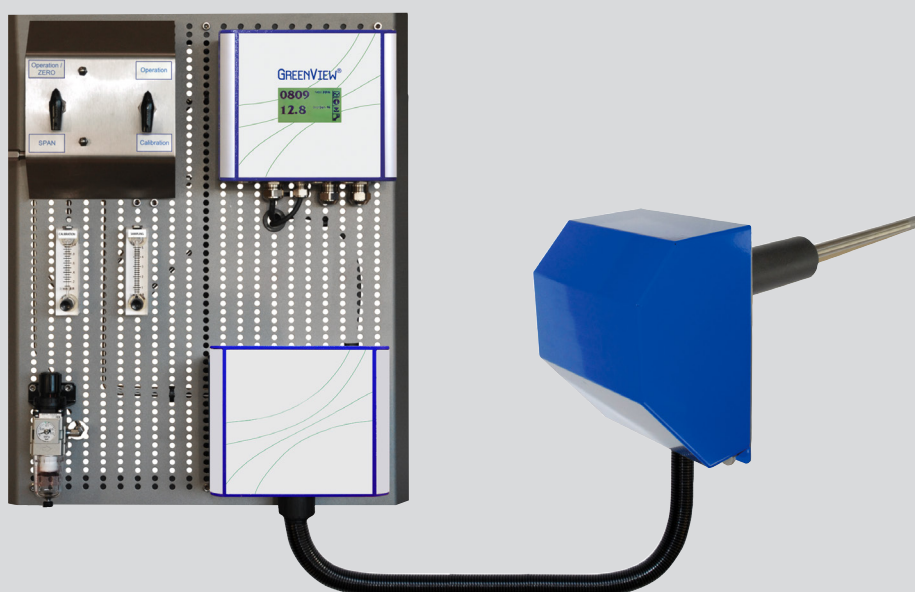


G4100

Analyzing System Manual



Document ID number.: 01271

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1 Introduction

1.1 About this Manual

This manual contains the data and instructions for the installation, operation, and maintenance of the gas sampling board with the sampling probe of the G₄₁₀₀ NO_x/O₂ Analyzing System.

The G₄₁₀₀ NO_x/O₂ Analyzing System consists of two parts:

- G₄₁ NO_x/O₂ Analyzer
- G₄₁₀₀ NO_x/O₂ gas sampling board with the sampling probe

The instructions for installation, operation, and maintenance of the analyzers are provided in the separate manual – the G₄₁ NO_x/O₂ Analyzer manual (p# 01250 or 01819).

For the installation, operation, and maintenance of the G₄₁₀₀ NO_x/O₂ Analyzing System, both manuals must be read carefully in their entirety.

The manual has been made in general terms and do not take into consideration a specific installation. As such, the instruction manual is designed for the standard sampling system fitting with the G₄₁ NO_x/O₂ Analyzer.

The manual does not describe all possible situations but only the most common and known situations and cannot replace the necessary instruction and education of the personnel.

Should situations not described in the manual occur, which cannot be solved in accordance with normal known practice and good workmanship, the operator should contact Green Instruments A/S for instructions.

This manual does not claim to cover all details or variations in equipment or to provide for every possible contingency that may arise during installation, operation, or maintenance.

Green Instruments A/S reserves the right to minor alterations and improvements owing to developments without being obliged to enter the corresponding changes in this manual.

Green Instruments A/S reserves the copyright of the manual. Without prior written permission of Green Instruments A/S, the manual may not be copied and given to unauthorized people.

1.2 Inquiries and Feedback

All claims and inquiries for spares shall be addressed to Green Instruments A/S or our distributors.

In all correspondence or when ordering spare parts, please carefully state the equipment type and serial number, which you can find on the label on the right side of the blue analyzer box.

Green Instruments A/S appreciates all feedback and suggestions for improvement. If you have any questions or find any errors in the manual, you are welcome to contact us:

Green Instruments A/S

Erhvervsparken 29

DK-9700 Brønderslev, Denmark

Phone: +45 9645 4500

Fax: +45 9645 4501

E-mail: sales@greeninstruments.com

Web: www.greeninstruments.com

2 System Specifications

Gas Connection

Span NO _x gas connection	For 6/4 mm tubing – max. 1 bar
Air supply filter regulator with filter 25 µm	1/8" BSP connection – max. 8 bar
Air supply quality	Instrument air quality according to ISO 8573.1.4.4.4

Analyzer

See details in the G₄₁ NO_x/O₂ Analyzer Manual

Analyzing Board Dimension

Analyzing board dimension	600 x 500 x 140 mm (H x W x D)
Weight	Approx. 10.0 kg without packaging

Ejector Probe

Sensor technology	Heated zirconia type sensor
Measurement range	NO _x : 0...1500 ppm (selectable range) O ₂ : 0.0...21 % (selectable range)
Sample temperature	0...500 °C
Probe insert length	App. 250...300 mm for duct diameters 290...2800 mm
Socket	OD: 61.5 mm L: 200 mm
Connection - ejector air (red)	6/4 mm tubing
Connection - calibration gas (white)	6/4 mm tubing
Calibration air flow	Approx. 0.5...1 l/m
Ejector air flow at 1 bar air supply	- App. 2 l/min ≈ Vacuum 200 mm H ₂ O - App. 3 l/min ≈ Vacuum 350 mm H ₂ O - App. 5 l/min ≈ Vacuum 500 mm H ₂ O
Ejector probe dimension	284 x 180 x 601 mm (H x W x L)
Weight including house	Approx. 5.0 kg without packaging

Umbilical cord

Cord length	3.0 m
Tubing	In 28 mm nylon conduit

Optional Equipment

Remote display with alarm relays, Recording and visualization
Marpol Reporting System, IMO NO_x Flange for testing purpose
Extension kit for umbilical cord

Specifications are subject to changes without notice.

