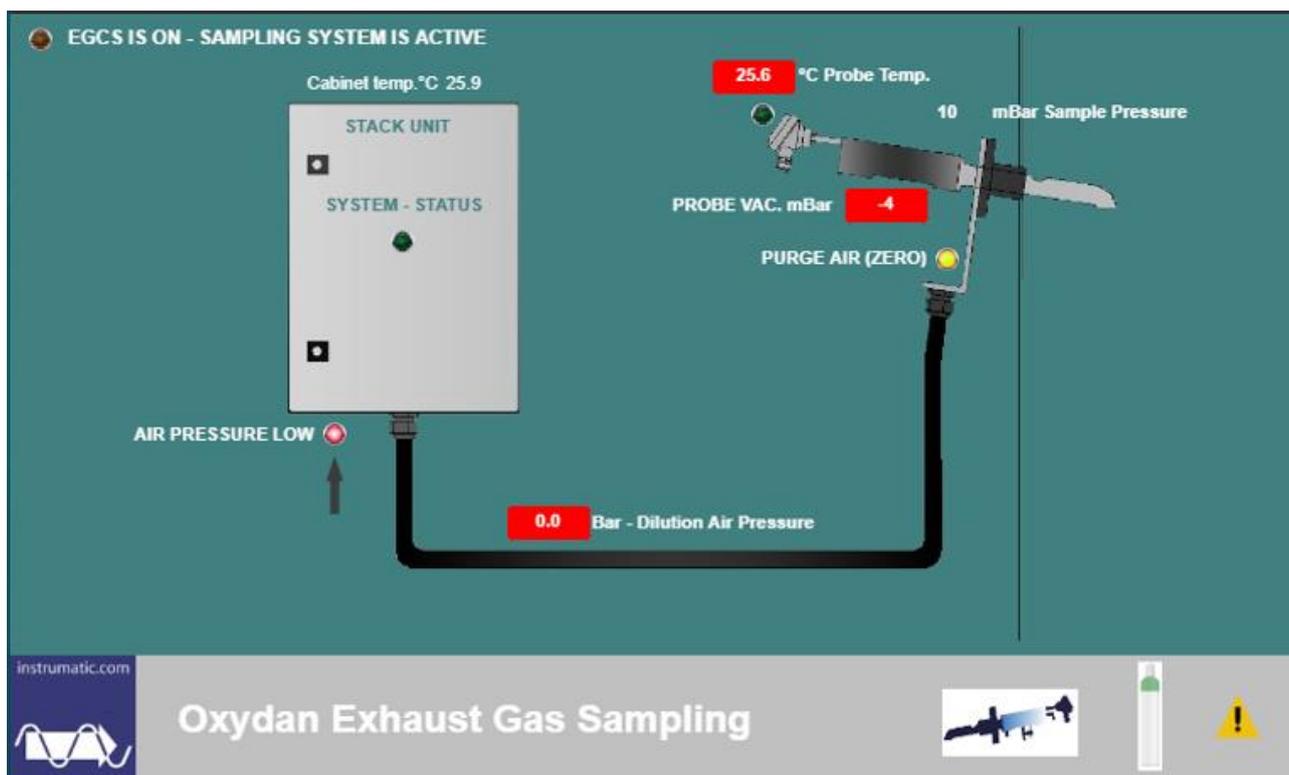


USER MANUAL



OXYDAN DP7900 DILUTION PROBE SAMPLING SYSTEM

for
Continuous Emission Monitoring System

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FIGURES

Title

FIGURE 1 : Warning Signs/pictograms

FIGURE 2 : DP 7900 SAMPLING SYSTEM “system overview”

FIGURE 3 : Analyzer cabinet panel - front

FIGURE 4 : Oxydan DP 7900 dilution probe

FIGURE 5 : Dilution probe heater cartridge.

REVISION HISTORY

DP 5.0 SAMPLING SYSTEM USER MANUAL.			
Date	Rev	Init	Change Summary
2017 May 17	A	ch	Initial release
2018 August	A.1	ch	Stack unit enclosure 500 x 500 mm
2021 Juli	A.2	ch	Revised for dilution sampling system content only
2024 January	A.3	ch	Updating cabinet cooling by vortex removed

1.0 INTRODUCTION

1.1 PREFACE

Instrumatic thanks you for having purchased the OXYDAN dilution probe system for your CEMS application. Instrumatic offers a full one year-warranty, and we will readily provide you with any support required so that you may utilize our equipment to its fullest extent.

1.2 WARRANTY

Prior to shipment, the CEMS is thoroughly inspected and tested. Should functional failure occur, we assure our customers that prompt service and support will be available. All equipment originally manufactured by Instrumatic found to be defective will be repaired or replaced subject to the following considerations:

Coverage

All equipment is warranted for 12 months, expendables not included. Any warranty is limited to 12 months. Warranty is limited to equipment and does not cover losses such as data loss or its effects. Units or parts returned, freight prepaid, will be repaired and/or replaced at Instrumatic 's discretion with no charge for labor and parts. Our warranty commences with shipment of the equipment.

After expiry of warranty period and throughout the equipment's lifetime, Instrumatic readily provides on-site service at reasonable prices similar to those of other manufacturers in the industry.

Non- Instrumatic manufactured equipment

Equipment provided but not manufactured and normally offered by Instrumatic is warranted and will be repaired to the extent and according to the current terms and conditions of the respective equipment manufacturer's warranty.

General

Under the Instrumatic Warranty, Warranty Extension, or On Site-Service Contract, the customer is responsible for all charges arising from modifications or additions to the equipment, to which Instrumatic's prior written consent have not been obtained, or if the equipment in Instrumatic's opinion has been subject to abnormal use. Under this warranty "Abnormal use" is defined as any use to which the equipment is exposed other than that specified or intended as evidenced by purchase or written sales representation. Other than the above, no other warranty, expressed or implied, shall apply to any and such equipment furnished and sold by Instrumatic.

Terms and conditions

All units or components should be properly packed for handling and returned freight prepaid to the nearest designated Service Center. After repair, the equipment will be returned, freight prepaid.



WARNING: Electrical Shock Hazard



HAZARD: Strong oxidizer



GENERAL WARNING/CAUTION: Read the accompanying message for specific information.



CAUTION: Hot Surface Warning



Do Not Touch: Touching some parts of the instrument without protection or proper tools could result in damage to the part(s) and/or the instrument.



Technician Symbol: All operations marked with this symbol are to be performed by qualified maintenance personnel only.



Electrical Ground: This symbol inside the instrument marks the central safety grounding point for the instrument.

Figure 1 - Warning Signs/pictograms

2.0 PRINCIPLE OF THE CEMS

The **DP 5.0 SAMPLING SYSTEM** system setup:

An OXYDAN® DP 5.0 Dilution probe sampling system consisting of the DP 5.0 dilution probe and Stack Unit with PLC controlled probe parameters and datalogging of sampling system parameters and gas analyzer/sensor signals. The diluted sampled is conveyed from the funnel area to the SO₂/CO₂ analyzer/analyzers situated in environments suitable.

2.1 PRINCIPLE OF DILUTION PROBE

The extractive dilution technique is the most widely used method for continuous emission monitoring of SO₂ and CO₂ and is ideal for use in continuous emission monitoring of SO₂ and CO₂ after wet scrubbers. Actually **93%** of all SO₂/CO₂ CEMS used on fossil fueled installations in USA are based on dilution CEMS. Combined with the option NoxyTron 2000 zirconium oxide sensor also continuous measurement of NO_x and O₂ is easily made available.

