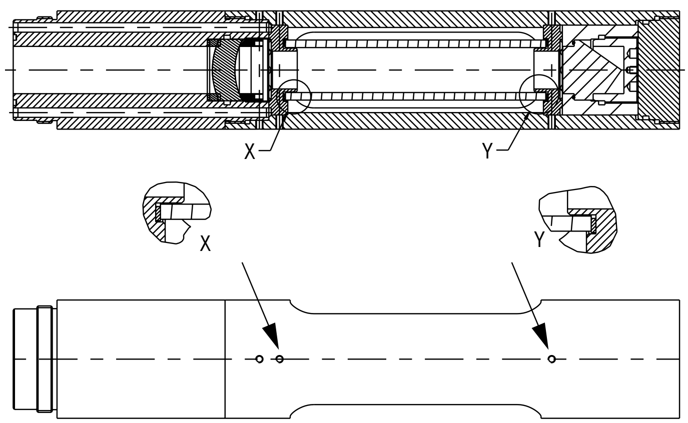


Figure 78 Cleaning / replacing the sinter filter (graphite sealing) (for NP probes with filter, B probes and W wafers). Arrows indicate the sunk-in screws to uninstall the filter.

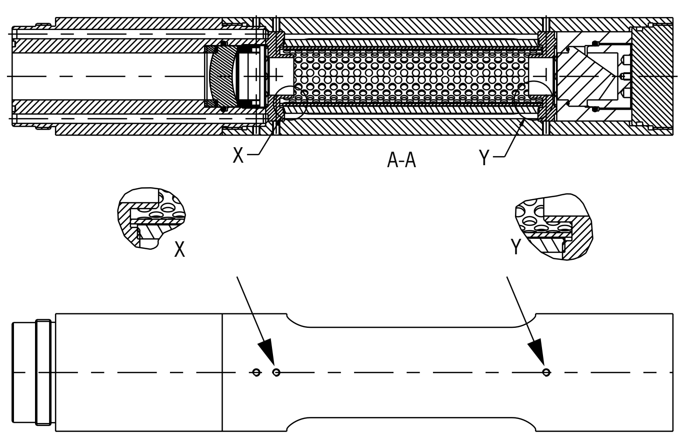


Figure 79 Cleaning / replacing the PTFE filter (no sealing) (for NP probes with filter, B probes and W wafers). Arrows indicate the sunk-in screws to uninstall the filter.

7.4 Calibration

If the GPro 500 is installed together with the M400 transmitter, then the M400 can be used to perform calibration/verification directly. See chapter 7.1 "M400" on page 111 or refer directly to the M400 manual for further information.

7.4.1 Process Calibration

Calibration directly in the process can be done if the concentration of the gas to be measured is known and stable. This is very convenient and is done very quickly from the calibration menu on M400. For details, see the M400 manual on page 56.

7.4.2 Calibration using calibration cells

The optional calibration cell can be used to provide a quick and accurate calibration/validation check. Doing this the TDL (the units head) needs to be removed from the probe. Then it has to be mounted on the calibration cell according to the illustration below. Before calibration is started new values for path length, temperature and pressure have to be entered on M400. Then the calibration gas is flowed through the calibration cell and the calibration is done in the calibration menu of M400.

☞ During calibration with the calibration cell the process is still sealed and no extra precautions need to be taken.

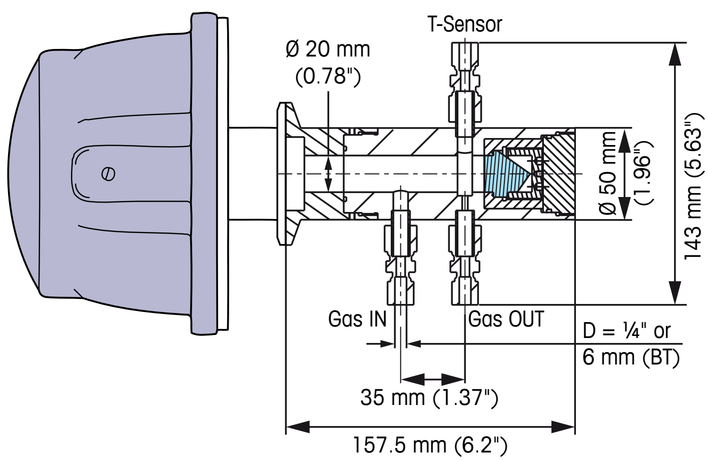


Figure 80 Calibration cell

7.5 Residual Hazards

☞ **Despite all precautionary measures taken, residual hazards still remain.**

7.5.1 Leaky connections

- Connections can become loosened through the effects of vibration.
- The connection between measurement probe and process adaption is a potential source of leakage.

☞ The connections between the measurement probe and the process adaption must be checked regularly by the user/operator, and kept in full working condition.

⚠	WARNING Leaky connections can allow process medium to escape to the environment, presenting a hazard for persons and the environment.

7.5.2 Electricity failure

WARNING

In case of electricity failure (releasing of the fuse) make sure that the mains power is properly disconnected before starting any trouble shouting.

7.5.3 Heat protection

WARNING

The housing is not equipped with heat protection. During operation the surface of the housing can reach high temperatures and cause burns.

7.5.4 External influences

☞ Objects falling on the housing can damage or destroy the TDL head, or cause leaks etc.

☞ Lateral forces may damage or destroy the TDL head.

