Instruction Manual
90002929_MLT 3
12/2007

Addendum

MLT 3 (Suppressed Ranges - Gas Purity)

for Instruction Manual

NGA 2000 Hardware Manual for MLT

4th Edition 12/2007

ROSEMOUNT® Analytical

EMERSON™ Process Management

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ESSENTIAL INSTRUCTIONS

READ THIS PAGE BEFORE PROCEEDING!

Emerson Process Management (Rosemount Analytical) designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you **MUST properly install, use, and maintain them** to ensure they continue to operate within their normal specifications. The following instructions **MUST be adhered to** and integrated into your safety program when installing, using and maintaining Emerson Process Management (Rosemount Analytical) products. Failure to follow the proper instructions may cause any one of the following situations to occur: Loss of life; personal injury; property damage; damage to this instrument; and warranty invalidation.

- **Read all instructions** prior to installing, operating, and servicing the product.
- If you do not understand any of the instructions, **contact your Emerson Process Management (Rosemount Analytical) representative** for clarification.
- **Follow all warnings, cautions, and instructions** marked on and supplied with the product.
- **Inform and educate your personnel in the proper installation, operation, and maintenance of the product**.
- **Install your equipment as specified in the Installation Instructions of the appropriate Instruction Manual and per applicable local and national codes**. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, **use qualified personnel** to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Emerson Process Management (Rosemount Analytical). Unauthorized parts and procedures can affect the product's performance, place the safe operation of your process at risk, **and VOID YOUR WARRANTY**. Look-alike substitutions may result in fire, electrical hazards, or improper operation.
- **Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury**.

The information contained in this document is subject to change without notice.

1st Edition 05/2004 *2nd Edition 11/2004* *3rd Edition 08/2007*
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1. Technical Description

The MLT 3 analyzer for suppressed ranges in the gas purity application is part of the NGA 2000 MLT family. The MLT 3 is enclosed in a 19 " housing with thermostat control (55 °C). The physical part (photometer bench, sensors etc.) is separated from the electronic part
(see also Fig.1-3)
The MLT 3 gas analyzer for N_2O, CO_2 or PO_2 gas purity can measure in two measuring modes:

1. absolute range: 0 - 100 % CO_2 / N_2O / PO_2 (paramagnetic oxygen)
2. suppressed range: 95 or 98 - 100 % CO_2 / N_2O / PO_2

Suppressed ranges, like 95 or 98-100 % CO_2, N_2O or PO_2 , are strongly influenced by pressure, temperature, flow and ambient CO_2 and water vapor. Special means are necessary to keep these factors as constant as possible to reduce their influence on the measurement.
An internal pressure regulator, capillary, pressure, temperature and flow sensor are provided to control flow and allow compensation for temperature and barometric pressure variations.
A special calibration procedure is necessary to achieve the requested suppressed range (see chapter 4). Purge of the optical bench with constant CO_2 and H_2O is requested (0.1-0.2 l/min).
The installation of the complete analytical equipment (MLT 3 gas analyzer, sample handling system and calibration gases [zero and span gas]) should be in an air conditioned room or at least in a well ventilated room to fulfill the permissible ambient temperatures (20 to 30 °C).

1.1 Front View

The front panel of the analyzer is the operating front panel (see Fig. 1-1).
Measured values and the entire operating procedure are displayed on a LC display. The operation and programming of the instrument is performed by using the four cursor keys, the ENTER key and the five soft keys (see separate MLT Software Manual).
The MLT 3 front panel for gas purity measurements is identical with the standard MLT 3 front panel. The internal mounting is described later under "Internal Construction" (see Fig. 1-3, 1-4).