3 System Installation

Read this chapter in its entirety before installing the system.

3.1 Control at Delivery

When you receive the G₄₁₀₀ NO_x/O₂ Analyzing System, please inspect and confirm that the received items are in accordance with the packing list and not damaged. Any discrepancy should be reported to the supplier immediately. If any of the received parts are damaged, the shipping company should be informed, and new parts should be made available before completing the installation.

3.2 Where to Install the System

Satisfactory operation, faultless functions, and minimal maintenance of the G₄₁₀₀ NO_x/O₂ Analyzing System are achieved by paying attention to the following points:

- Make sure to install the ejector probe in a suitable location where it will extract the gas that is going to be tested.
- The ejector probe shall be fitted at least 10 pipe diameters after the outlet of the engine, the turbocharger, or the last after-treatment device – choose whichever is further downstream. However, the ejector probe shall also be placed at least 0.5 m or 3 pipe diameters upstream from the exit of the exhaust gas system – choose what provides the greatest length. See Figure 3-1 for the installation layout of the ejector probe. If you find it difficult estimating where to install the ejector probe, please contact Green Instruments A/S for more instructions.
- As a standard scope of supply, the analyzing board can be installed up to 3 m from the ejector probe. If necessary, the umbilical cord can be extended.
- The analyzing board shall be placed and installed where the ambient temperature is below 55 °C at any time.
- The system shall be installed in a clean place away from dust, oil mist, and moisture. The elements of the system shall be installed at viewing level so that it is easy accessible in connection with operation and service.

3.3 Safety Aspects

Attention

Make sure to follow the operating instructions!
Read the manual before operating and servicing the system.

Hot sensor/probe!

The sensor/probe is hot and can cause severe burning of personnel if not handled with care.

Installation and operation!

It should be pointed out that installation and operation of the G₄₁₀₀ NO_x/O₂ Analyzing System and associated equipment must be carried out by skilled, trained, and certified personnel, and that Green Instruments A/S does not take any responsibility for the operation of the system and associated equipment whatsoever. The successful and safe operation of this equipment is dependent upon proper handling, installation, operation, and maintenance.

Recycling!

Please do not dispose the G₄₁₀₀ NO_x/O₂ Analyzing System with regular refuse. Disposal should be in accordance with the requirements of the current statutory regulations.



3.4 Ejector Probe

The ejector probe is supplied with a mounting socket, gasket, sample tube, connection for ejector air, connection for test gas and back-flushing air, sensor, and housing with mounting plate.

The ejector probe has a small air operated ejector, which will propel the sample gas into the sensor and back into the stack. The sample gas flow is drawn through the sample filter element into the sensor area via a narrow passage securing quick response time. The sample gas velocity and responding time is controlled by the flow of the ejector air.

The gas, which passes the ejector probe, must represent the gas to be tested. Holes and leaks in the gas ducting system before and after the probe may influence the accuracy of the measurement.

The ejector probe shall be placed so that it is protected against mechanical damage. The flue gas temperature cannot exceed the given temperature limit of the ejector probe.

When welding the mounting socket to the stack, make sure that the mounting plate of the ejector probe is mounted with the sampling hose connection facing down and the ejector

probe protection house mounted in a vertical position of the stack. The insert length of the ejector probe (250-300 mm) should be greater than 10 % of the duct diameter. See Figure 3-1 for the installation layout of the ejector probe.