8 Explosion Protection

8.1 ATEX

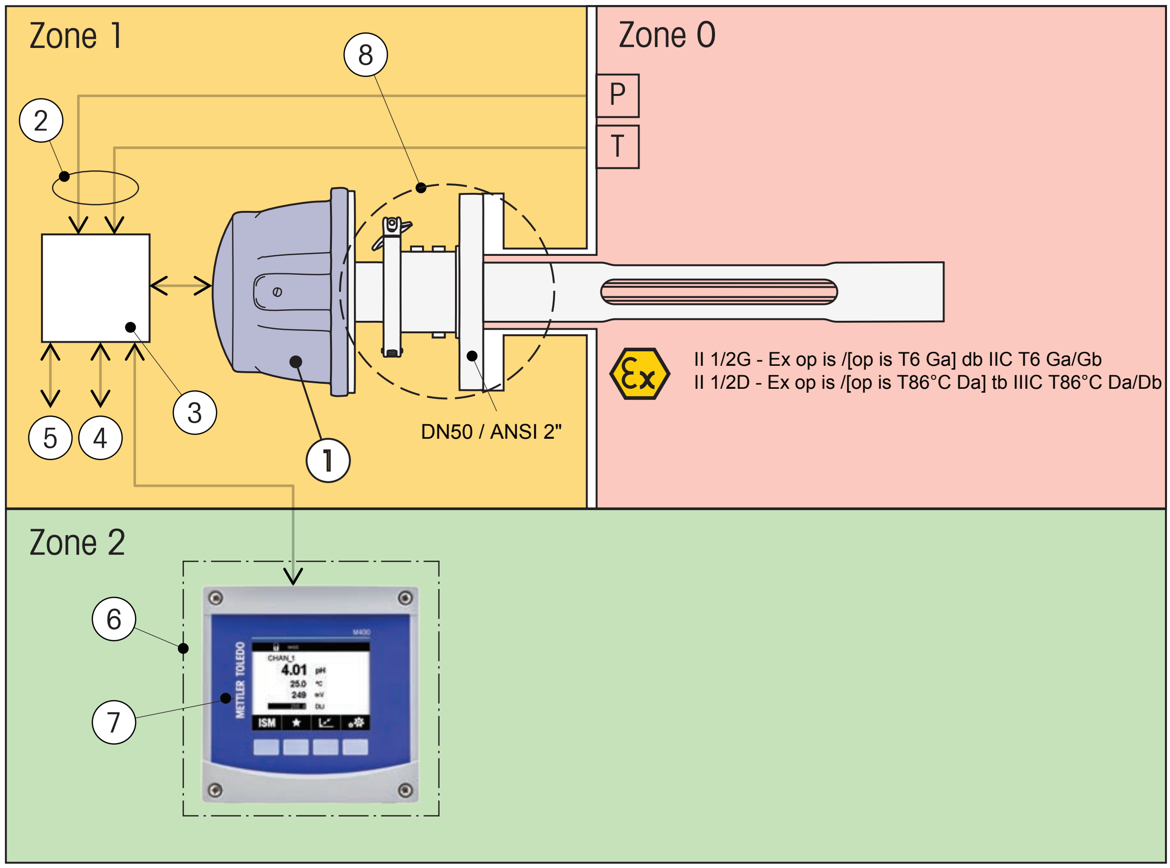


Figure 81 Ex setup

1 GPro 500
2 2 x 4...20 mA (pressure and temperature)
3 Junction Box (Ex-e)
4 Ethernet
5 External power supply
6 Purge box for Zone 1 (optional)
7 M 400
8 For detailed cross section view – see Figure 82 "The GPro 500 Interface between Zone 0 and Zone 1" on page 122

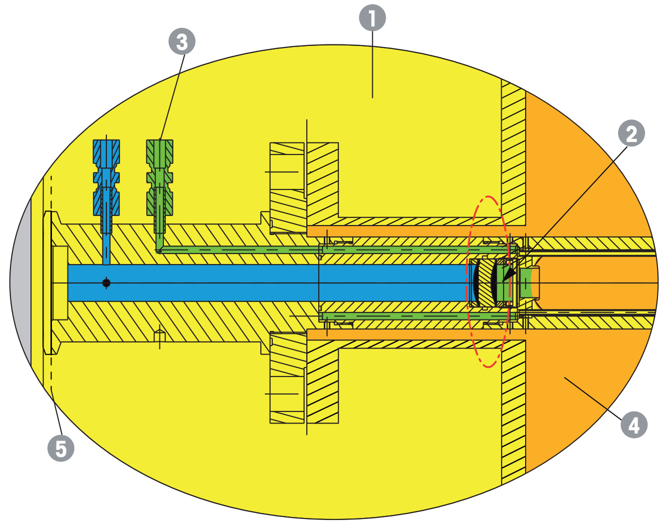


Figure 82 The GPro 500 Interface between Zone 0 and Zone 1

1 Zone 1 region
2 Process window
3 Check valve
4 Zone 0 region
5 Interface sensor head – probe

The process window and the check valve make sure that Zone 0 and Zone 1 are physically separated. The sensor head is always in Zone 1 and the probe is in Zone 0.

Non-metallic boundary wall Sensor Head

– Material of non-metallic boundary wall: Fused silica glass C 7980
– Temperature range of the non-metallic boundary wall: –20–55 °C
– Maximum pressure of non-metallic boundary wall: 0.5 barg

CAUTION
For intended installation in an Ex classified area, please observe the following guidelines (ATEX 2014/34/EU[1]).
([1] For UK statutory Requirements SI 2016 No. 1107)

Ex classification: **Ex II 1/2G - Ex op is/[op is T6 Ga] db IIC T6 Ga/Gb**
and
Ex II 1/2D - Ex op is/[op is T86 °C Da] tb IIIC T80 °C Da/Db

Designation and number of the declaration: **SEV 15 ATEX 0131X**
IECEx SEV 15.0013X
CML 22 UKEX 2213X

WARNING

Repairs of the flameproof joints must be made in compliance with the constructive specifications provided by the manufacturer.