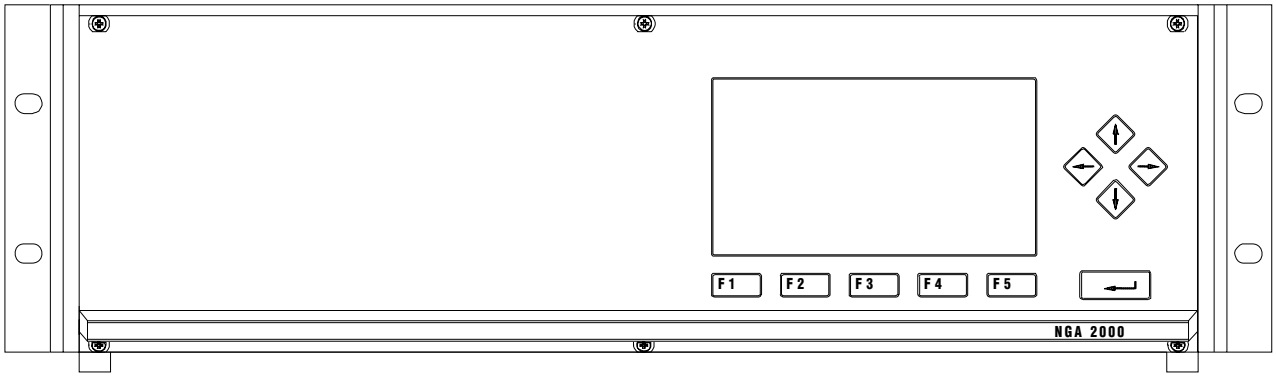


Fig. 1-1: MLT 3 (1/1 19" housing), front view

1.2 Rear View

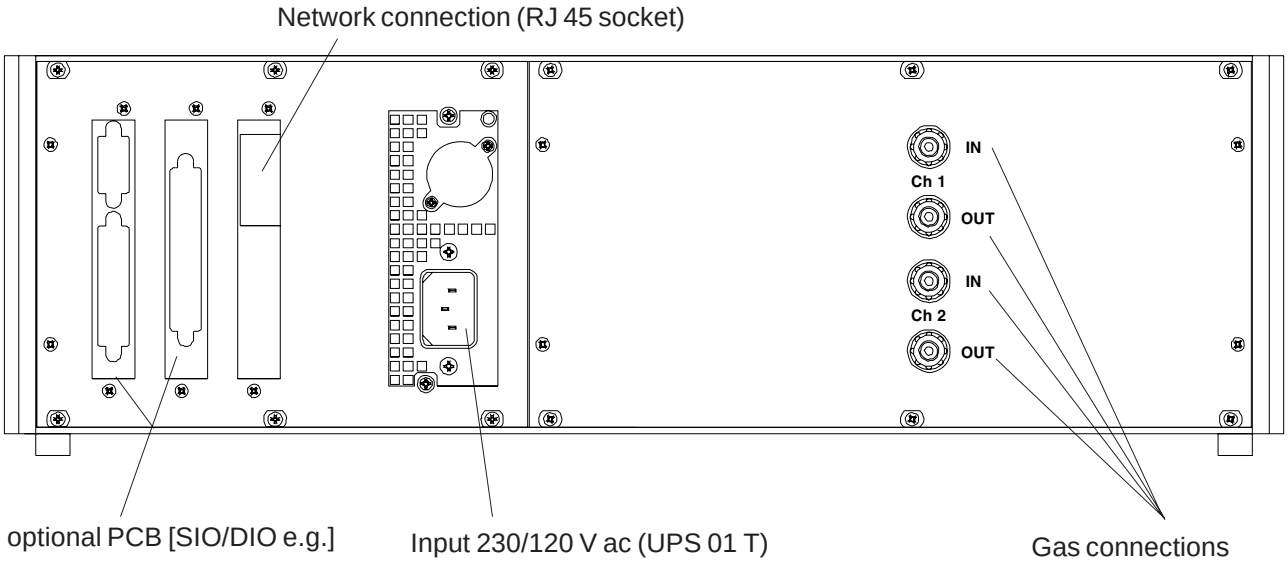


Fig. 1-2a: MLT 3 (standard version), Rear view

See Figures 1-2a and 1-2b for differences between the "standard MLT 3" and the "MLT 3 for gas purity measurement". The "MLT 3 for gas purity measurement" is equipped with a solenoid valve block for the supply of sample, zero and span gas, which is controlled by the analyzer. The control is done with the relay outputs of I/O Board "SIO" via an external connection cable "SIO => Solenoid Valve Block" (pin assignments see Fig. 21-4 in the standard MLT manual).The gas connections are shown in Fig. 1-2b and are marked specific to the application. The outlet of the valve block is connected to the gas inlet of the MLT 3.