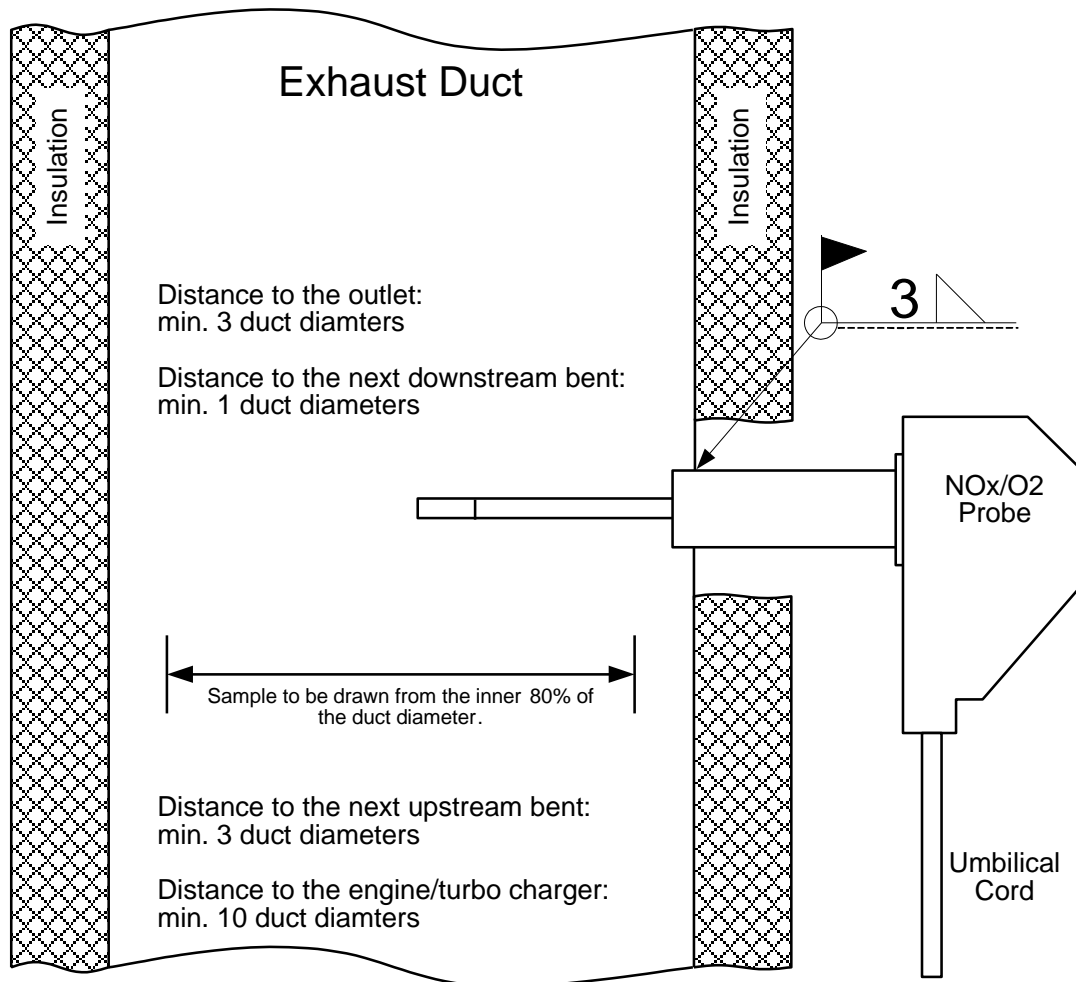


Figure 3-1: Installation layout of the ejector probe

The figure below shows the dimensions of the ejector probe.

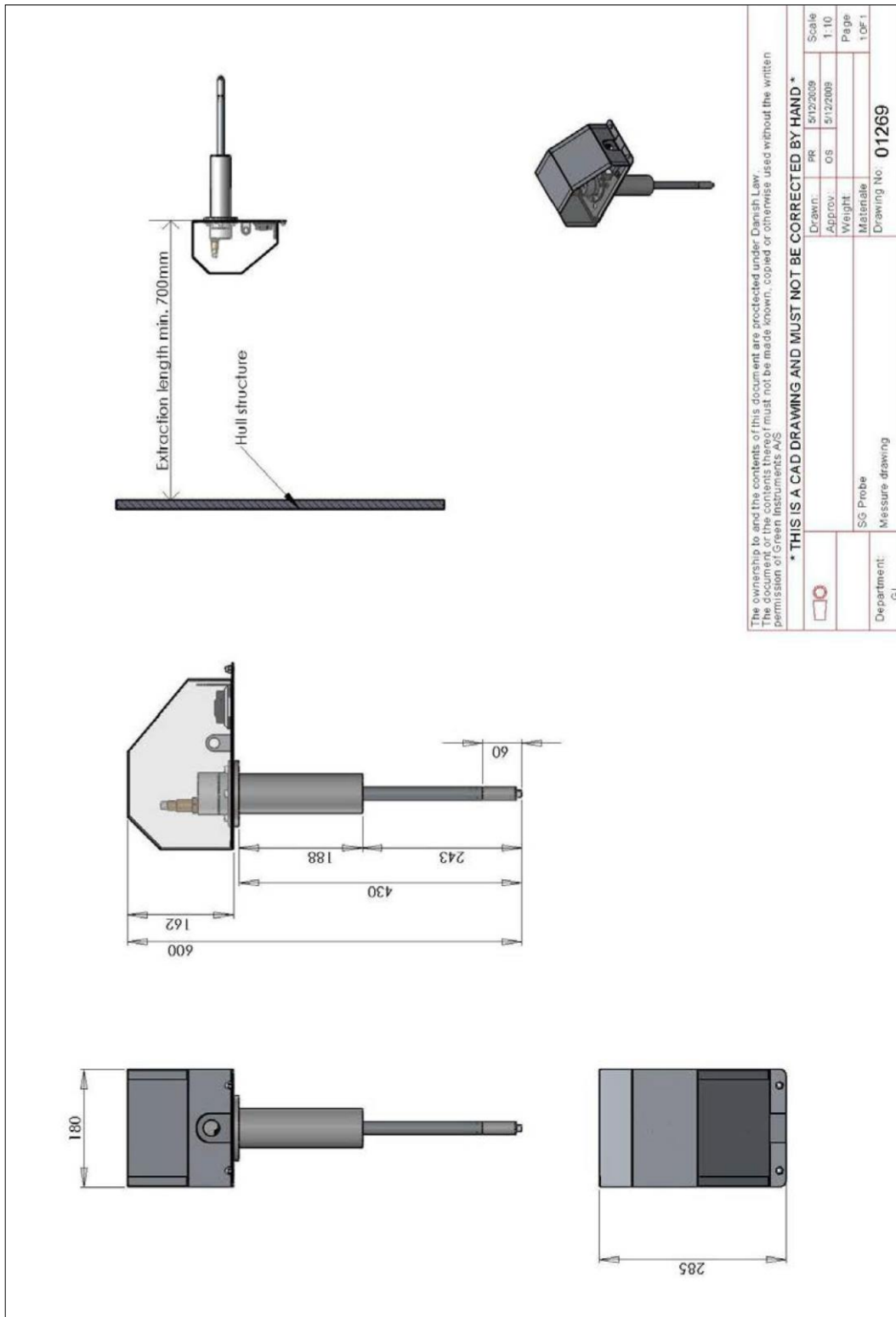


Figure 3-2: Ejector probe dimensions

The figure below shows the dimensions of the board.

