DANETV DOC. NO. D-6

Environmental Testing of DANETV Products

Environmental test specification for Green Instrument G_{4100} NO_X/O_2 Analyzing System

Ver. 0

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Susanne Otto

DANETV

DANish Environmental Technology Verification

www.etv-denmark.com

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The Danish Centre for Verification of Climate and Environmental Technologies, DANETV, offers independent tests of technologies and products for the reduction of climate and environmental changes and of monitoring equipment detecting environmental changes. The focus is on technologies that are of great importance to the progress of climate and environmental strategy and also on the positioning of Danish suppliers of innovative technologies. DANETV is a co-operation between five technological service institutes: DHI, Danish Technological Institute, FORCE Technology, DELTA and AgroTech. DANETV has been established with financial support from the Danish Ministry of Science, Technology and Innovation.

Table of contents

1. Introduction

This document presents the proposal for an environmental test specification for the G_{4100} NO_X/O_2 Analyzing System manufactured by Green Instruments A/S. The document is a part of the DELTA activities within the DANETV project.

The purpose of the test specification is to define a number of environmental tests to be performed on the G_{4100} NO_X/O_2 Analyzing System, or critical parts of it.

The specification is based on the manufacturer's product sheet, IACS E10 Rev. 5 Dec. 2006: "Test Specification for Type Approval", Lloyd's Register: "Lloyd's Register Type Approval System, Test Specification Number 1", 2002, Commision Directive 2009/26/EC (Marine equipment directive), EN 61000-6-2:2005: "Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments", and EN 61000-6-4:2006: "Electromagnetic compatibility (EMC) - Part 6-4: Generic standards – Emission standard for industrial environments".

The purpose of the environmental testing is to verify the ability of the test object to withstand or operate within specified tolerances, while being exposed to the environmental conditions likely to be encountered during normal use.

The selection of the severity of each of the tests is based on the following conditions:

- The test aims to produce the same failure mechanisms as may be encountered during use.
- Only a few samples of the test objects are exposed to each test. Thus, variations in tolerances have to be taken into account.
- The verbal description of the use environment, see section 2.1.

The compliance of the G_{4100} NO_X/O_2 Analyzing System to electrical safety is not covered.

In the following, the test object, the use environment, the functional check, the environmental tests, and the accelerated tests are described.

1.1 Product description

The G_{4100} NO_X/O_2 Analyzing System is direct in-situ gas analyser that is used to monitor NO_X and O_2 concentrations in emission gas. The system helps fulfilling emission regulations as well as supporting the operation for all types of combustion processes.

The G_{4100} NO_X/O_2 Analyzing System consists of the following modules:

- Analyzer
- Analyzer board with connections
- Ejector probe

The system can be used for both marine and land based applications.

The G_{4100} sensor can be installed directly on the stack without special protection.

Please, refer to Annex 1 for further details.

1.2 Use environment

The proposal for the environmental test specification for the G_{4100} NO_X/O_2 Analyzing System is based on the following:

- For the marine application, the relevant "Environmental Categories" (defined by Lloyd´s Register of Shipping) for the analyser and the analyser board with connections are ENV1: "Controlled environments" and ENV2: "Enclosed spaces subject to temperature, humidity and vibration".
- The Ejector probe can be installed directly on the stack without special protection and thus exposed to combinations of high temperature and vibration.

1.3 Delimitations

The following delimitations apply to this specification:

- Inclination is omitted due to no moving part.
- The compliance of the G_{4100} NO_X/O_2 Analyzing System to electrical safety is not covered.
- Performance test according to Commision Directive 2009/26/EC (Marine equipment directive) and thus IMO Res. MEPC 103(49) or MEPC 177(58) is not covered.

1.4 Functional check and visual inspection

A functional check, demonstrating compliance with the requirements stated by Green Instruments A/S, is performed before the actual testing is started.

The functional check is performed before, in some cases during, and after each environmental exposure in order to verify the ability of the test object to withstand the environmental conditions without impairment of the function.