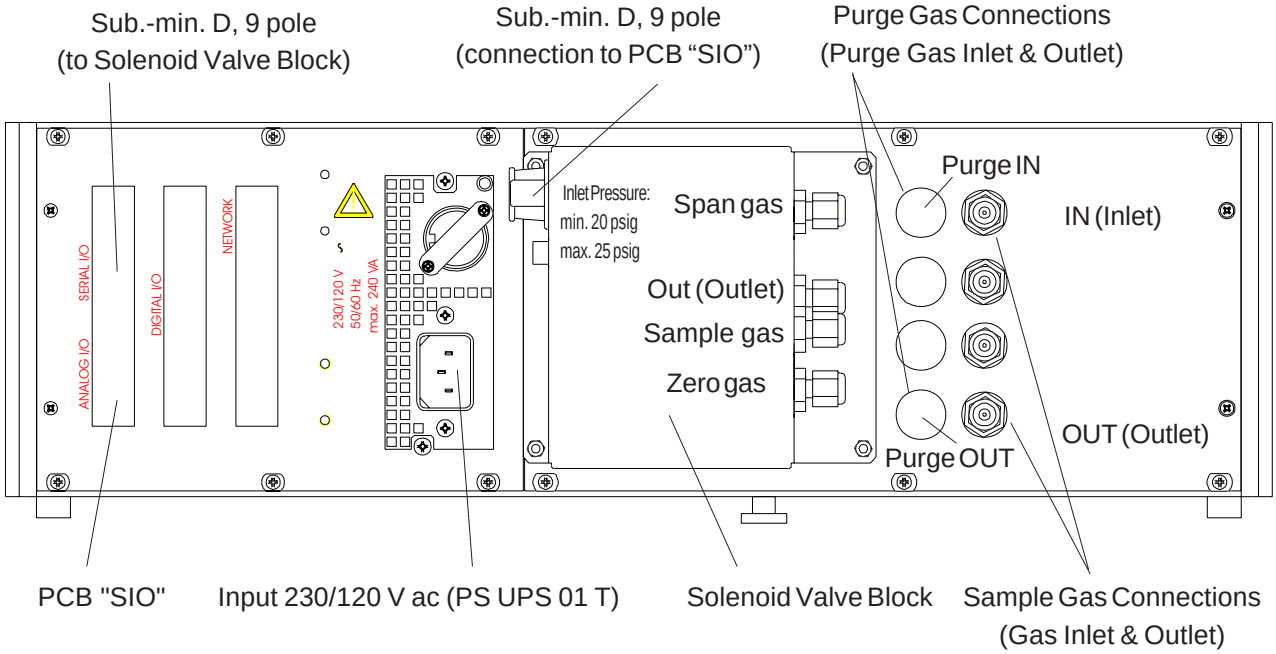


Fig. 1-2b: MLT 3 (gas purity measurement), Rear view

1.3 Internal Construction

The photometer assembly and physical parts is located on the left side (front view) while the electronic part with interconnection board and PCBs is located on the right.