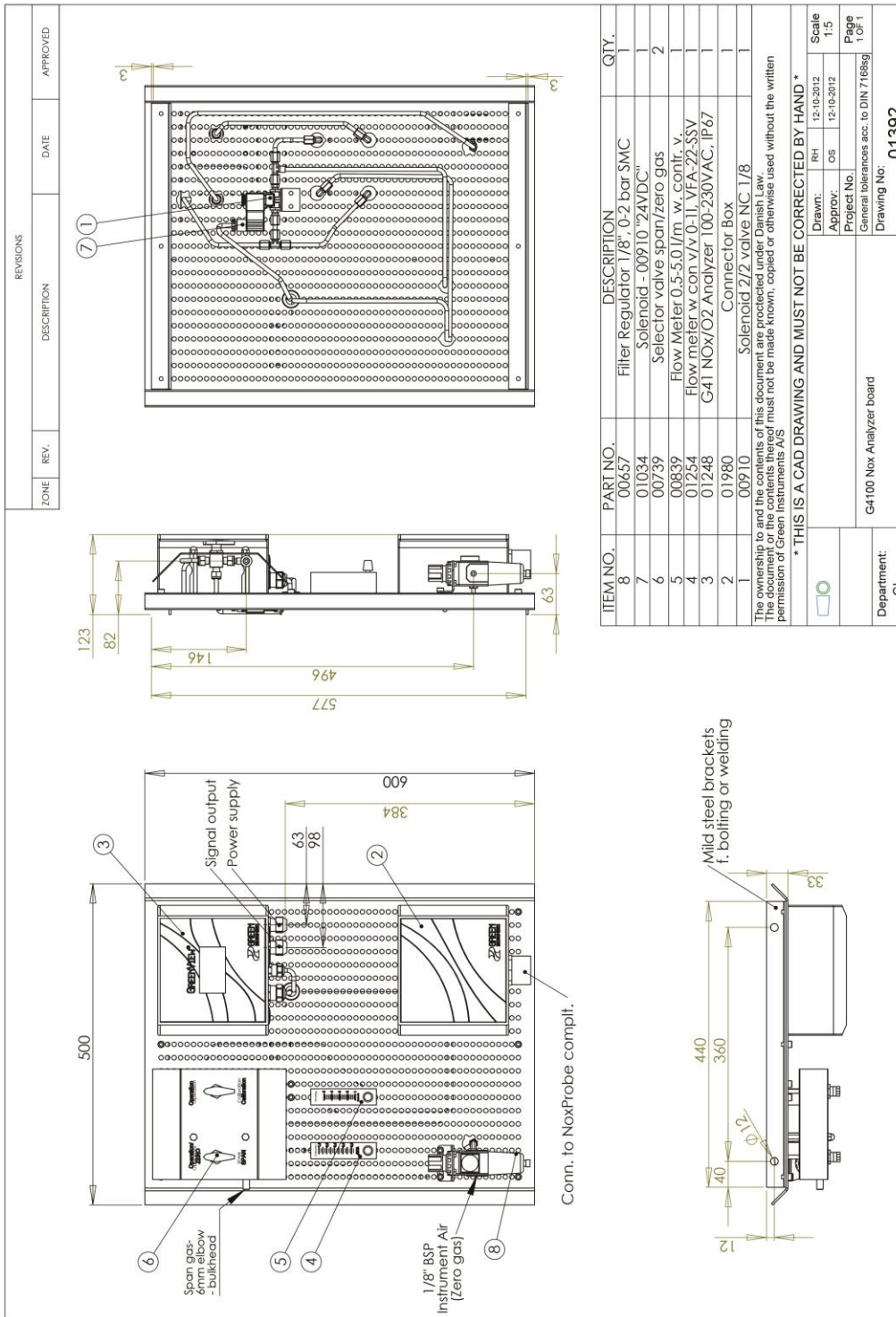


Figure 3-3: Analyzing Board with G41 NO_x/O₂ Analyzer mounted on board

3.5 Analyzing Board

3.5.1 Mounting Panel

The analyzer board has two angle iron mounting brackets. The brackets are made of ordinary mild steel and can be welded or bolted directly to a chosen location structure as required.