Repairs must not be made on the basis of values specified in tables 1 and 2 of IEC 60079-1 Ed. 7.0.

WARNING

In the normal configuration, the temperature at the interface between the sensor head and the probe may not exceed 55 °C. If the temperature exceeds 55 °C at the interface to the sensor head temperature class T6 (85 °C) is no longer valid and the ATEX classification is violated.

WARNING

If the temperature at the interface between the sensor head and the probe exceeds 55 °C, the Thermal Barrier – see Appendix 2, chapter 2.3 “Accessories” on page 139 – has to be used so that the temperature at the interface to the sensor head never exceeds 55 °C. If the temperature exceeds 55 °C at the interface to the sensor head temperature class T6 (85 °C) is no longer valid and the ATEX classification is violated.

WARNING

The metallic enclosure of the TDL sensor has to be connected by conductive wiring with the grounding system of the plant.

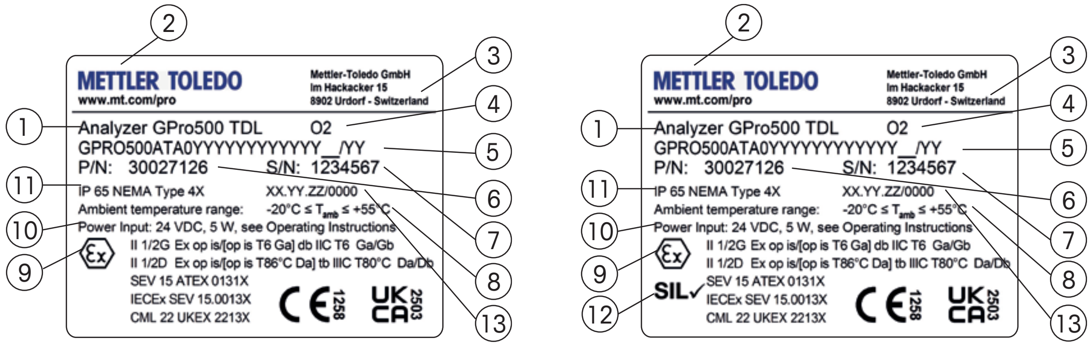


Figure 83 Label.

1 Product name
2 Manufacturer
3 Country of origin
4 Gas to be measured
5 Product key
6 Part no.
7 Serial no.
8 Ambient temperature limits
9 ATEX markings
10 Power rating
11 Enclosure ratings
12 SIL Mark
13 FW/HW version

Figure 84 Note label.

For further guidelines for ATEX compliance please also consult the following chapters of these operating instructions:

– see chapter 3 “Installation and Start-up” on page 35
– see chapter 5 “Electrical Connections” on page 81
– see chapter 7 “Operation, Maintenance and Calibration” on page 111

Figure 85 Grounding label.

Mettler-Toledo GmbH
Process Analytics

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Account no. | 370501-21-4 CHF/IBAN CH65 0483 5037 0501 2100 4

www.mt.com/pro

SIL Declaration of Conformity
Functional safety according to
IEC 61508 and 61511

We

Mettler-Toledo GmbH, Process Analytics
Im Hackacker 15
8902 Urdorf
Switzerland Schweiz

declare under our sole responsibility that the product

Description **GPro 500 Gas Analyzers Series**

Smart Key GPRO500****************__/_A

We as manufacturer declare that the above gas analyzer series GPro500 are suitable for use in safety instrumented systems according to IEC 61508 and IEC 61511. The primary function of the GPro500 is the measurement of the concentration of the target gas for a safety instrumented function of Safety Integrity Level (SIL) 2. The appropriate safety instructions according to the operating instructions manual GPro500. The software Product revisions will be carried out by the manufacturer in accordance with IEC 61508. The software version (V6.X) encodes with "X" special modifications for each gas type and mechanical construction which has no influence on the safety function and detection capability. The failure rate calculations were carried out by EXIDA and calculated via an FMEDA according to IEC 61508.

	Failure rates (in FIT)
Fail safe detected (λ_{SD})	0
Fail Safe Undetected (λ_{SU})	0
Fail Dangerous Detected (λ_{DD})	2820
Fail Dangerous Undetected (λ_{DU})	292
Total Failure Rate (safety function)	3112
Safe Failure Function (SFF)	90%
SIL AC	SIL2

Mettler-Toledo GmbH, Process Analytics

Jean-Nicolas Adami
SPG Gas Leader

Peter Rowing
Head of Quality Management

Place and Date of issue Urdorf, 08.11.2022

This Original shall not be copied, as subject to technical changes

CO_SIL Declaration of Conformity GPro 500V4_November2022.doc

Figure 86 SIL Declaration of conformity

8.2 FM Approval (US Version) Oxygen Measurement

Ex classification: Cl I, Div 1, Grp A, B, C, D, T6
Cl II, III, Div 1, Grp E, F, G, T6