Further, a visual inspection with the un-aided eye is performed after each exposure in order to detect mechanical damages or deteriorations.

1.5 Criteria for compliance

No change of the actual operational states of the test object is allowed. However, temporary change is allowed during the power supply failure test.

In addition, the following generic acceptance criteria for compliance shall be in force during the EMC immunity testing:

- Performance Criterion A: (For continuous phenomena): The EUT shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed as defined in the relevant equipment standard and in the technical specification published by the manufacturer.
- Performance Criterion B: (For transient phenomena): The EUT shall continue to operate as intended after the tests. No degradation of performance or loss of function is allowed as defined in the technical specification published by the manufacturer. During the test, degradation or loss of function or performance

which is self-recoverable is, however, allowed but no change of actual operating state or stored data is allowed.

- Performance Criterion C: Temporary degradation or loss of function or performance is allowed during and after the test, provided the function is self-recoverable, or can be restored by the operation of the controls as defined in the relevant equipment standard and in the technical specification published by the manufacturer.

2. Environmental tests

This part describes the environmental tests to be performed based on the description of the use environment. Each of the tests is described by purpose, reference specification, severity and procedure.

2.1 Visual inspection and performance test (G_{4100} NO_X/O_2 Analyzing System)

Specification & Test method

IACS E10, Test No. 1 and 2.

Procedure

The conformance to drawings and the functional performance are demonstrated to the society surveyors present at DELTA during the type approval testing.

The functional test is also demonstrated.

2.2 External power supply failure (G_{4100} NO_X/O_2 Analyzing System)

Specification & Test method

IACS E10, Test No. 3.

Procedure

The power supply is interrupted 3 times within 5 minutes with a break time of 60 seconds.

Normal power-up procedure is to be obtained after each power break.

2.3 Power supply variations (permanent) (G_{4100} NO_X/O_2 Analyzing System) (AC supply)

Specification & Test method

IACS E10, Test No. 4.

Procedure (230 VAC supplied)

Unom.	=	Nominal supply voltage	=	100 - 230 VAC
fnom.	=	Nominal supply frequency	=	50/60 Hz

Exposures, each with a duration of 15 minutes, are performed at the following supply voltages and frequencies:

U	=	Unom. + 10 %	=	253 VAC
U	=	Unom. - 10 %	=	90 VAC
f	=	fnom. + 5 %	=	63 Hz
f	=	fnom. - 5 %	=	47.5 Hz

2.4 Power supply variations – permanent (G_{4100} NO_X/O_2 Analyzing System) (DC supply)

Specification & Test method

IACS E10, Test No. 4.

Procedure

$U_{nom.}$ = Nominal supply voltage = 24 VDC

Exposures, each with a duration of 15 minutes, are performed at the following supply voltages:

U_1 = Un +30 % = 31.2 VDC

U_2 = Un -25 % = 18.0 VDC

The test object is observed during the exposures, and a functional test is performed at the end of each exposure.

An additional power supply variations test is performed as part of the functional test during the low temperature and the dry heat exposures.

2.5 Power supply variations (transient) (G_{4100} NO_X/O_2 Analyzing System) (AC supply)

Specification & Test method

IACS E10, Test No. 4.

Procedure

$U_{nom.}$ = Nominal supply voltage = 100 - 230 VAC

$f_{nom.}$ = Nominal supply frequency = 50/60 Hz

Ten exposures, 1 / min, are carried out at each of the following combinations:

- $U_{nom.}$ + 20 % = 276 VAC Duration = 1.5 s
  $f_{nom.}$ + 10 % = 66 Hz Duration = 5.0 s
- $U_{nom.}$ - 20 % = 80 VAC Duration = 1.5 s
  $f_{nom.}$ - 10 % = 45 Hz Duration = 5.0 s

The test object is observed during the exposures, and a functional test is performed at the end of each combination.