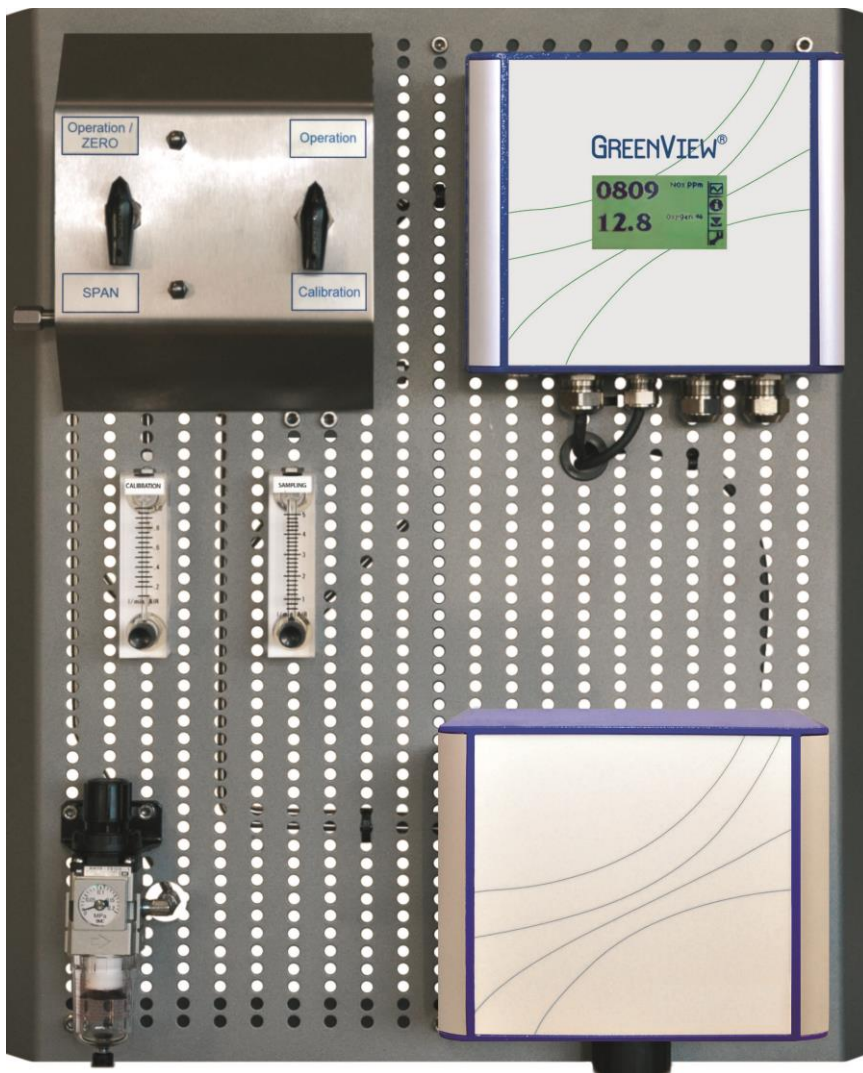


Figure 3-4: The G₄₁₀₀ NO_x/O₂ analyzing board

The two mounting brackets are mounted horizontal and parallel with a distance of 580 mm.

When the analyzing board and the ejector probe are installed in appropriate locations, the instrument air and power can be connected as described below.

The figure below shows the piping and connection of the system.

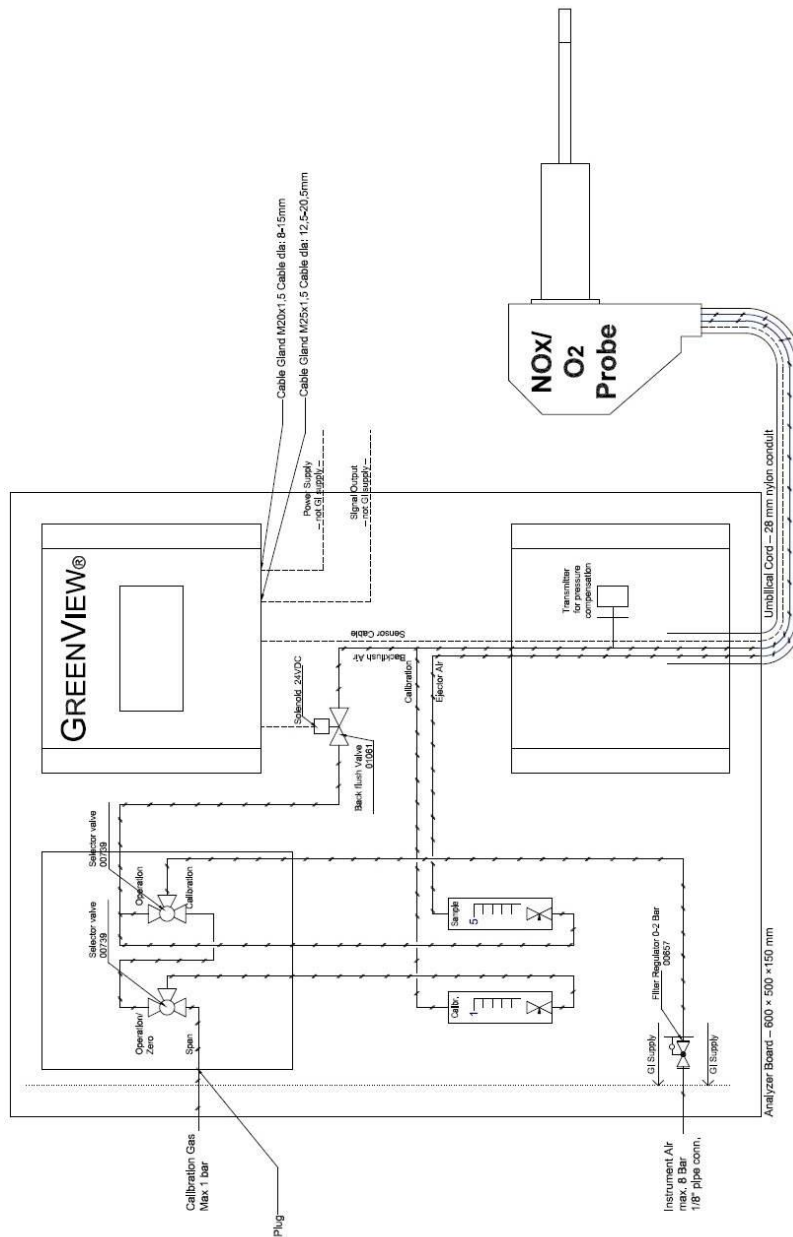


Figure 3-5: Piping and connection diagram

3.5.2 Air Supply Connection

For air ejection, back-flushing, and zero calibration, the instrument air is connected directly to the air supply filter regulator. The filter regulator has a filter and a drain. The air supply connection to the filter regulator is a 1/8" BSP female connection.