- The dilution probe system uses dry contamination-free air (“dilution air”) and an ejector (also referred to as a venturi pump) to extract a diluted exhaust gas sample from the exhaust stack or duct.
- It is not necessary to remove the moisture from the flue gas sample prior to analysis by the analyzer(s), because the sample is diluted sufficiently to avoid condensation problems during analysis at normal ambient temperatures, however, the concentration is still a wet-basis measurement.
- Dilution probe systems provide wet-basis concentrations that works very well with flue gas flow rate monitor which also provides wet-basis stack flow rate values, therefore no moisture analyzers are required for data correction.

Theory of Operation

The technique is based on extracting a small sample from the stack, removing particulates by a proprietary filter and then accurately diluting the sample with clean, dry zero air thus, reducing the dew point in order to prevent condensation of water vapor and acid mist in the sample lines. The diluted sample is then sent down unheated umbilical lines to the location where it is analyzed.

3.0

DESCRIPTION OF THE DILUTION PROBE SAMPLING SYSTEM

3.1 DESCRIPTION OF THE SYSTEM FUNCTION

The DP 5.0 SAMPLING SYSTEM has been developed and designed as a modular system based on years of experience with extractive sampling using dilution probes in combination with ambient analyzers/sensors.

The DP 5.0 SAMPLING SYSTEM is a small size alternative to traditional CEMS sampling systems, offering

- * Easy menu driven operation local or remote from any of the major web browsers.
- * Read only datalogging capabilities with CSV files for easy download.
- * OPC UA connectivity for easy integration with Class EU MRV service solutions.
- * Easy system service and maintenance.
- * A variety of built-in self-checks and diagnose.
- * Automatic / remote initiated calibration features assuring reliable function and verification.

For operation, the DP 5.0 SAMPLING SYSTEM the system only needs connection of a power supply and a supply of oil-free, non-condensing compressed air.

The DP 5.0 SAMPLING SYSTEM includes all necessary parts to sample, monitor and data log SO₂/CO₂ exhaust gas emissions. (optional NO_x/O₂)

The central part of the DP 5.0 SAMPLING SYSTEM is the OXYDAN DP 5.0 dilution probe sampling system with a WAGO PLC controller integrated, controlling and monitoring all operational parameters of the sampling system and the sensors by:

- 1: Datalogging of key parameters.
- 2: System data presentation via integrated web server.
- 3: System parameter setup.
- 4: System warnings and control parameters.
- 5: Calibration and one button calibration sequences for ZERO/SPAN
- 6: Dilution probe system parameters readings and controls.
- 7: Heatless air drier sequence.
- 8: Solving the NO_x equation with the optional NO₂/NO_x sensor and displaying the resulting value.
- 9: TCP/IP, Modbus TCP, OPC UA communications.

3.2 SYSTEM OVERVIEW

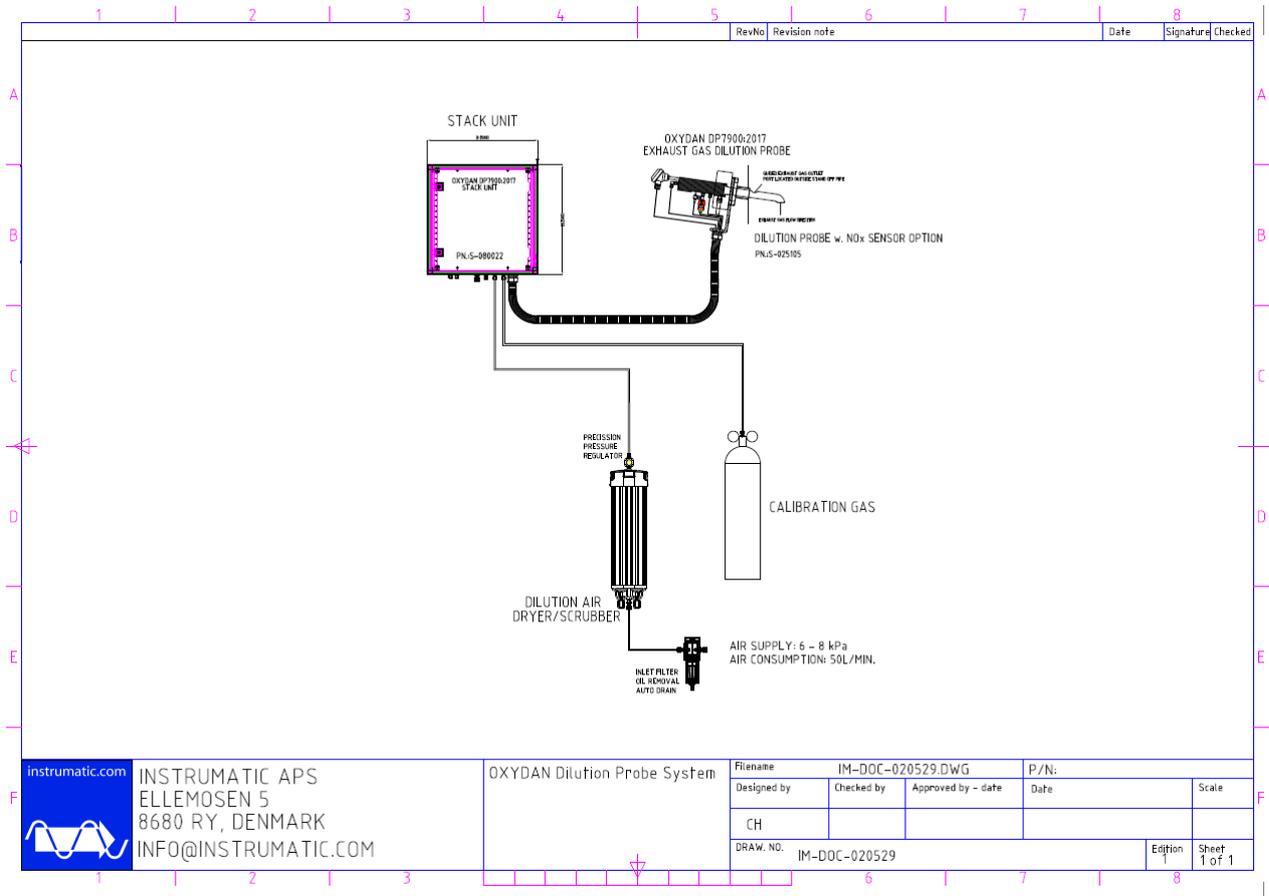


Figure 2 - DP 7900 SAMPLING SYSTEM overview

4.0 TECHNICAL SPECIFICATIONS

PROBE SPECIFICATIONS

Temperature Range	: -10 to 85° C.
Power supply	: 240 VAC 50 Hz / 110 VAC 60 Hz. via umbilical cord/cabinet
Power consumption	: 300 W
Junction box	: IP65
Dimensions	: 300(H) mm x 250(W) mm x 500(L) mm.
Weight	: 8 Kgs.

SU 5.0 STACK UNIT

Temperature Range	: 0 - 55° C.
Outputs	: 4 - 20 mA (optional NOx/O2 sensor)
Communication	: TCP/IP, Modbus TCP/IP, Modbus RTU, OPC UA
Status output	: SPDT-contact closure for common alarm.
Power supply	: 240 V AC 50 Hz / 110 V AC 60 Hz.
Power consumption	: Max 350 W incl. DP 7900 probe.
Air supply	: Min. pressure 6 kPa compressed air, non-condensing
Air consumption	: 30 NLPM including dilution probe.
Enclosure	: IP65
Dimensions	: 500(H) mm x 400(W) mm x 210(D) mm.
Weight	: 20 Kgs.

NO_x SENSOR SPECIFICATIONS (OPTION):

Range	: User selectable from 0 to 50 ppm up to 0 to 2000 ppm.
Lower detection limit	: ~ 1 ppm
Lag time	: < 5 sec.

O₂ SENSOR SPECIFICATIONS (OPTION):

Range	: User selectable from 0 to 5 % up to 0 to 25 %
Lower detection limit	: 0.1 %
Lag time	: < 5 sec.