2.6 Low temperature (cold) (G_{4100} NO_X/O_2 Analyzing System)

Specifications

IACS E10, Test No. 11.

Test method

IEC 60068-2-1:2007, Test Ad: Cold for heat-dissipating object with gradual change of temperature.

Severity and procedure

Temperature : +5 °C

Duration : 16 hours

The test object is de-energised during the exposure. However, during the last 2 hours of the exposure, the test object is energised and a functional test is performed.

After recovery, a functional test and an insulation resistance test ref. Section 2.10 is performed in standard environment.

2.7 Dry heat (Analyzer and Analyzer board with connections)

Specifications

IACS E10, Test No. 5.

Test method

IEC/EN 60068-2-2:2007, Test Be: Dry heat for heat-dissipating specimen with gradual change of temperature.

Severity and procedure

Temperature	:	+55 °C
Duration	:	16 hours
Humidity	:	Below 50 %RH

The test object is energised and in normal operating condition during the exposure. During the last hour of the exposure, a functional test is performed.

After recovery, the functional test is repeated in standard environment.

2.8 Damp heat, cyclic (G_{4100} NO_X/O_2 Analyzing System)

Specifications

IACS E10, Test No. 6.

Test method

IEC 60068-2-30 (2005), Test Db: Damp heat cyclic (12 + 12 hours' cycle), Variant 1.

Severity and procedure

Lower temperature	:	25 °C
Humidity at lower temperature	:	>95 %RH
Upper temperature	:	55 °C
Humidity at upper temperature	:	93 %RH
Number of cycles	:	2

During the first cycle, the test object is energised and in normal operational mode. A functional test is performed during the first 2 hours of the 55 °C phase.

During the second cycle, the test object is de-energised. However, during the last 2 hours of the second 55 °C phase, the test object is energised and a functional test is performed.

After recovery the test object is energised and a functional test and an insulation resistance test ref. Section 2.10 are performed in standard environment.

2.9 Corrosion (salt mist) (Ejector probe)

Specification

IEC 60945: 2002, Section 8.12.

Test method

IEC 60068-2-52, severity 1.

Severity and procedure

Concentration of NaCl	:	5 %
PH of salt solution	:	6.5 - 7.2
Number of cycles	:	4
Total duration	:	28 days

The test object is installed in the salt mist chamber and sprayed with the salt mist solution for a period of 2 hours.

At the end of the spraying period, the test object is transferred to a humidity chamber and stored at a temperature of 40 ºC ±2 ºC and a relative humidity of 93 % +2 / -3 % for a period of 7 days.

The above constitutes one cycle, which is repeated three times.

The test object is de-energised during the exposure.

After the finalisation of the entire exposure, a functional test and a visual inspection are performed.

2.10 Insulation resistance (UN<65V)

Specification & Test method

IACS E10, Test No. 9.

Procedure

The insulation resistance is measured between shorted supply terminals and earth with 50 VDC for 24 VDC power ports. The insulation resistance has to be above 10 MΩ initially, and above 1 MΩ after the cold, damp heat and high voltage exposures.

2.11 Insulation resistance (UN>65V)

Specification & Test method

IACS E10, Test No. 9.

Procedure

The insulation resistance is measured between shorted supply terminals and earth with 500 VDC. The insulation resistance is to be above 100 MΩ initially, and above 10 MΩ after the cold, damp heat, and high voltage exposures.

2.12 High voltage (UN<65V)

Test method

IACS E10, Test No. 10.

Procedure

550 VAC, 50 Hz is applied between shorted supply terminals and earth for 1 minute for the 24 VDC supply line.

No flashover, breakdown etc. is acceptable.

2.13 High voltage (UN>65V)

Test method

IACS E10, Test No. 10.

Procedure

1500 VAC, 50 Hz is applied between shorted supply terminals and earth for 1 minute for the 230 VAC supply line.

No flashover, breakdown etc. is acceptable.