– Designation and number of the declaration: Original project ID 3044884

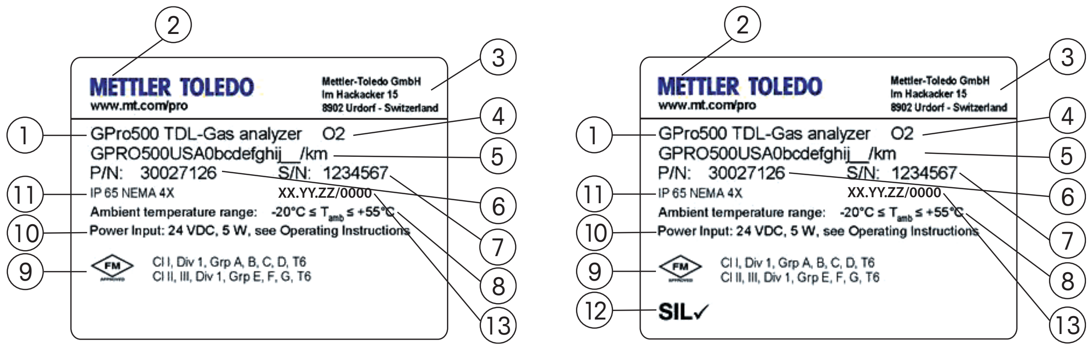


Figure 87 Label for US version.

1 Product name
2 Manufacturer
3 Country of origin
4 Gas to be measured
5 Product key
6 Part no.
7 Serial no.
8 Ambient temperature limits
9 FM markings
10 Power rating
11 Enclosure ratings
12 SIL Mark
13 FW/HW version

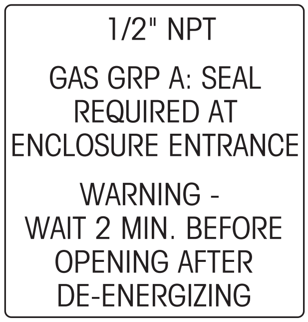


Figure 88 Note label.

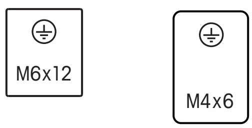


Figure 89 Grounding labels.

For further guidelines for FM compliance please also consult the following chapters of these operating instructions:

– see chapter 3 "Installation and Start-up" on page 35
– see chapter 5 "Electrical Connections" on page 81
– see chapter 7 "Operation, Maintenance and Calibration" on page 111

9 Functional Safety

9.1 Safety Function and Safety parameters

The GPro 500 TDL Analyzers with configurations

GPro 500A0************_/*A and SM500**A0************_/*A**

carry out the safety function defined as:

Measure the concentration of gas and provide the correct 4-20mA output value

The implementation of the above safety functions takes into account the following functional safety parameters:

Mode:	Low demand / Demand mode
Type	B
HFT:	0
Hardware route: Systematic route:	2H
Systematic route:	2S
Systematic capability:	SC3
Failure rates (FIT):	SD=0, SU=0, DD=2820, DU=292
Diagnostic coverage:	90%
Fit for use up to:	SIL 2
Fit for use up to:	STL 4

9.1.1 Verification and calibration

The GPro 500 is factory calibrated and - proper operation and maintenance assumed - they do not require any calibration during the whole service life. The drift of the spectrometer's laser diode is negligible since it does not come into contact with the process and does not decay drastically over time, thus, we only recommend a verification check once a year. Wavelength stability is checked and ensured by the unique line-lock feature using the reference signal.

9.1.1.1 Preparation

For verification/calibration you will need

- Certified calibration gas or ambient air for oxygen calibration
- Verification/calibration kit
- For cross-pipe process adaption and configurations with MR2/3 tool the ND-filter kit is necessary in addition to the calibration kit.
- If you are only performing a simple verification, observe the values of the reading and record it for documentation and certification purposes. It is possible to document the verification result at the memory of the TDL head using CALIBRATION (see below).

Calibration kit for O_2; 200 mm opl, 6 mm	P/N 30 034 139
Calibration kit for O_2; 200 mm opl, ¼"	P/N 30 445 252
Calibration kit for O_2; 400 mm opl, 6 mm	P/N 30 445 253
Calibration kit for O_2; 400 mm opl, ¼"	P/N 20 445 254
ND-filter kit	P/N 30 428 120

Table 11 Ordering information for calibration kits GPro 500.

Attention: The ND filter shortens the optical path length by 9 mm:

- 200 mm → 191 mm
- 400 mm → 391 mm

9.1.1.2 Calibration/Validation with M400

A Switch to the TDL's calibration menu as described in the manual of the M400.

A one-point calibration with oxygen is always a slope calibration.

Select 1-Point as calibration type and press [Options].

Enter values for the effective temperature and pressure values of the gas used for calibration. When using the calibration tube for calibration, use values measured manually for the gas present in the calibration tube.

Adjust the optical path length for your individual system and press [Done].

Press [Cal]

Enter the concentration of the calibration gas and press [Next].

In case of a successful calibration, the calibration values are stored in the cal history and taken over [Adjust] or stored in the cal history and not taken over [Calibrate] or discarded [Cancel].