5.0 INSTALLATION

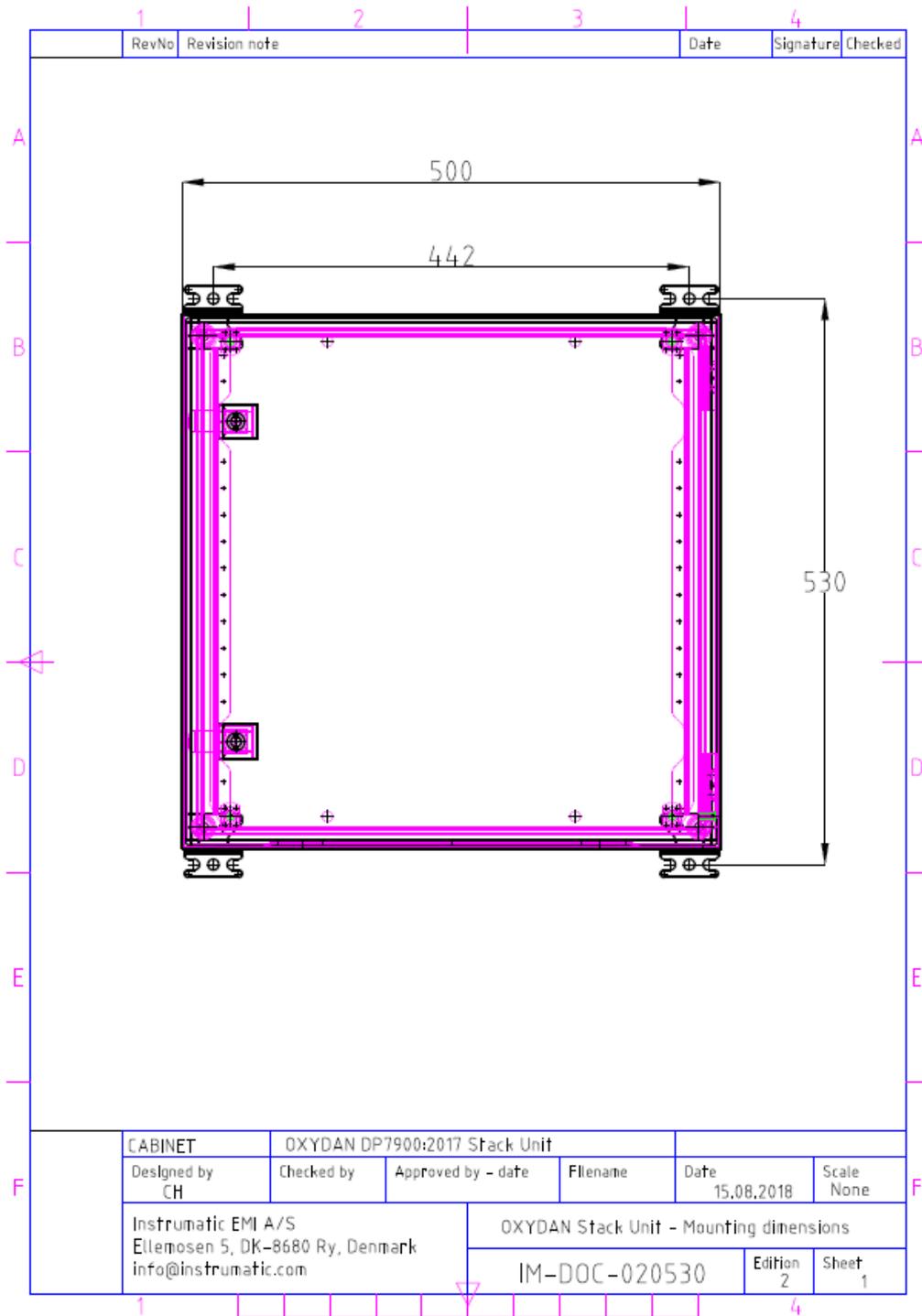
When unpacking, please observe that all goods specified on the packing list are present and in a good condition; Otherwise notify the shipping company immediately.



Ensure you have read and understood the T100 analyzer user manual prior installation, the installation requiring skills which normally are on-board vessels. Machine engineers and electricians are able to do installations. If in doubt, please do not hesitate to contact Instrumatic or any of our representatives.

5.1

MOUNTING OF THE CEMS CABINET



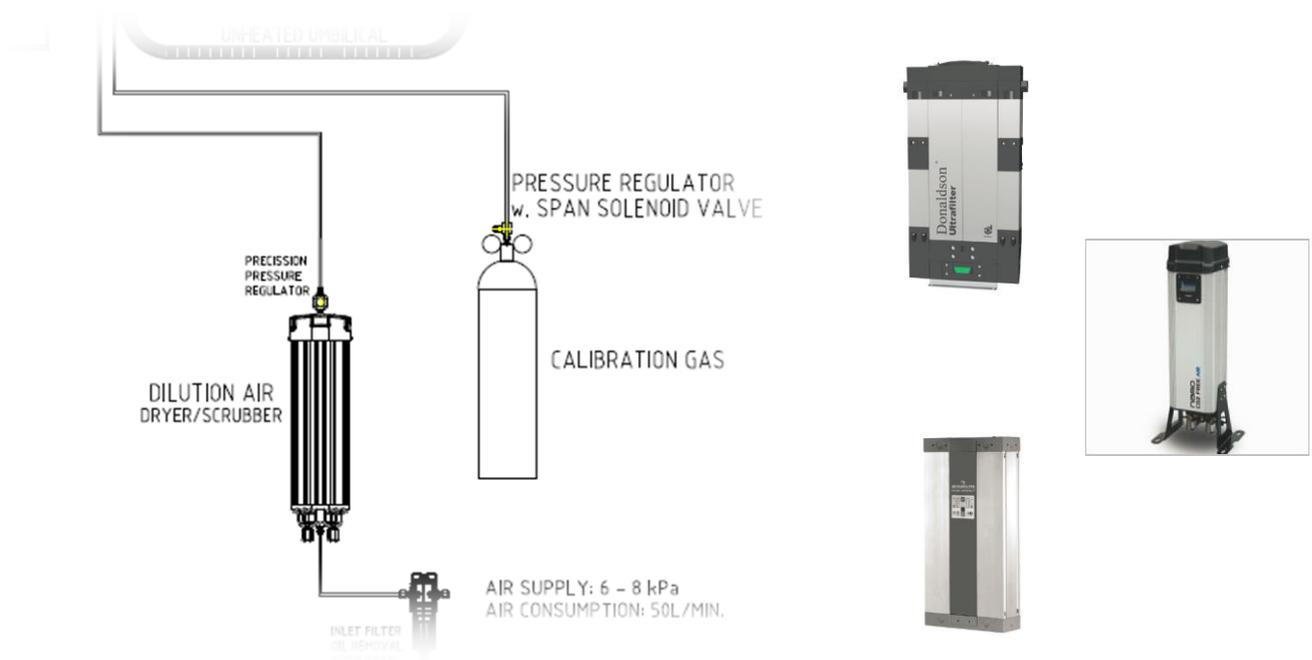
The cabinet is placed on the bulk and fastened to the bulk by means of 4 Ø10 mm holes in cabinet mounting brackets. For easy operation and maintenance, please mount the cabinet in an easily accessible place, with space for access via the front cabinet door.

5.1.1 CONNECTION of COMPRESSED INSTRUMENT AIR



Before connecting the analyzer with instrument air, please make certain, appropriated filtering is used to remove water, oil and particulates prior connection to the T100 Compact Marine CEMS. Instrument air quality corresponding to ISO 8573-1:2010 quality classes 1-2:1-2:1-2 are required. **If not, any system warranty is voided!**

To ensure proper function of the system for many years, it is a must, the system is fitted with a heatless air dryer/scrubber*, such units are delivered by many different manufactures. A special configured dilution air generator can be delivered by Instrumatic. *(a few models pictured below)*



Inlet pressure on the heatless air dryer determine the maximum efficiency of the dryer and the minimum requirements of the CEMS. Based on calculation an inlet pressure of 7 kPa will secure the best efficiency of the dryer up to an ambient temperature of 55°C. (Calculations based on Ultracac® mini 0005)

1. Instrument air connection is in bottom of cabinet and connected to Ø6 mm compression fittings marked "Instrument air"



DO NOT – turn on instrument air until CEM system is ready for startup!