2.14 Resonance search (Analyzer and Analyzer board with connections)

Specifications

IACS E10, Test No. 7.

Test methoIEC 60068-2-6:2007, Test Fc: Vibration (sinusoidal).

Severity and procedure

Frequency range	:	2 - 100 Hz		
Frequency / amplitude	:	2 – 13.2 Hz	:	± 1.0 mm
		13.2 - 100 Hz	:	± 0.7 g
Sweep rate	:	Max. 0.5 octave/min.		
Number of axes	:	3 mutually perpendicular		

The test objects are de-energised during the exposure.

During the resonance search, the resonance frequencies are determined by means of stroboscopic light with slow motion facility and accelerometer measurements of the amplification factors (Q).

Resonance frequencies with an amplification factor above 2 are recorded. In general, no mechanical amplification factor greater than 10 will be accepted.

2.15 Resonance search (Ejector probe)

Specifications

IACS E10, Test No. 7.

Test method

IEC 60068-2-6:2007, Test Fc: Vibration (sinusoidal).

Severity and procedure

Frequency range	:	40 - 2000 Hz		
Frequency / amplitude	:	40 – 2000 Hz	:	± 10 g
Sweep rate	:	Max. 0.5 octave/min.		
Number of axes	:	3 mutually perpendicular		

The test object is de-energised during the exposure.

During the resonance search, the resonance frequencies are determined by means of stroboscopic light with slow motion facility and accelerometer measurements of the amplification factors (Q).

Resonance frequencies with an amplification factor above 2 are recorded. In general, no mechanical amplification factor greater than 10 will be accepted.

2.16 Endurance - sinusoidal vibration (Analyzer and Analyzer board with connections)

Specifications

IACS E10, Test No. 7.

Test method

IEC 60068-2-6 (2007), Test Fc: Vibration (sinusoidal).

Severity and procedure

Frequency range	:	2 - 100 Hz		
Frequency range	:	2 - 100 Hz		
Frequency / amplitude	:	2 – 13.2 Hz	:	± 1.0 mm
		13.2 - 100 Hz	:	± 0.7 g
Procedure	:	Dwell on found resonances.		
Dwell conditions	:	$Q \geq 5$	:	120 minutes at resonance frequency
		$Q < 5$	:	120 minutes 30 Hz
Number of axes	:	3 mutually perpendicular		

A narrow sweep will be used if 2 resonances in the same axis are close to each other.

The test object is energised and a functional test is performed during the entire exposure.

2.17 Endurance - sinusoidal vibration (Ejector probe)

Specifications

IACS E10, Test No. 7.

Test method

IEC 60068-2-6 (2007), Test Fc: Vibration (sinusoidal).

Severity and procedure

Frequency range	:	40 - 2000 Hz		
Frequency / amplitude	:	40 - 2000 Hz	:	± 10 g
Temperature	:	500 °C		
Procedure	:	Dwell on found resonances.		
Dwell conditions	:	$Q \geq 5$	:	120 minutes at resonance frequency
		$Q < 5$	:	120 minutes 30 Hz
Number of axes	:	3 mutually perpendicular		

The vibration exposure is performed under the specified temperature conditions.

A narrow sweep will be used if 2 resonances in the same axis are close to each other.

The test object is energised and a functional test is performed during the entire exposure.

2.18 IP X9K (water) (Ejector probe)

Test specification and method

DIN 40050 Teil 9: “Strassenfahrzeuge IP-Schutzarten Schutz gegen Fremdkörper, Wasser und Berühren Elektrische Ausrüstung”, Mai 1993

Severity

IP X9:

This is the code of DIN 40050 Part 9 for high pressure jets of 80ºC water impinging on an enclosure with an impact pressure of 100 kPa. For this severity, the guidelines of the NT ELEC 023 standard are followed.

Impact pressure	:	100 kPa
Water temperature	:	80 ºC
Distance nozzle-specimen	:	250 mm
Test duration	:	1 min per m², at least 3 min.