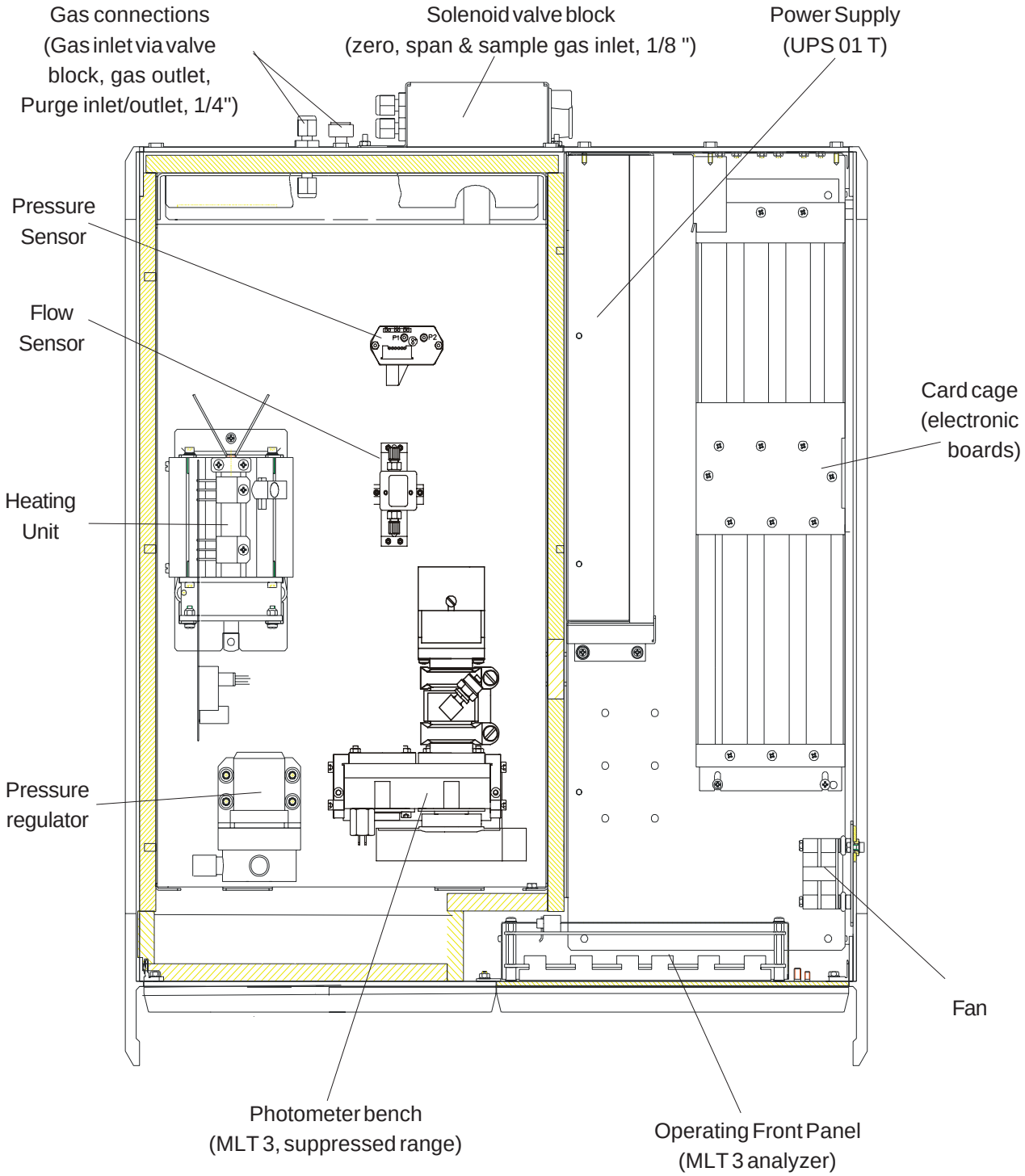


Fig. 1-3: MLT 3 (gas purity measurement), Top view

1.3.1 Internal Gas Paths

The materials used for the gas paths are selected to suit the intended application - gas purity with suppressed N_2O, CO_2 or PO_2 range. The gas inlet is connected by SS tubing to the internal pressure regulator. This gas path also includes a fine dust safety filter (SS version). A capillary is installed after the pressure regulator. This design enables a constant flow if the requested inlet pressure is kept between 1.4 and 3 barg (20 to 45 psig. A pressure of 1.4 to 1.7 barg (20 to 25 psig) is recommended. The optional electronic flow sensor follows the capillary. The outlet of the flow sensor is connected by a viton tubing to the photometer cell. The measuring cell outlet is tubed in Viton to a Tee. One part of the Tee is connected to an atmospheric pressure sensor. The other Tee part is tubed in Viton and connected to the gas outlet fitting.

a) Gas Path Material

Fittings

The sample gas fittings located at the sample gas inlet (including the valve block), sample gas outlet and between sample gas inlet, safety filter, pressure regulator and flow sensor are stainless steel Swagelok® fittings.
The sample gas inlet fittings for zero, span and sample gas are 1/8" Swagelok® fittings. The sample gas outlet is a 1/4" Swagelok® fitting.
The purge gas fittings for purge gas inlet and purge gas outlet are 1/4" PDF fittings,
Fig. 1-4 shows all fittings including the internal fittings.

Tubings

All gas path tubings from gas inlet at the solenoid valve block are SS. This includes all connections from gas inlet to the flow sensor. The remaining gas paths are tubed in Viton (from flow sensor to the outlet fitting).

b) Internal gas paths (Gas Path Lay-out)

The complete internal construction including all gas connections is shown in Fig. 1-4.
Up to the internal pressure regulator the gas paths are stainless steel tubings. The gas paths are connected with viton tubing following the flow meter.

All external sample gas fittings are stainless steel Swagelok®, 1/8 " or 1/4 ". Purge gas fittings are PVDF, 1/4 " or 6/4 mm.