5.1.2 ELECTRICAL & SIGNAL CONNECTIONS



All electrical installations have to be performed by technicians with the correct skill and training.

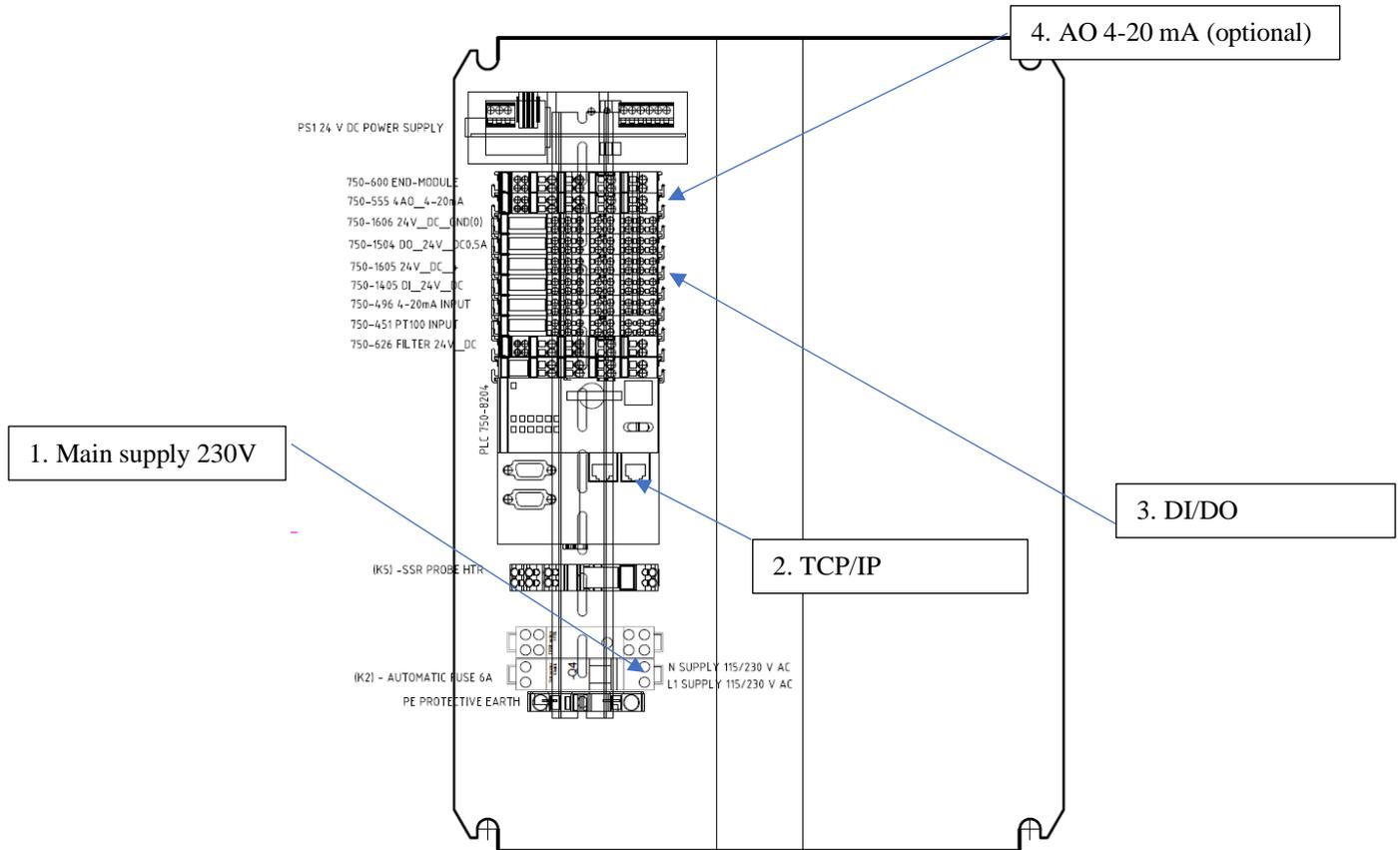


Figure 3 – DP 5.0 STACK UNIT CONNECTIONS

Connect the following electrical connections to the analyzer ():

- 1: Connect main supply (230VAC)
 LINE X1.1 GREY
 NEUTRAL X1.2 BLUE
 PROTECTIVE EARTH X1.3 GREEN/YELLOW
- 2: Connect on-board LAN TCP/IP RJ45 to the PLC TCP/IP port X1
- 3: Connect digital input and output signals
 - 1) ZERO VALVE - REMOTE
 - 2) SPAN VALVE - REMOTE
 - 3) DO Common system warning
- 4: Connect 4-20 ma signal to the PLC AO module (Optional)
 - 1) NOX ppm signal
 - 2) O₂ % signal



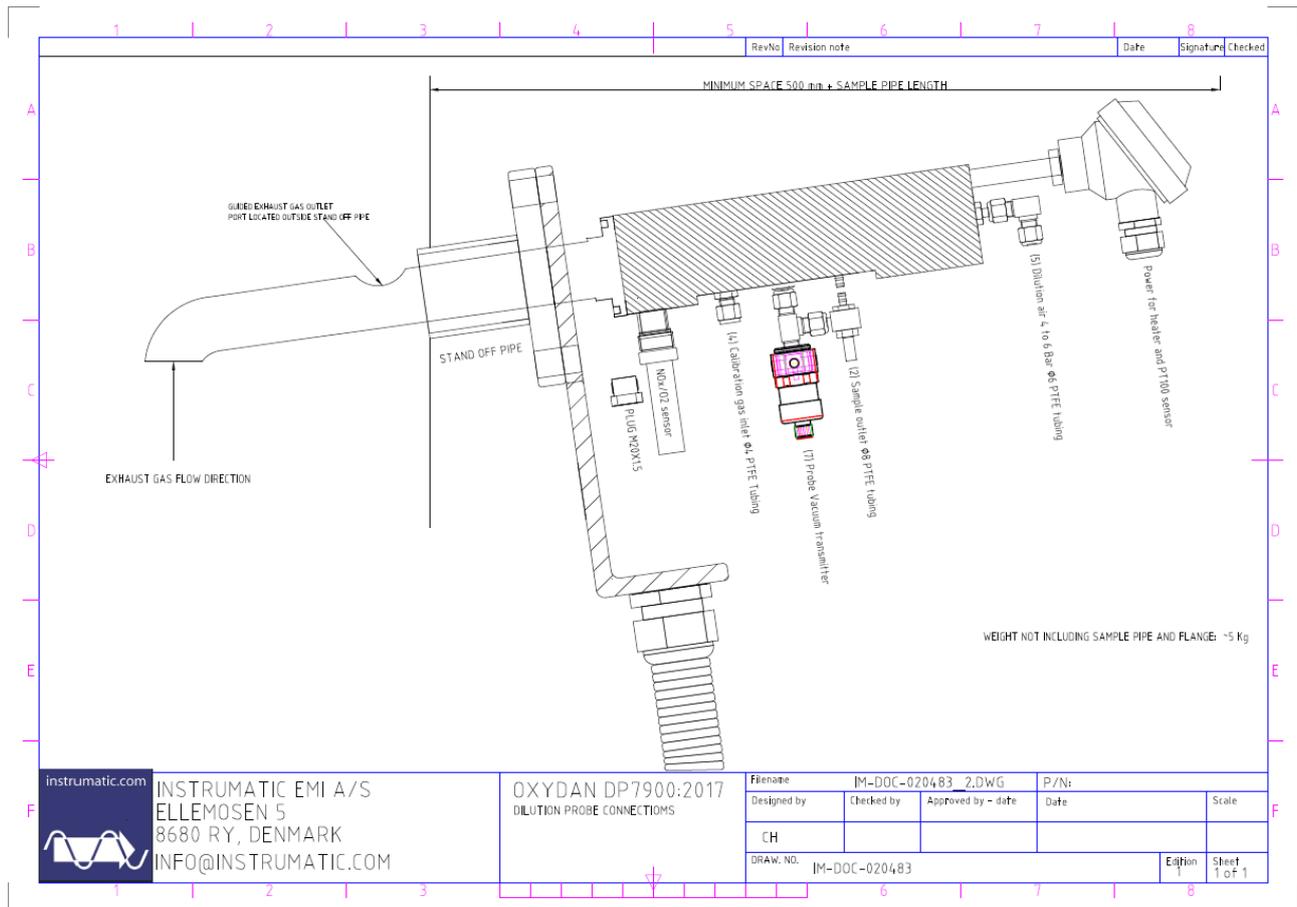
Before switching on power ensure all connections between STACK UNIT and PROBE are correctly installed.