Figure 90 Calibration operated via M400

9.1.1.3 Verification/Calibration using MT-TDL Suite

Switch to the tab-menu Calibration

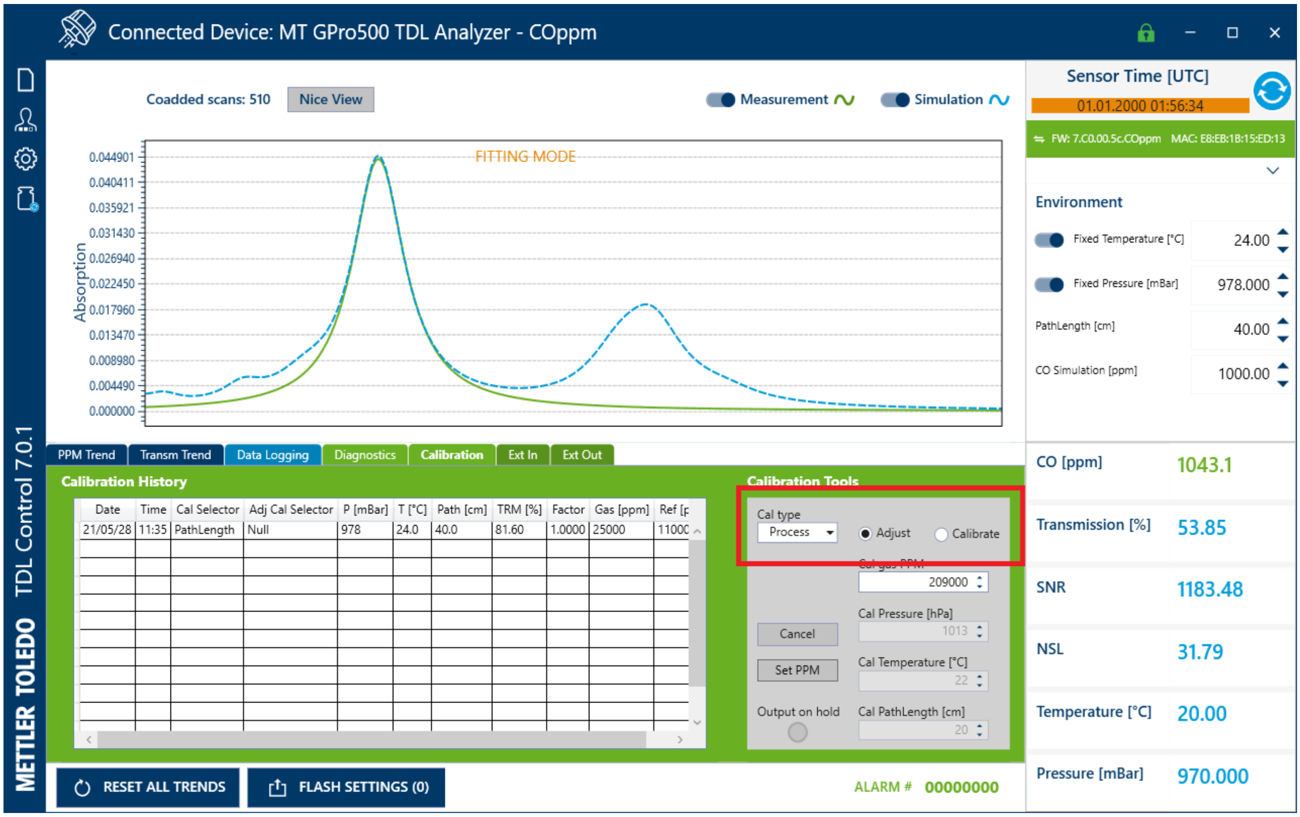
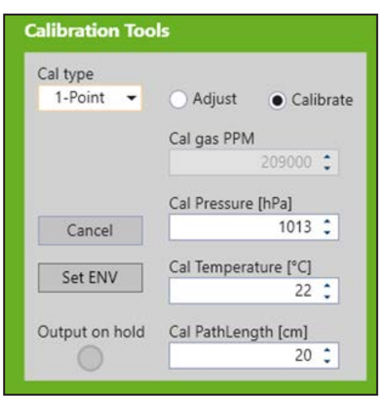
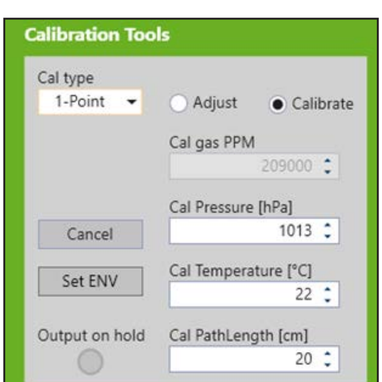


Figure 91 Tab-menu Calibration



- Choose 1-Point in the Cal-type field.
- Select Adjust or Calibrate.
- Set the correct values for temperature and pressure.
- Set the right OPL (Cal PathLength).
- Press [Set ENV].



- Enter the correct calibration gas concentration (Cal gas PPM).
- Press [Set PPM].

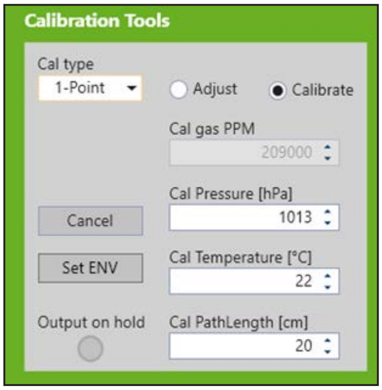


Figure 92 One-point calibration

- Wait until Output on Hold turns green.
- Observe the reading of the TDL.
- Click [Store].
- Wait until the Output on Hold green light turns off.
- The 1-point adjustment/calibration is now finished.

9.1.1.4 Difference between "adjust" and "calibrate"

Adjust: Correcting factor ("Factor" column in the calibration history table in the calibration menu), will be used for the measurement.

Additionally, the data will be stored in the calibration history table.

Calibration: The correction factor will be stored in the history for documentation but will not be used for the measurement. The correction factor from the last valid adjustment will continue to be further used for the measurement.

NOTE: If the procedure fails, please contact your supplier or METTLER TOLEDO support.

Regardless of whether a validation or calibration is carried out, we strongly recommend measuring the analog value of the analyzer and checking whether the expected value is shown in the DCS.