Procedure

The test object is switched OFF during the exposure.

2.19 IP 6X Dust (Ejector probe)

Test specification and method

EN/IEC60529: 2001 Degrees of protection provided by enclosures (IP Code).

Severity and procedure

IP 6X (dust protected):

Category	:	1
Test means	:	Temperature stabilized surroundings
Test powder	:	Talcum
Air pressure	:	Max. 2 kPa depression
Duration	:	8 hours.

The test object is de-energised during the exposure.

The test object is placed inside the dust test chamber. Hereafter, they are exposed to swirling dust conditions as described in the reference specification.

2.20 Electrostatic discharge (G_{4100} NO_X/O_2 Analyzing System)

Specifications

IACS E10, Test No. 13 and EN 61000-6-2:2005: “Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments”.

Test method

IEC 61000-4-2:2001: Testing and measurement techniques - Electrostatic discharge immunity test.

Severity and procedure

Air discharge	:	2, 4 and 8 kV
Contact discharge	:	2, 4 and 6 kV
Energy storage capacitance	:	150 pF
Discharge resistance	:	330 Ω
Polarity	:	+ and -
Number of discharges	:	10 per polarity at each test point

The discharges are applied only to such points and surfaces of the test object, which are accessible to personnel during normal use.

Contact discharges are applied to conductive surfaces and coupling planes. Air discharges are applied to insulating surfaces.

The test object is energised and in normal operational mode during the exposure. The test object is observed during the exposure, and a functional test is performed after the exposure.

Performance criterion: B.

2.21 Radiated radio frequency interference (G_{4100} NO_X/O_2 Analyzing System)

Specifications

IACS E10, Test No. 14 and EN 61000-6-2:2005: “Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments”.

Test method

IEC 61000-4-3:2006: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test.

Severity and procedure

Frequency range	:	80 - 2700 MHz
Field strength	:	80 – 2000 MHz: 10 V/m 2000 – 2700 MHz: 1 V/m
Modulation	:	80 %AM, 400 Hz sine wave

The test is performed in a semi anechoic room. The field is generated using linearly polarised broadband antennas.

The test object is energised and in normal operational mode during the exposure. The test object is observed during the exposure and a functional test is performed after the exposure.

Performance criterion: A.

2.22 Conducted low frequency interference (G_{4100} NO_X/O_2 Analyzing System) (AC supply)

Specification

IACS E10:2006, Test No. 15.

Test method

IEC 61000-4-16 (1998-01): Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz.

Severity and procedure

Frequency range	:	0.05 - 10 kHz
Amplitude (AC-supplied)	:	50 Hz - 15th harmonic : 10 % of Unom. 15th - 100th harmonic : 10 % - 1 % of Unom. 100th - 200th harmonic : 1 % of Unom.
Maximum applied power	:	2.0 W

The impedance of the test generator is less than 1 Ω.

The test signal is superimposed on the power supply lines via a coupling transformer.

The test object is energised and in normal operational mode during the exposure. The test object is observed during the exposure, and a functional test is performed after the exposure.

2.23 Conducted low frequency (G_{4100} NO_X/O_2 Analyzing System) (DC supply)

Specification

IACS E10:2006, Test No. 15.

Test method

IEC 61000-4-16 (1998-01): Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz.

Severity and procedure

Frequency range	:	0.05 - 10 kHz	
Amplitude (DC-supplied)	:	0.05 - 10 kHz	: 10 % of $U_{nom./}$ min. 3 Vrms
Maximum applied power	:	2.0 W	

The impedance of the test generator is less than 1 Ω.

The test signal is superimposed on the power supply lines via a coupling transformer.

The test object is energised and in normal operational mode during the exposure. The test object is observed during the exposure, and a functional test is performed after the exposure.

Performance criterion: A.

2.24 Conducted radio frequency interference (G_{4100} NO_X/O_2 Analyzing System)

Specification

IACS E10, Test No. 16 and EN 61000-6-2:2005: “Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments”.