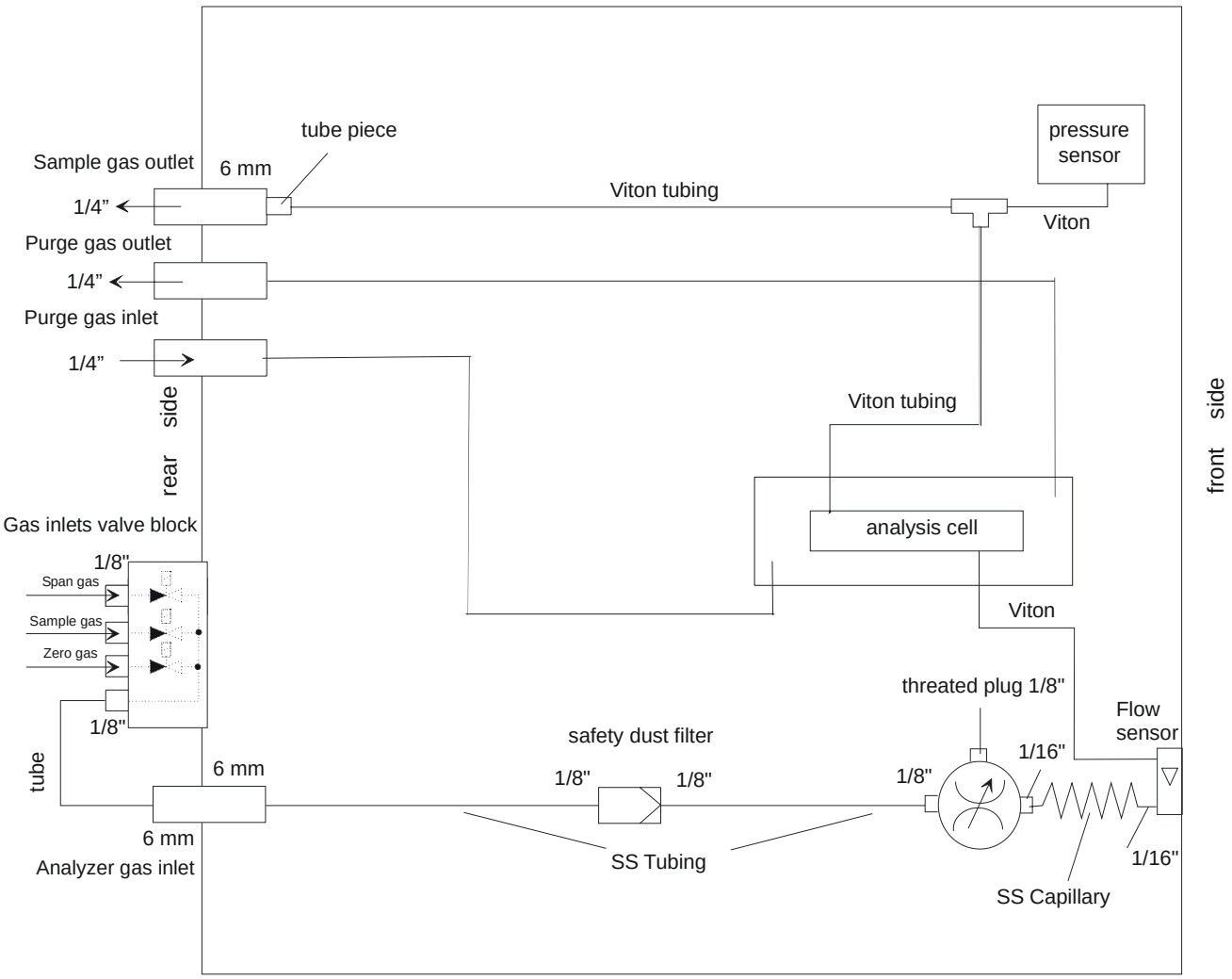


Fig. 1-4: MLT 3 (gas purity measurement), gas path layout
(1 measuring channel with solenoid valve block option)

2. Start-up

Please check the packing and its contents immediately upon arrival.
If any item is damaged or lost you are kindly requested to notify the forwarder to undertake a damage survey and report the loss or damage to us immediately.

2.1 Installation Site

Be sure to observe the additional notes, safety precautions and warnings given in the individual manuals (see Analyzer Discription as well as MLT Instruction Manual) !

The MLT must not operate in explosive atmosphere without supplementary protective measures !

Free flow of air into and out of the MLT (ventilation slits) must not be hindered by nearby objects or walls ! Purge gas is required for the optical bench: approx. 0.1 to 0.2 l/min gas with constant CO_2 (N_2 or air via scrubber)!

The installation site for the MLT has to be dry and remain within the permissible ambient temperature at all times. For suppressed ranges we recommend installation between 20 °C and 30 °C (68 to 86 °F).
The MLT must be exposed neither to direct sunlight nor to strong sources of heat. The room should be well ventilated or air conditioned.
Sample handling system and all calibration gases - zero gas and span gas - should be installed under the same conditions (in one room).