5.1.3 CONNECTION OF CABINET COOLING AIR (Optional)

Air condition of cabinet in situations which require such is available consult factory.

5.2

INSTALLATION OF DILUTION SAMPLING PROBE



WARNING!

Do not mount the sampling probe BODY to the exhaust gas duct before the probe:

- 1. Is heated to its setpoint temperature 180°C**
- 2. or the cabinet are operational, so the probe is purged with zero air.**



WARNING!

The probe body are heated to 180 - 200°C – Work only with the use of heat insulated gloves!

5.2.1 PNEUMATIC CONNECTIONS (PROBE)



Before you mount the compression, fittings ensure the ferrules are correctly orientated - make sure fittings are not under nor overtighten, and the tubes are properly inserted.

Connect the following tubes to the sample dilution probe:

- 1: Connect tube 2. Sample outlet \varnothing 8/6
- 2: Connect tube 4. Cal. Gas \varnothing 4/2
- 3: Connect tube 5. Dilution Air \varnothing 6/4

5.2.2 ELECTRICAL & TC CONNECTIONS (PROBE)



Before any electrical work are performed, ensure analyzer cabinet main switch are turn off!

Connect the following electrical connections to the sampling probe:

Probe heater cartridge.



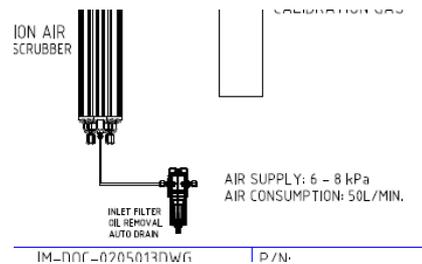
- 1: Connect heater power cable 1. and 2. to the two orange wires spring terminals (115V / 230V)
- 2: Connect wire 3. and 4. to PT100 temperature sensor blue wire spring terminals.
- 3: Connect green/yellow protective earth wire to the junction box mounting screw PE

6.0 SYSTEM START-UP PROCEDURE

Step by step guide ensuring the system is started up in correct sequence preventing damage of the sampling system and analyzers.

6.1 INSTRUMENT AIR PRESSURE

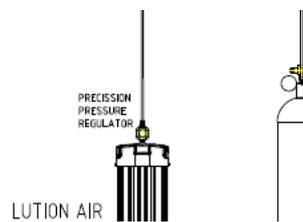
- Adjust instrument air pressure regulator to feed the dilution air dryer with **7-8 kPa**.



- Ensure there is not leakage of air.

6.2 DILUTION AIR PRESSURE

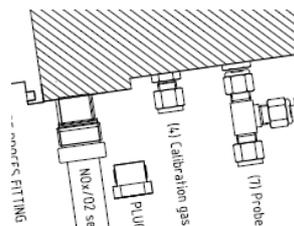
- Adjust dilution air precision pressure regulator to feed the analyzer cabinet with **4.5 kPa**.



- Ensure there is not leakage of air. (you will hear a whistling of air from the cabinets vent port in the bottom right)

6.3 MOUNT DILUTION PROBE BODY TO THE PROCESS FITTING ON THE EXHAUST DUCT

- Verify ZERO air is feed to the probes calibration gas inlet port (4) this can be done by disconnecting the $\varnothing 4$ compression fitting and hold the tube under your nose and feel the small flow which purge the probe when the probe temperature is below 150°C!



- Verify seal ring between probe body and process fitting is available and correct located.
- Attach probe body to process fitting and lock the clamps which hold the probe body fixed hereto.

6.4 POWER UP – STARTUP OF SYSTEM

- Verify the connected power are as the markings on the cabinet either **230V AC** or **115V AC**.
- Verify Protective Earth / Ground are properly connected.
- Then turn ON power and start NumaView Remote on a PC/Laptop connected to the T100 SO2/CO2 analyzers TCP/IP connection.

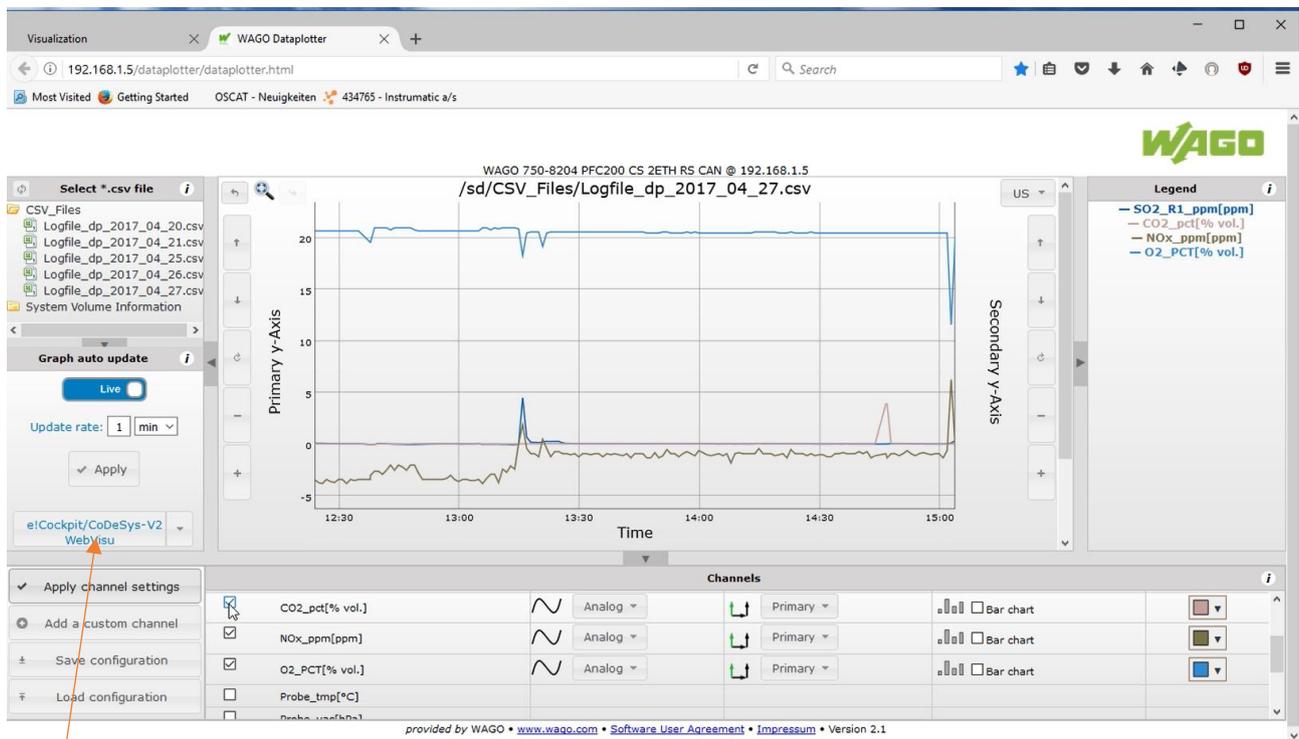
7.0 OPERATION OF THE DP 5.0 SAMPLING SYSTEM

The DP 5.0 SAMPLING SYSTEM has a local 10" Panel PC, which are located in the analyzer cabinet's front door.