The pressure of the air supply must not exceed 8 bar. To see the layout of the analyzing board see Figure 3-3.

3.5.3 Span NO_x Gas Connection

For span calibration, span NO_x gas with a certain percent of NO_x and without the content of O₂ is connected to the span NO_x gas port. The connection is arranged on the left upper corner of the analyzing board. The connection is a 1/8" BSP female connection.

The pressure of the Span NO_x gas must not exceed 1 bar. The gas flow should be approximately 0.5...1 l/m. To see the layout of the analyzing board see Figure 3-3.

3.5.4 Analyzer and Electrical Connections

The G₄₁ NO_x/O₂ Analyzer is mounted on the right upper corner of the analyzing board. To see the layout of the analyzing board see Figure 3-3.

The instructions for electrical connections are described in the G₄₁ NO_x/O₂ Analyzer manual.

4 Commissioning

Before starting the system for the first time after completing the installation, please check the installation and setup of the system.

4.1 Installation Checks of the Sampling Board

- Check that the ejector probe is installed in accordance with the instructions i.e. in a suitable location that represents the gas to be tested. Make sure there is no leaks and that the installation is in accordance with good installation practice.
- Check that the air supply is connected to the air supply filter regulator without leaking and in accordance with good installation practice.
- Re-check all connections to make sure there is no air leaking. A leaking connection will result in a loss of air or calibration gas and may result in poor calibration.

4.2 Commissioning of the Analyzer

Check that all electrical connections and analyzer settings are correct according to section 3 and 5 in the G₄₁ NO_x/O₂ Analyzer manual.

4.3 Start of Systems

Using the G₄₁ NO_x/O₂ Analyzer manual, follow the instructions for commissioning of the analyzer and start the system. For calibration, follow the instructions in section 6.

5 Operation

5.1 Calibration Mode

In the calibration mode (both Zero and Span), the selector valve must stay at the Calibration position.

For zero calibration

- Turn the selector valve to **Zero** position.
- Check that the instrument air (zero NO_x gas) is connected to the air supply filter regulator.
- The pressure of the zero NO_x gas must not exceed 8 bar and should be reduced to 0.3-1 bar at the air supply filter regulator station. The flow of zero NO_x gas should be approximately 0.5...1 l/min. which can be adjusted at the calibration flow meter.

For span calibration

- Turn the selector valve to **Span** position.
- Check that the span NO_x gas is connected to the span NO_x gas connection.
- The pressure of the span NO_x gas should be approximately 1 bar. The flow of the calibration gases should be approximately 0.5...1 l/min. which can be adjusted at the calibration flow meter, or at the fixed flow valve of the test gas bottle.

After calibration, remember to turn both selector valves back to the **Operation** position.

5.2 Measurement Mode

In the measurement mode, both selector valves must point to the **Operation** position.

To adjust the sample air flow, you have to adjust the flow of the ejector air at the sampling flow meter. In the normal condition, the ejector air flow shall be approximately 2 l/min. at the pressure of 1 bar. If you need more suction, see section 2 for ejector probe specifications.

The instrument air for back-flushing is regulated by the solenoid valve which is controlled by the analyzer. For back-flushing, the solenoid valve will be opened automatically to allow the ejector probe back-flushing with high air flow. To set up the back-flushing interval, see the instruction in the analyzer manual.

6 Routine Maintenance

6.1 Air Flow System

Routine inspection and maintenance of the air flow system and connections is required to make sure no gas is leaking from the system. It is important that air flow and pressure are stable. Failure to periodically inspect and maintain the air flow system and connections may lead to imprecise analyzer readings and thus a malfunction of the system.

Make sure that the instrument air that is supplied at the air supply filter regulator is maximum 8 bar and has a temperature of maximum 60 °C. Always prevent ultraviolet rays from reaching the air supply filter regulator.

Before cleaning and servicing the air flow system, depressurize the air supply filter regulator. When cleaning do not use an adhesion of organic solvents to the air supply filter regulator.

The flow meter and the control valve do not require any special maintenance. Dirt and oil on the surface of the flow meters are to be removed carefully using neutral detergent and a clean dry rag.

6.2 Sensor



Attention

The analyzer must be turned off and the air supply must be disconnected before you start changing the sensor.

If you remove the sensor while there is exhaust gas in the stack, there is a risk that hot exhaust gas will come out of the sensor house.

The probe and the sensor are hot and can cause severe burning of personnel if not handled with care.

To change the sensor, please go through the following steps:

- Turn off the analyzer and disconnect the air supply.
- Unscrew the nuts and remove the blue cover plate of the ejector probe.
- To disconnect the sensor electronic control unit (ECU) press the small button on the plug at the end of the cable to the ECU and pull out the plug.

- To dismount the ECU, loosen the two nuts on the back of the mounting plate.
- Use a spanner to loosen the sensor.
- Insert a new sensor into the sensor house.
- Mount the ECU back on the mounting plate.
- Reconnect the cable to the ECU.