2.2 Gas Conditioning (Sample Handling)

The conditioning of the sample gas is of greatest importance for the successful operation of any analyzer.

All gases have to be supplied to the MLT as conditioned gases !
The use of corrosive gases is not provided for gas purity measurement with suppressed ranges.
It is to be verified that there are no gas components which may damage the gas path components.

The gas has to fulfill the following conditions:

- It must be free of condensable constituents, free of dust and free of aggressive constituents

- Temperatures and pressures within the specifications stated in “Technical Data” and under "Installation Site" of this manual.
  For suppressed ranges a constant pressure between 1.4 and 3 barg (20 - 45 psig) and controlled temperature (20 - 30 °C, 68 - 86 °F) are very important.

2.2.1 Fine Dust Filter

The MLT 3 has a built-in fine dust safety filter (filter material SS).

2.2.2 Pressure Sensor

An atmospheric pressure sensor with a range of 950 - 1050 hPa is implemented to compensate the analyzer concentration readings for changes of the barometric pressure (see Technical Data).

2.2.3 Gas Flow

The gas flow rate is controlled by an internal pressure regulator (see Fig. 1-3 and 1-4) and the correct gas inlet pressure of 1.4 to 3 barg (20 to 45 psig; recommended: 1.4 to 1.7 barg / 20 to 25 psig). There is an optional internal electronic flow sensor which allows monitoring the flow rate on the analyzer display.
The range of the flow sensor is 0 - 2 l/min (0.2 l/min to 1.5 l/min max. recommended) !

2.3 Gas Connections

All fittings as well as gas inlet pressure are clearly marked.

The fittings are located on the rear panel of the MLT 3 instrument.
The exhaust gas lines have to be mounted in a declining slope.

The exhaust gas line at the gas outlet (OUT) should be a minimum 1/4" od with max. length less than 3 m (10 ft.), so that outlet pressure drops are insignificant.

2.3.1 MLT 3 with solenoid valve block

The necessary gas connections are marked at the valve block.
Special requirements for inlet pressure are indicated as well:

A constant input pressure between 1.4 and 3 barg (20 to 45 psig) is necessary for sample gas as well as for zero gas and span gas.

The connections of sample gas, zero gas and span gas have to be fixed by the user to the solenoid valve block on the rear side of the instrument (Fig. 1-2b and Fig. 2-1).
The common exhaust gas outlet (OUT) of the solenoid valve block is connected to the "standard" sample gas inlet of the MLT 3 instrument via a stainless steel tubing (see Fig. 1-4).

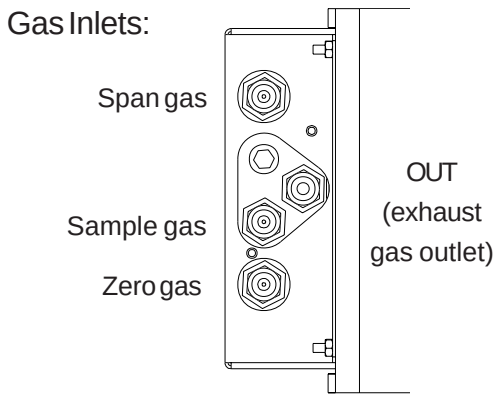
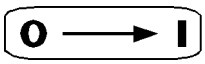


Fig. 2-1: Solenoid valve block MLT 3 (gas purity measurement) *(side view)*

3. Switching On 

Be sure to observe the safety precautions and warnings !
Be sure to observe the additional notes, safety precautions and warnings given in the individual manuals (see standard MLT Instruction Manual) !

Once the instrument has been correctly assembled and started up in accordance with the general instructions given in section 2 "Start-up", the equipment is ready for operation.
The equipment is switched on by providing the required voltage.
Upon switching on, the analyzer will perform a self-diagnostic test routine.

For additional information about display messages during start-up see respective software manual.

The "standard MLT 3" analyzer needs approx. 55 minutes to warm-up after switching on, depending on the installed detectors and thermostatically controlled temperature !
For suppressed ranges of 95/98 - 100 % CO_2, N_2O, PO_2
we recommend warming-up the analyzer over night and start calibration next morning (12 hours) to achieve best results!

The equipment has an internal power supply with “autoranging” for operating voltages of 230 V AC or 120 V AC resp., 47-63 Hz.