9.1.2 Maintenance and repair

Please refer to Chapter 7.3 and 10.

9.2 Error messages in the control unit

During operation essential status information about the instrument is displayed on M400. The instrument messages and their possible explanations and actions to be taken are given in the table below.

Table 12 Error messages

Fault message	Explanations and actions	Action
Signal Process Failed	Error during the fitting procedure	FAULT
Laser Source Error	Internal laser parameter out of tolerance	FAULT
Bad Signal Quality	Transmission absent or too low; Signal too noisy	FAULT
Flashcard Error	Database error	FAULT
Simulation Mode Active	O_2 value manually set, not measured	FAULT
Pressure Input Error	4–20 mA signal out of range	MAINTENANCE REQUIRED
Pressure Input Invalid	Pressure out of range	MAINTENANCE REQUIRED
T Input Error	4–20 mA signal out of range	MAINTENANCE REQUIRED
T Input invalid	Pressure out of range	MAINTENANCE REQUIRED
Diskspace Low	Diskspace on flashcard low	MAINTENANCE REQUIRED
Laser Control Error	Failure or malfunction of laser temperature controller	FAULT
Internal T Exceeded	System board temperature exceeds range	MAINTENANCE REQUIRED
Configuration Mode	Ethernet connection active	MAINTENANCE REQUIRED
Hardware Error	Software-hardware inconsistent; on-board voltage out of range	FAULT
Laser Source Error	Laser current zero or out of range	FAULT

Messages	Comment	Action	Source	Relay State	Mapping
No sensor on channel 3	The M400 is unable to detect any of the ISM sensor(s) it can identify. If no sensor is found it will display the message NO SENSOR DETECTED	– This is the initial message after Power on. – Wait for the GPro™ 500 to fully boot. – Check if the GPro™ 500 is powered and wait until the system is fully started. – Check the RS485 wiring of the GPro™ 500 to the M400 – Check with the MT-TDL software and the Ethernet port if the system is running correctly. – If timeout still occurs after 60 s, send unit back to METTLER TOLEDO.	M400	Fault	B disconnected
Signal Processing Failed	Fitting of the line profiles failed.	Send unit back to METTLER TOLEDO	TDL	Fault	Software error
Laser Source Error	Internal laser parameter out of tolerance	Call METTLER TOLEDO Service	TDL	Fault	System error
Bad Signal Quality	Transmission lower than 5% threshold	Clean corner cube and process window. Check the gasket between TDL and probe. Rotate TDL on the probe to maximize Transmission. Reduce the dustload in the process.	TDL	Fault	System error
Flashcard Error	Missing or bad calibration and/or database data	Perform a calibration with the calibration tube. If still not successful, send unit back to METTLER TOLEDO for Flashcard exchange.	TDL	Fault	Software error
Pressure Input Error	Pressure reading out of extended range: 0.1 bara < P < 10 bara 4–20 mA input error: 4 mA > P > 20 mA	Check external pressure sensor and mapping	TDL	Maintenance request	System error
Temperature Input Error	Pressure reading out of extended range: –20°C<T<100°C 4–20 mA input error: 4 mA > P > 20 mA	Check external temperature sensor and mapping	TDL	Maintenance request	System error
Configuration Mode	Ethernet port in use: diagnostic or configuration in progress	Disconnect Ethernet cable	TDL	Maintenance request	Software error
The GPro™ 500 error messages can be found in the M400 under the following path: Menu → Service → Diagnostics → TDL → Messages					

10 Decommissioning, Storage and Disposal

Please refer to chapter 1.1 "Safety information" on page 11. Decommissioning may only be carried out by persons with appropriate training or by skilled technicians.

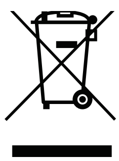
10.1 Decommissioning

Proceed as described in chapter 7.3.2 "Remove the probe or wafer cell from the process" on page 115.

10.2 Storage

Store the GPro 500 in a dry place.

10.3 Disposal



It is recommended that the operator disposes of the device in accordance with local regulations. The operator must deliver the device either to a licensed private or public disposal company, or dispose of it himself in accordance with prevailing regulations. Waste is to be recycled or disposed of without causing any risk to human health, and without using procedures or methods that might harm the environment.

EC guidelines 75/442/EEC
91/156/EEC

Sorting

Sorting into waste groups takes place when dismantling the device. The groups are listed in the current European Waste Catalogue. This catalog is valid for all wastes, whether intended for disposal or for recycling.

The packaging is made up of the following materials:

– Cardboard
– Foam plastic

The housing is made of the following materials:

– Steel
– Polypropylene
– Medium wetted polymers as given in the specifications

Appendix 1 Compliance and Standards Information

- The GPro 500 TDL complies with the European Community "Electromagnetic Compatibility Directive" and "Low Voltage Directive".
- The TDL is rated in accordance to Over voltage Category II, Pollution Degree.
- The TDL complies with the Class B digital apparatus requirements of ICES-003 of Canada through the application of EN 55011:2007.
- L'analyseur est conforme aux Conditions B numériques d'appareillage de classe de NMB-003 du Canada par l'application du EN 55011:2007.
- This TDL complies with Part 15 of the US FCC Rules for Class B equipment. It is suitable for operation when connected to a public utility power supply that also supplies residential environments.
- The TDL has been assessed to IEC 61010-1:2001 +Corr 1: 2002 + Corr 2:2003 for electrical safety including any additional requirements for US and Canadian national differences.
- METTLER TOLEDO Ltd is a BS EN ISO 9001 and BS EN ISO 14001 certified organization.