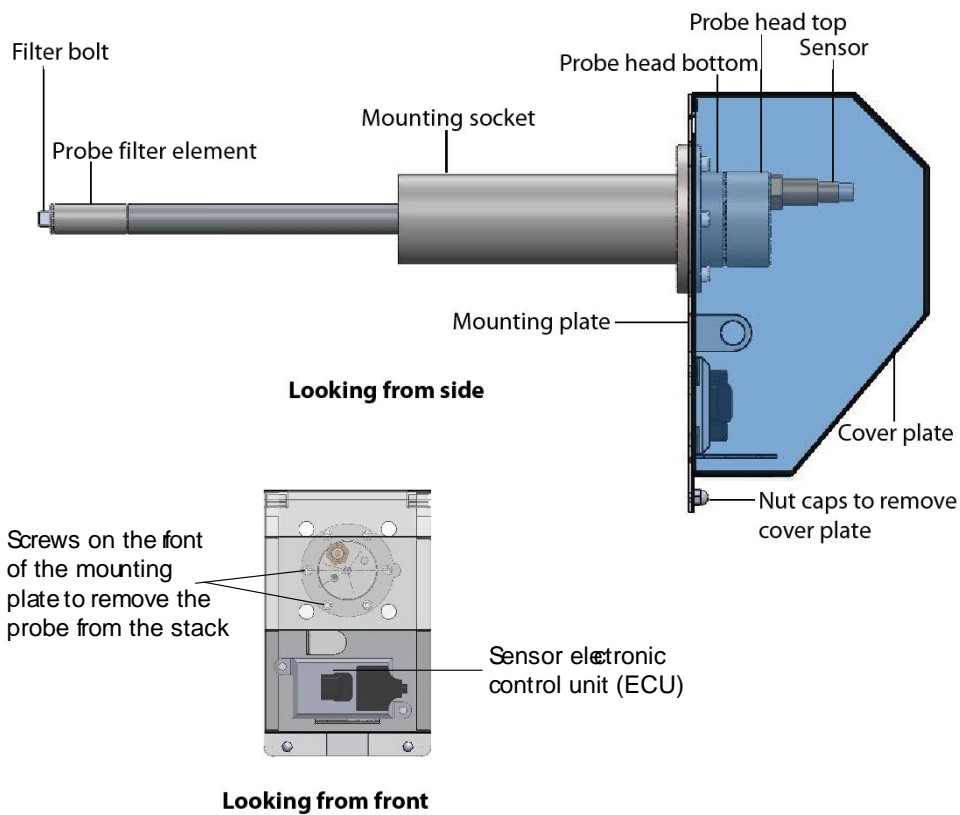


Figure 6-1: Ejector probe

6.3 Ejector Probe

The probe filter element is normally cleaned by back-flushing. The period between back-flushings depends on the actual flue gas condition and how dirty the filter gets.

Regular back-flushing will normally keep the filter clean. However, a slow response to NO_x/O₂ changes in the flue gases indicates that the ejector probe filter or the ejector probe venturi air nozzle may be contaminated. In that case, manual cleaning of the ejector probe is required.

**WARNING**

The analyzer must be turned off and the air supply must be disconnected before you start working with the probe.

If you remove the ejector probe while there is exhaust gas in the stack, there is a risk that hot exhaust gas will come out of probe hole.

The probe and the sensor are hot and can cause severe burning of personnel if not handled with care.

To clean the ejector probe, start by removing the ejector probe from the stack:

- Turn off the analyzer and disconnect the air supply.
- Unscrew the nuts and remove the blue cover plate of the ejector probe.
- Use a spanner to loosen the sensor. Unplug the sensor and the two sampling tubes. Remember that the sensor can be extremely hot!
- Unbolt the 6 bolts at the bottom of the probe head bottom and pull out the ejector probe.

Cleaning the probe filter element:

- To clean the probe filter element manually, remove the filter element by unscrewing the filter bolt.
- Clean or change the filter.

Cleaning the ejector probe venturi air nozzle:

- Unbolt the red bolt on the probe head top and pull the ejector probe venturi air nozzle out.
- Clean the ejector probe venturi air nozzle with pressurized instrument air. The gas canals in the ejector probe head top can also be cleaned with pressurized instrument air.