Verify beforehand that the line voltage stated on the power supply agrees with that of your power supply line !
The socket outlet shall be installed near the equipment.

o Connect mains line and internal power supply (UPS 01 T) (see Fig. 3-1, Plug AC).

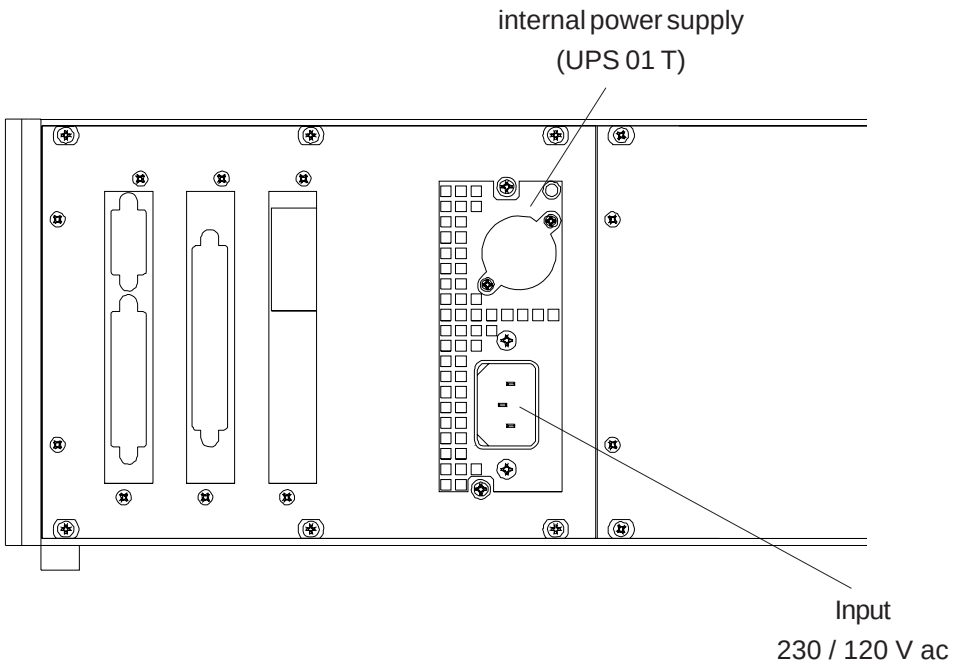


Fig. 3-1: MLT 3, Voltage supply

4. Calibration Procedure

4.1 Measurement

Before starting gas purity measurement of a suppressed range the analyzer needs to be warmed up adequately and the calibration procedure needs to be performed.
Then sample gas can be introduced into the analyzer.

Follow the start-up procedure before starting measurement!

4.2 Calibration

To insure correct measurement results, zeroing and spanning should be carried out according to the calibration procedure for suppressed ranges:

Calibration is carried out in the absolute range of: 0 - 100 % CO_2/N_2O/PO_2

The zero adjustment must be done before running a span adjustment.

MLT 3 for gas purity measurement with suppressed range has to be calibrated once a day!

For the calibration procedure the required zero and span gases have to be connected to the analyzer through the respective gas inlets (valve block) with the same pressure as the sample gas !

For gas purity measurement an input pressure of 1.4 to 3 barg (20 - 45 psig) is necessary for sample gas as well as for zero gas and span gases.
An inlet pressure of 1.4 to 1.7 barg (20-25 psig) is recommended!

o For correct adjustment of the analyzer please refer to the MLT software manual !

4.2.1 Test Gases

a) Zero Gas

For zeroing, the analyzer has to be flushed with 100 % nitrogen (N_2) [best quality]

.

b) Span Gas

For spanning, the analyzer has to be adjusted with 100 % CO_2/N_2O/O_2 [best quality].

Observe the safety regulations for the respective gases (sample gas, zero and span gases) and the gas bottles!

Pressure of sample gas / test gases: 20 - 25 psig!
All calibration gases need to hold the same temperature as sample gas!
Sample gas need to be conditioned to the ambient temperature of the analyzer (20 - 30 °C)!

4.2.2 Purge Time

Zero and span calibration requires a certain purge time. After that the calibration routine can take place with the internal stability and averaging procedures (calibration time).
After switching back from the absolute measuring mode to the suppressed range the same purge time is necessary again. The purge time is timed from the MLT 3 gas inlet (not including the sample handling system):

purge time:	> 240 sec (from sample to zero gas; from zero to span gas)
calibration time:	approx. 40 sec
purge time:	> 240 sec (from zero to span or sample gas; from span to zero gas)

5. Maintenance

In general only the sample handling system (gas conditioning) will require maintenance; the analyzer itself requires very little maintenance.