The display works as an ordinary windows panel PC with a web browser, which is used as a common operation panel with controls and system setup etc.

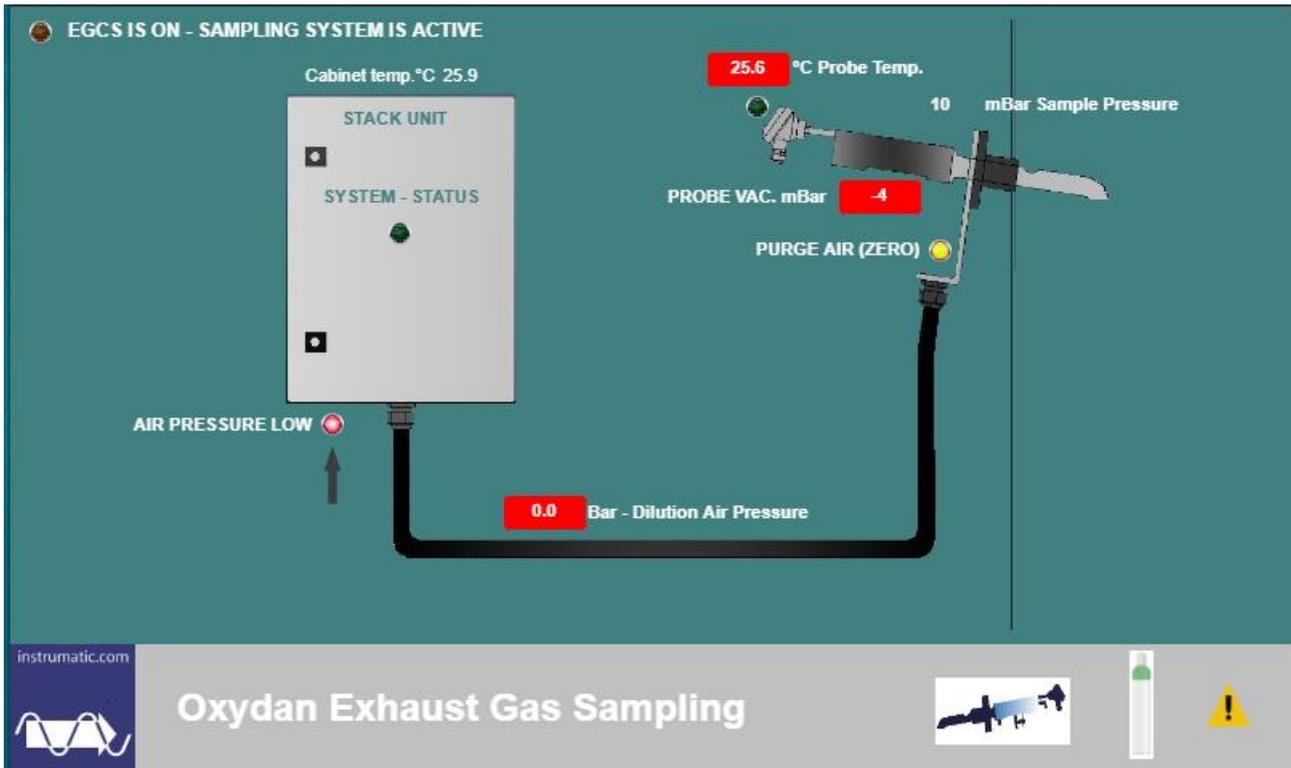
The datalogging capabilities of the PLC is used to store data and are available as read only data in CSV file format. When the system is started up open your web browser and write the IP address of the system PLC followed by **/dataplotter/dataplotter.html**

Data are attainable by downloading the data to your local PC or remotely to any system, for further description of the WAGO datalogger/dataplotter function please see the WAGO data plotter user manual.



Click on the Webvisu button and the Graphical User Interface (GUI) of the DP 5.0 SAMPLING SYSTEM will open in a new tab/window.

7.1 MAIN USER INTERFACE



The upper turquoise background of the main screen shows the readings.

In the upper left corner, the system indicates when the EGCS / Process is active, and the sampling system is enabled and is sampling.

If the reading background is red, the reading is out of limit and have reached the threshold limit, this can either be a low or high limit.

7.2 USE OF MENU BUTTONS

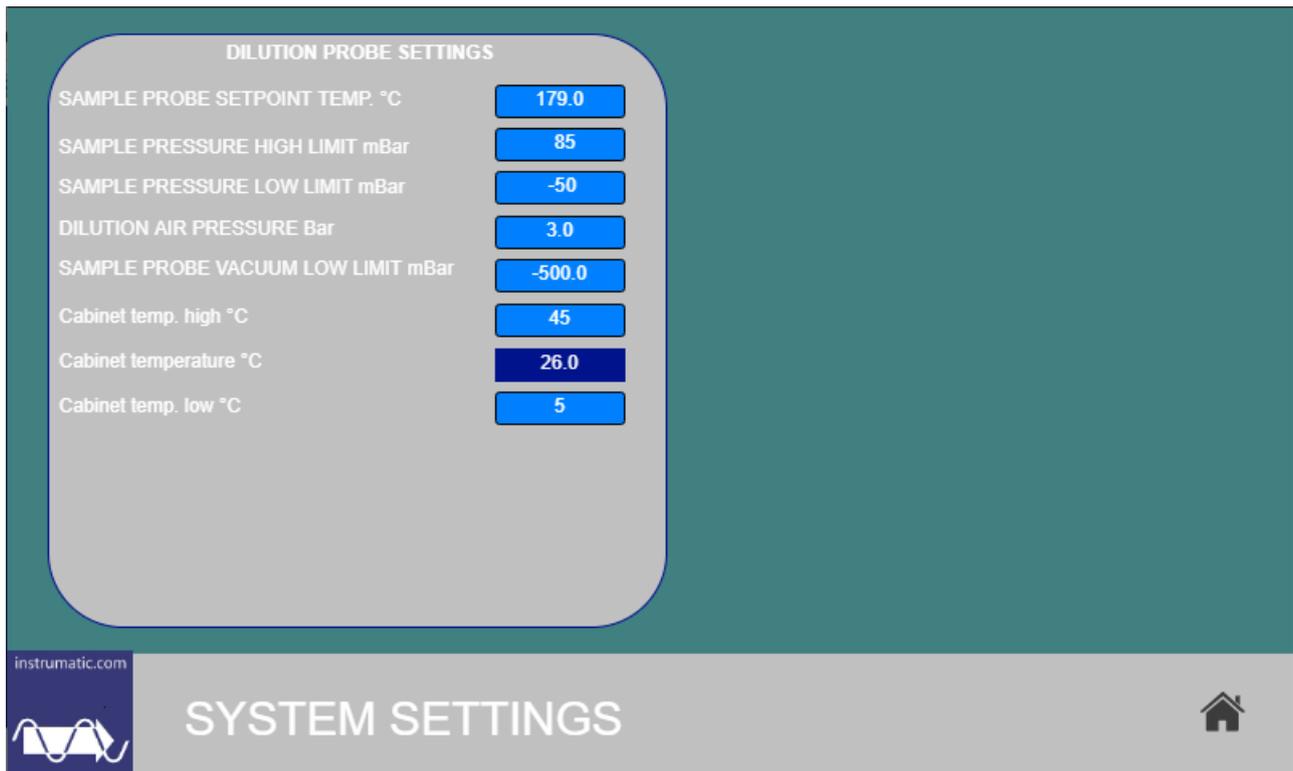
The lower grey background of the main screen is the menu line, where from the lower right corner starts with:

1. WARNING AND CONTROLS
2. CALIBRATION AND VERIFICATION
3. SAMPLING SYSTEM SETTINGS

To get back to the main interface click on the home  button or the instrumatic logo (arrow with sine wave)

7.3

SYSTEM SETTINGS



Point the mouse pointer on the value to be set and a tool tip will appear and inform about the settings.