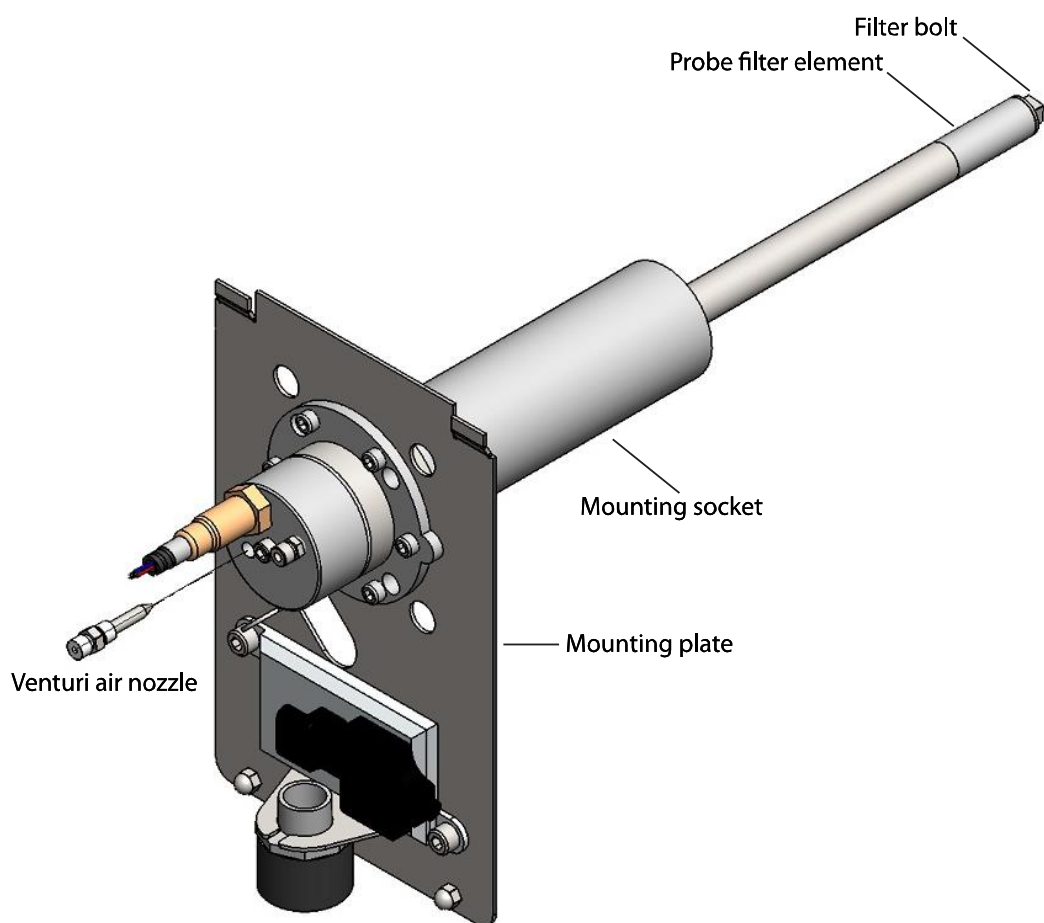









Figure 6-2: Ejector probe – removing the venture air nozzle


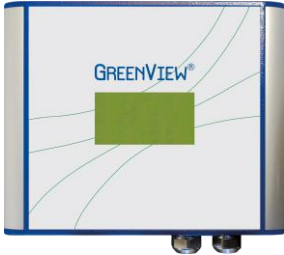
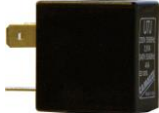




- After cleaning put the ejector probe venturi air nozzle back in place and insert the ejector probe back into the mounting socket.
- Place the blue cover plate back to the probe.

7 Parts List

Spare parts are not included in the standard delivery. Spare parts can be ordered when necessary. When ordering spare parts, please mention the serial number of the analyzer, which you can find on the label on the right side of the blue analyzer box.

Part No.	Description	The specific appearance of the spare parts is subject change without notice; the function however will not change
00573	Probe filter element - 25 micron	
00670	NO _x /O ₂ sensor	
00657	Filter regulator 0–2 bar	
00739	Selector valve	
00839	Flow meter for sample 5 l/m	
01254	Flow meter for calibration 1 l/m	
01251	Fuse for analyzer 2 AT (pkg of 10)	
01047	Cable glands – M20	

Parts List

Part No.	Description	The specific appearance of the spare parts is subject change without notice; the function however will not change
01061	Back flush valve	
01248	G ₄₁ NO _x /O ₂ Analyzer 100-230 VAC	
01034	Solenoid 24 VDC	
00472	Flange gasket OD 100 for stack probe	
01268	Inner gasket OD 64 for stack probe	
01627	Air Jet v3	
01250	Manual G ₄₁ NO _x /O ₂ Analyzer - Software version 2.04	
01271	This instruction manual	
01267	Filter bolt	

Part No.	Description	The specific appearance of the spare parts is subject change without notice; the function however will not change
01269	Probe complete with protect housing Dimension 284 X 180 x 440 mm (HxDxL)	
01393	Umbilical cord complete with sensor cable and air hoses - 3 m	
01572	Additional meters for # 01393 Umbilical Cord (per additional meter)	
33592	Signal amplifier (4-20 mA) (optional)	
01333	Gas flow regulator SS 0.5 l/m – 1200 PSI Fit cylinder: 103 L - Valve inlet: C-10	
01332	Span test gas bottle 1200 ppm NO _x in N ₂ – 112DA container	
01950	Span test gas bottle 400 ppm NO _x in N ₂ – 112 DA container	
01673	Span test gas bottle 1500 ppm NO _x in N ₂ – 112DA container	
00774	IMO NO _x flange for testing purpose	

Other optional equipment – e.g. flow alarm, remote digital display, visualization, recording and data logging, monitoring of gas temperature, pressure, and load – can be supplied.

EUROPE

Green Instruments A/S

Erhvervsparken 29
9700 Brønderslev, Denmark
Tel: +45 96 45 45 00

sales@greeninstruments.com

AMERICA

Green Instruments USA, Inc.

6750 N. Andrews Avenue Suit 200
Fort Lauderdale, FL-33309, USA
Tel: +1 954 613 0400

usa@greeninstruments.com

ASIA

Green Instruments (S) Pte. Ltd.

4008 Ang Mo Kio Avenue 10
#01-09/10 Techplace I, Singapore 569625
Tel: +65 3100 0577

sales.sg@greeninstruments.com



For more information, please visit www.greeninstruments.com.