Appendix 2 Spare Parts and Accessories

2.1 Configuration Options

The complete ordering information of the GPro 500 can be depicted from the table below. An example order number might be GPRO500ATA0PBKS020PA1XX__/AX which would be a unit with ATEX approval, measuring O_2 with standard purged process adaption, standard window, standard O-ring, steel of quality 316L, optical path length 200 mm, ANSI 2"/300 lbs process flange, 100mm wall thickness, no add-on module, 5m cable, RS485.

Table 13 GPro 500 Product key

Gas Analyzer (sample)	GPro 500	A	T	A	0	P	B	K	S	0	2	0	P	D	1	X	S	_	_	/	A	X
30 538 717 (delivery time 3 weeks)	GPro 500	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	/	Y	Y
30 027 126 (delivery time 6 weeks)	GPro 500	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	/	Y	Y
Hazardous area approvals																						
ATEX/IECEx Ex d		A	T																			
FM Class 1 Div 1		U	S																			
Gases																						
Oxygen				A	0																	
CO				C	0																	
H_2O				H	0																	
H_2O ppm				H	1																	
CO_2 %				C	2																	
CO %				C	1																	
CO % + CO_2 %				C	C																	
CO ppm + CH_4 %				C	M																	
H_2S				S	1																	
HCl ppm				L	0																	
CH_4 ppm				M	0																	
NH_3 ppm				N	0																	
NH_3 ppm + H_2O %				N	H																	
Process interfaces																						
Standard Probe purged (SP)						P																
Non-purged Filter Probe (NP)						F																
Non-purged Filter Probe with Blow-back (BP)						B																
Wafer (W)						W																
Extractive Cell (E)						E																
Cross-pipe Folded Path (C)						C																
Standard Purge Twin						T																
Probe non-purged Twin						R																
Non-purged w. blow-back Twin						U																
Process optics* **																						
Borosilicate							B															
Quartz							Q															
Sapphire							S															
Dual Window Borosilicate							C															
Dual Window Quartz							R															
Dual Window Sapphire							T															
Process sealings* **																						
Kalrez® 6375								K														
Graphite								G														
Kalrez® (FDA grade) 6230								F														
Kalrez® 6380								S														
Kalrez® 0090								R														
PFA-coated FEP								P														
Wetted materials* **																						
1.4404 (equivalent to 316L)									S	0												
Hastelloy C22									C	0												
Optical path probes and extractive cell* **																						
200 mm (7.9")											2	0										
400 mm (15.7")											4	0										
800 mm (31.5")											8	0										
1 m (3.3 ft)											0	1										
2 m (6.6 ft)											0	2										
3 m (9.8 ft)											0	3										
4 m (13.1 ft)											0	4										

Gas Analyzer (sample)	GPro 500	A	T	A	0	P	B	K	S	0	2	0	P	D	1	X	S	_	_	/	A	X
30 538 717 (delivery time 3 weeks)	GPro 500	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	/	Y	Y
30 027 126 (delivery time 6 weeks)	GPro 500	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	/	Y	Y
Optical path probes and extractive cell* **																						
5 m (16.4 ft)											0	5										
6 m (19.7 ft)											0	6										
10 m (32.8 ft)											1	0										
None											X	X										
Process connections*																						
DN 50/PN 25													P	D								
ANSI 2"/300 lbs													P	A								
DN 50/PN 16													L	D								
ANSI 2"/150 lbs													L	A								
DIN 80/PN 16													G	D								
ANSI 3"/150 lbs													G	A								
DIN100/PN25													N	D								
ANSI 4"/300 lbs													N	A								
ANSI 4"/150 lbs													M	A								
DN 50/PN 16 and 40													W	1								
DN 80/PN 16 and 40													W	2								
DN 100/PN 16													W	3								
ANSI 2"/150 lbs													W	4								
ANSI 3"/150 lbs													W	5								
ANSI 4"/150 lbs													W	6								
Swagelok 6 mm													E	M								
Swagelok ¼"													E	I								
Wall thickness* **																						
100 mm															1							
200 mm															2							
300 mm															3							
None															X							
Filters* **																						
Filter A – 40 µm																A						
Filter B – 100 µm																B						
Filter C – 200 µm																C						
Filter D – 3 µm																D						
Filter PTFE Membrane																E						
No Filter																X						
Add-on modules* **																						
None																	X	_	_	/		
With Thermal Barrier (up to 600 °C)																	H	_	_	/		
2-fold Multireflection Cell																	2	_	_	/		
3-fold Multireflection Cell																	3	_	_	/		
Cable																						
5 m (16.4 ft)																					A	
15 m (49.2 ft)																					B	
25 m (82.0 ft)																					C	
40 m (131.2 ft)																					D	
None																					X	
Communication interfaces																						
RS 485 (for M400)																						X
RS 485 and Direct Analog (SIL)																						A

* Other configurations upon request.