All settings are set from factory and do normally not have to be changed afterwards.

DI - INPUTS

- EGCS IS ON - SAMPLING SYSTEM IS ACTIVE
- PROBE PURGE ON

DO - OUTPUTS

- ZERO VALVE / PURGE AIR ON (YELLOW)
- SPAN VALVE ON (YELLOW)
- PROBE HEATER CONTROL
- DRYER VALVE COLUM 1.
- DRYER VALVE COLUM 2.
- BLOW-BACK VALVE SEQUENCE
- STACK UNIT CABINET TEMPERATURE OK

SAMPLING SYSTEM WARNINGS

- PROBE TEMPERATURE HIGH
- PROBE TEMPERATURE LOW
- PROBE VACUUM LOW
- PROBE SAMPLE PRESS. HIGH
- PROBE SAMPLE PRESS. LOW
- PROBE DIL. AIR PRESSURE LOW

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WARNINGS & CONTROLS

SYSTEM PARAMETERS/CONTROLS.

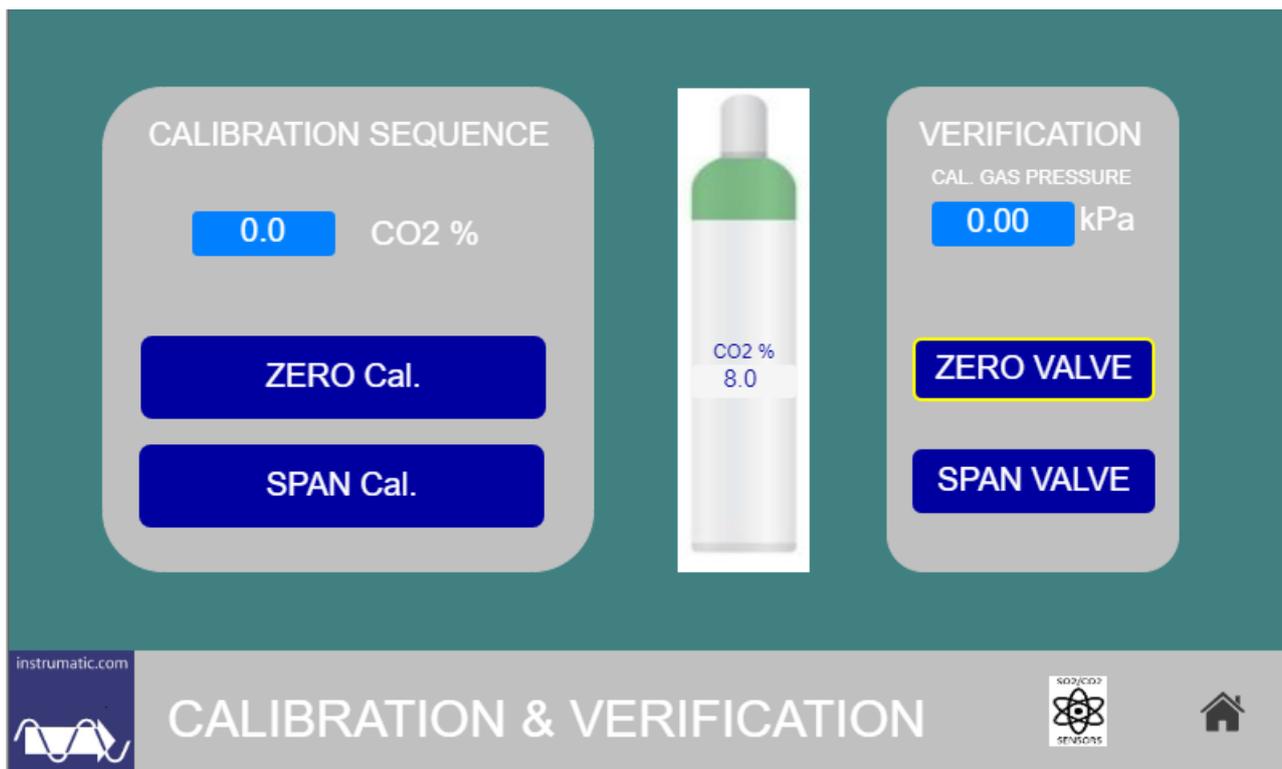
System parameters and controls are informative indications only.

SYSTEM WARNINGS.

Actions only have to be taken if a system warning is indicated. If the mouse pointer is pointed at the warning lamp, a tool tip informs possible reason.

System warnings are not resettable or acknowledgeable!

Note! Sample pressure high will be indicated during calibration and when the probe is purged – action is therefore not needed.

**CALIBRATION GAS CYLINDER.**

Before any calibration is performed, verify the calibration gas concentrations shown on the calibration gas certificate is the same as written in GUI gas cylinder.

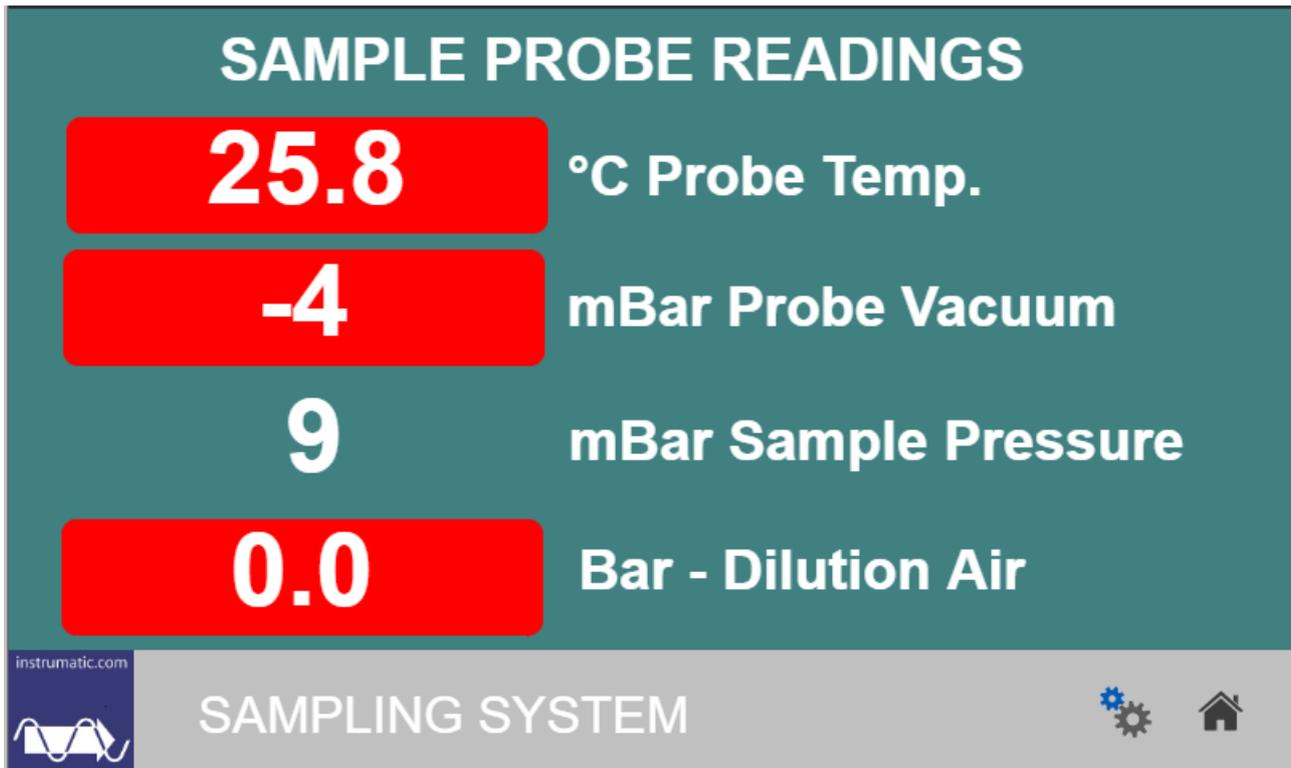
CALIBRATION.