The following checks are recommended for maintenance of the proper operation of the analyzer.

Zero adjustment: daily

Span adjustment: daily

Leak testing: 6 times annually.

The maintenance frequencies stated above are presented as guidelines only:
Maintenance operations may be required more or less frequently, depending upon usage and site conditions.
For gas purity measurements with suppressed ranges a daily zeroing is strongly recommended.
Span gas adjustment may be necessary less frequently depending on recognized span gas deviations. It might be extended from daily adjustment after practical experience.

6. Technical Data

For "complete and standard Technical Data" refer to the standard MLT Instruction Manual.

SPECIFICATIONS - MLT 3: Gas Purity - Absolute and Suppressed Range

	0 - 100 % CO_2		**95/98 - 100 % CO_2**
	0 - 100 % N_2O		**95/98 - 100 % N_2O**
	0 - 100 % PO_2		**95/98 - 100 % PO_2**
Detection limit	≤ 1 % [1) 4)]	**Noise**	≤ 2 % [8) 4)]
Linearity	≤ 1 % [1) 4)]	**Linearity**	≤ 2 % [8) 4)]
Zero-point drift	≤ 2 % per week [1) 4)]	**Zero-point drift**	≤ 800 / 500 ppm per day [4) 9) 11) 16)]
Span (sensitivity) drift	≤ 0.5 % per week [1) 4)]	**Span (sensitivity) drift**	≤ 800 / 500 ppm per day [4) 9) 11) 16)]
Repeatability	≤ 1 % [1) 4)]	**Resolution**	800 / 500 ppm [16)]
Response time (t_{90})	3 s ≤ t_{90} ≤ 30 s [3) 5)]	**Response time (t_{90})**	≤ 30 s [3) 13)]
Permissible gas flow	0.2 - 1.5 l/min	**Gas flow (internal press. regulator)**	defined by inlet pressure [14)]
Influence of gas flow	-	**Inlet pressure**	1.4 to 3 barg (20 to 45 psig) [9)]
Max. pressure	≤ 1,500 hPa abs.	**Min. Pressure**	1.4 barg (20 psig)
		Max. pressure	3 barg (45 psig); 1.7 barg (25 psig) [15)]
Influence of pressure		**Influence of atmospheric pressure**	≤ +-2 % [8) 14)]
- At constant temperature	≤ 0.1 % per hPa [2)]	- 950 to 1050 hPa (at const. temp.)	
- With pressure compensation [10)]	≤ 0.01 % per hPa [2)]	with pressure compensation [10)]	
Permissible ambient temperature	+ 5 °C to + 40 °C [7)]	**Influence of temperature**	+ 20°C to + 30°C [7)]
Influence of temperature		(at constant pressure)	
(at constant pressure)		- On zero point	≤ +-2 % [8)]
- On zero point	≤ 1 % per 10 K [1)]	- On span (sensitivity)	≤ +-2 % [8)]
- On span (sensitivity)	≤ 5 % (+ 5 to + 40°C) [1) 6)]	**Thermostat control**	55 °C
Thermostat control [12)]	55 °C	**Warm-up time** [12)]	Approx. 50 minutes
Warm-up time [12)]	Approx. 50 minutes	Purge gas for optical bench (CO_2/N_2O)	Approx. 0.1 - 0.2 l/min
		(N_2 or air with const. CO_2 & H_2O)	

1) Related to full scale
2) Related to measuring value
3) From gas analyzer inlet at 0.8 l/min gas flow
4) Constant pressure and temperature
5) Depending on integrated photometer bench
6) Starting from 20°C (to + 5°C or to + 40°C)
7) Different ambient temperatures (15 - 35 °C) on request
8) Related to suppressed range (95/98 - 100 % CO_2/N_2O/PO_2)
9) Between min. and max. pressure
10) Barometric pressure sensor required
11) Daily calibration requested
12) Thermostatically controlled box: 55 °C, warm-up time approx. 50 min. (ambient temperature: 20-30 °C); Final stability: over night warm-up recommended!
13) Switch from absolute to suppressed range requires purge time of > 240 seconds
14) Gas outlet open to atmosphere (tube 1/4", 3 m length)
15) Recommended inlet pressure
16) 800 ppm with 95...100 %; 500 ppm with 98...100%

Addendum MLT 3 Gas Purity

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