2.2 Spare parts

Table 14 Spare parts

Spare parts	Order number
Kit Flat gasket ST	30 080 914
Kit Flat gasket HT (Graphite)	30 080 915
Spares Kit FM spectrometer	30 252 641
Sunk-in screws set (20 pc) 1.4404	30 297 253
Sunk-in screws set (10 pc) 1.4571	30 297 254
Sunk-in screws set Hastelloy C22 (5 pc)	30 297 255

2.3 Accessories

Table 15 Accessories

Accessories	Order number
Thermal barrier	30 034 138
Junction box	30 034 149
Purging box for M400 Ex d	30 034 148
O2 Calibration Kit GPro OPL200 6mm	30 034 139
O2 Calibration Kit GPro OPL200 1/4 inch	30 445 252
O2 Calibration Kit GPro OPL 400 6mm	30 445 253
O2 Calibration Kit GPro OPL 400 1/4 inch	30 445 254
Check valve	To be provided by the user
Cable GPro 500 ATEX, FM 5 m	30 077 735
Cable GPro 500 ATEX, FM 15 m	30 077 736
Cable GPro 500 ATEX, FM 25 m	30 077 737
Cable GPro 500 ATEX, FM 40 m	30 422 256
GPro 500 cross-pipe installation positioning kit	30 392 869
Accessory ND-Filter Verification Tool	30 428 120
M400, Type 3	30 374 113
M400 Pipe mount kit	30 300 480
M400 Panel mount kit	30 300 481
M400 Protective hood	30 073 328
GPro Pin Spanner	30 129 726
Tri-Clamp 2.5" High Pressure	30 297 256

Table 16 Corner cube module O-ring set for Standard Temperature (ST)

Accessories	Order number
Kalrez 6375	30 428 051
Kalrez 6230 (FDA grade)	30 428 052
Kalrez 6380	30 468 293
Kalrez 0090	30 468 294
EPDM	30 468 295

Table 17 Filter O-ring set for all metal filters (A, B, C, D)

Accessories	Order number
Kalrez 6375	30 428 053
Kalrez 6230 (FDA grade)	30 428 054
Kalrez 6380	30 468 296
Kalrez 0090	30 468 297
EPDM	30 468 298
Graphite	30 428 055

Appendix 3 Disposal in Accordance with the Waste Electrical and Electronic Equipment (WEEE) Directive

The GPro 500S TDL is not considered to be within the scope of the Waste Electrical and Electronic Equipment (WEEE) Directive.

The TDL is not intended for disposal in a municipal waste stream, but shall be submitted for material recovery and recycling in accordance with any appropriate local regulations.

For additional information and advice on the disposal of the TDL, contact METTLER TOLEDO:

Mettler-Toledo GmbH
Im Hackacker 15
CH-8902 Urdorf
Switzerland
Tel: +41 44 729 61 45
Fax: +41 44 729 62 20
Global e-mail: info@mt.com

If you send the TDL to METTLER TOLEDO or your local METTLER TOLEDO agent (see "Sales and Service" on page 144) for disposal, it must be accompanied by a correctly completed decontamination certificate.

Appendix 4 Equipment Protection

4.1 Traditional Relationship of Equipment Protection Levels (EPLs) to Zones

Equipment Protection Level Zone (EPL)	Zone
Ga	0
Gb	1
Gc	2
Da	20
Db	21
Dc	22

When these are used in the installation, no further risk assessment is required. Where a risk assessment has been used, this relationship can be broken so as to use a higher or lower level of protection.

For more information on Equipment Protection Levels (EPLs) refer to Annex D of IEC 60079-0:2007 or EN 60079-0:2009

Ga 0 Gb 1 Gc 2 Da 20 Db 21 Dc 22

4.2 Relationship of Equipment Protection Levels to ATEX Categories

Equipment Protection Level Zone (EPL)	ATEX Category
Ga	1G
Gb	2G
Gc	3G
Da	1D
Db	2D
Dc	3D

Appendix 5 ESD Guidelines

ESD (ElectroStatic Discharge)

ESD is the rapid, spontaneous transfer of electrostatic charge induced by a high electrostatic field. Electrostatic damage to electronic devices can occur at any point from manufacture to field service. Damage results from handling the devices in uncontrolled surroundings or when poor ESD control practices are used. Generally damage is classified as either a catastrophic failure or a latent defect.

A catastrophic failure means that exposure to an ESD event has caused an electronic device to stop functioning. Such failures can usually be detected when the device is tested before shipment.

A latent defect, on the other hand, is more difficult to identify. It means that the device has only been partially degraded from exposure to an ESD event. Latent defects are extremely difficult to prove or detect using current technology, especially after the device is assembled into a finished product.

☞ Usually, the charge flows through a spark between two objects at different electrostatic potentials as they approach one another.

It is of utmost importance that ESD protective procedures are used during service in the field. The components used in GPro 500 have all been protected from ESD through the whole production chain.

Ground Everything

Effective ESD grounds are of critical importance in any operation, and ESD grounding should be clearly defined and regularly evaluated. According to the ESD Association Standard ANSI EOS/ESD all conductors in the environment, including personnel, must be bonded or electrically connected and attached to a known ground, bringing all ESD protective materials and personnel to the same electrical potential. This potential can be above a "zero" voltage ground reference as long as all items in the system are at the same potential. It is important to note that non-conductors in an Electrostatic Protected Area (EPA) cannot lose their electrostatic charge by attachment to ground.

ESD guidelines

In many facilities, people are one of the prime generators of static electricity. Therefore, wrist straps must be used while carrying out maintenance and service on the GPro 500, to keep the person wearing it connected to ground potential. A wrist strap consists of the cuff that goes around the person's wrist and the ground cord that connects the cuff to the common point ground.

Work Surface

An ESD protective work surface is defined as the work area of a single individual, constructed and equipped to limit damage to ESD sensitive items. The work surface helps to define a specific work area in which ESD sensitive devices may be safely handled. The work surface is connected to the common point ground by a resistance to ground of 106 Ohms to 109 Ohms. This is done by using a soft bench mat, which is connected to ground, on the work surface. All equipment must be connected to grounded outlets and all personnel must wear wrist straps connected to the bench mat using a cord.

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