If you click on the ZERO or SPAN button, a calibration sequence will start. This will take approximately 15 minutes and the readings during this time will be readings of the calibration gas cylinders certified concentrations, as the gas are flowed to the sampling probe tip, ensuring the hole system is calibrated.

At the end of the sequence the analyzer/sensor readings will be corrected/calibrated to the certified concentrations.

VERIFICATION.

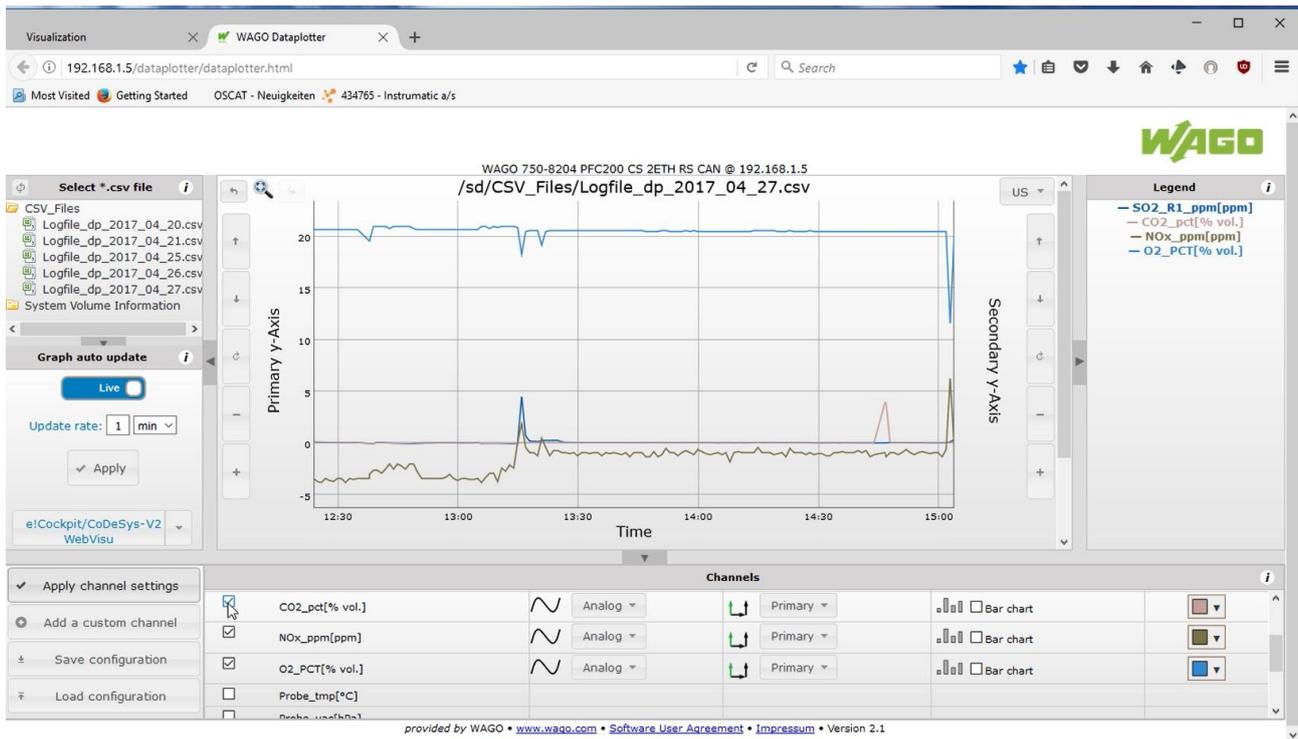
If you click on the ZERO or SPAN valves ON/OFF switch the calibration gas from the cylinder will be flowed to the probe tip, and a verification of the analyzer/sensor readings can be done. No correction/calibration are done by the system.

**SAMPLE PROBE READINGS**

All the readings are indicative and reading backgrounds will be green if within threshold values and red if outside the acceptable limits.

Warning indicated for Probe Vacuum and Dilution Air, possible reason no compressed air is feed to the system, and if no Dilution Air are feed to the probe then there will be no Probe Vacuum of course!

7.7 WAGO DATAPLOTTER



The WAGO datalogger and Dataplotter are storing emission readings and system parameter readings, as read only data.

Data are time stamped with the PLC clock.

Data can be downloaded as CSV file format and used in MS Excel or other spread sheet programs for reporting to the authorities.

Raw data are always accessible to the authorities for verification purpose for at least the last 2 years.

8.0 SERVICE AND MAINTENANCE

The **DP 5.0 SAMPLING SYSTEM** does not require much maintenance. By following the maintenance guidelines mentioned below the analyzer should be able to function without any problems. Only by following these guidelines Instrumatic can guarantee correct functioning sampling system.

Maintenance guidelines:

When	What to do	Appendix
Daily:	Check STATUS at graphic user interface GUI or via Modbus TCP.	
Weekly:	Check compressed air inlet filter are clean and free from oil and condensate.	
Every 6 months:	Check calibration gas cylinder pressure for sufficient calibration gas, and order new cylinder in due time.	
Every 12 months:	Check air scrubber columns and replace if necessary.	

If you are in doubt or have any questions, please contact your local representative or

Instrumatic EMI A/S

Ellemosen 5

DK-8680 Ry

Denmark

E-mail: info@instrumatic.com

9.0 FINAL TEST SHEET

PLC SERIAL S/N: _____ SOFTWARE VER.: _____

DILUTION PROBE S/N: _____ DILUTION RATE.: _____

DILUTION AIR DRYER S/N: _____

NO_x SENSOR OPTION BLOW-BACK OPTION MASS FLOW OPTION

PASSWORD GUI : _____

O₂ CALIBRATION DATA:

O₂ SENSOR RANGE (0-5): _____ % OFFSET VALUE: _____ mV

O₂ SLOPE: _____ O₂ SPAN GAS: _____ %

NO_x CALIBRATION DATA:

NO_x SENSOR RANGE: _____ PPM OFFSET VALUE: _____ PPM

NO_x SLOPE: _____ NO_x SPAN GAS: _____ PPM

SAMPLING PROBE DATA:

PROBE VACUUM: _____ mBar VACUUM WARNING: _____ mBar

SAMPLE PRESSURE: _____ mBar SAMPLE PRESSURE LOW WARNING: _____ mBar

SAMPLE PRESSURE HIGH WARNING: _____ mBar

SAMPLE PRESSURE LOW WARNING: _____ mBar

DILUTION AIR PRESSURE: _____ Bar

CALIBRATION GAS PRESSURE: _____ Bar

TEMPERATURE DATA:

PROBE TEMP SP.: _____ °C

PROBE TEMP LOW AL.: _____ °C

PROBE TEMP HIGH AL.: _____ °C

CABINET TEMP LOW.: _____ °C

CABINET TEMP HIGH.: _____ °C

DATE: _____

TESTED BY: _____ QA: _____