Test method

IEC 61000-4-6:2007: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields.

Severity and procedure

Frequency range	:	150 kHz - 80 MHz	
Amplitude	:	0.15 - 80 MHz	: 10 Vrms
Modulation	:	80 %AM, 400 Hz sine wave	

The test object is supplied with power via a coupling / decoupling network.

The test signal is coupled to the power lines and signal lines via coupling networks. The coupling impedance is 150 Ω.

The test object is energised and in normal operational mode during the exposure. The test object is observed during the exposure, and a functional test is performed after the exposure.

Performance criterion: A.

2.25 Fast transients (burst) (G_{4100} NO_X/O_2 Analyzing System)

Specifications

IACS E10, Test No. 17 and EN 61000-6-2:2005: “Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments”.

Test method

IEC 61000-4-4:2004: Testing and measurement techniques - Section 4: Electrical fast transient / burst immunity test.

Severity and procedure

Amplitude	:	2 kV on power lines
	:	1 kV on signal lines
Pulse rise time	:	5 ns
Pulse duration	:	50 ns
Generator impedance	:	50 Ω
Repetition rate	:	5 kHz
Burst duration	:	15 ms
Burst period time	:	300 ms

The test object is supplied with power via a transient coupling network. The test signal is successively coupled to each power line and protective earth with reference to the ground plane.

The test signal is injected on the signal lines using a capacitive coupling clamp. The clamp is successively used on selected signal cables.

The test signal is injected on the power lines for 5 minutes, using each coupling mode and each polarity, and then on the signal lines for 5 minutes using each polarity.

The test object is energised and in normal operational mode during the exposure. The test object is observed during the exposure and a functional test is performed after the exposure.

Performance criterion: B.

2.26 Slow transients (surge) (G_{4100} NO_X/O_2 Analyzing System)

Specifications

IACS E10, Test No. 18 and EN 61000-6-2:2005: “Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments”.

Test method

IEC 61000-4-5:2005: Testing and measurement techniques - Surge immunity test.

Severity and procedure

Amplitude power ports	:	1 kV line-to-earth, 0.5 kV line-to-line
Voltage rise time	:	1.2 µs (open circuit)
Voltage decay time	:	50 µs (open circuit)

The impedance of the test generator is 2 Ω for line-to-line coupling and 12 Ω for line-to-earth coupling.

The test object is energised and in normal operational mode during the exposure. The test object is observed during the exposure, and a functional test is performed after the exposure.

Performance criterion: B.

2.27 Rated power frequency magnetic field (G_{4100} NO_X/O_2 Analyzing System)

Procedure

EN 61000-6-2:2005: “Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments”

Test method

IEC 61000-4-8:2001: Testing and measurement techniques - Power frequency magnetic field immunity test.

Severity and procedure

Magnetic field strength	:	30 A/m
Test frequency	:	50 Hz

The test is performed in three orthogonal orientations.

The test object is energised and in normal operational mode during the exposure. The test object is observed during the exposure, and a functional test is performed after the exposure.

Results

No malfunction was observed during the exposure and the function of the test object was OK after the exposure.

Performance criterion: A.

2.28 Immunity to AC mains voltage dips and interruptions (G_{4100} NO_X/O_2 Analyzing System)

Procedure

EN 61000-6-2:2005: “Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments”

Test method

EN/(IEC) 61000-4-11:2004

Severity (control unit and level sensor including all cables)

Line @ 0 % of nominal for 1 cycle

Line @ 40 % of nominal for 10 cycles (50 Hz)

Line @ 70 % of nominal for 25 cycles (50 Hz)

Line @ 0 % of nominal for 250 cycles

Procedure

The test object is energised and in normal operational mode during the exposure. The test object is observed during the exposure, and a functional check is performed after the exposure.

2.29 Radiated emissions (G4100 NOX/O2 Analyzing System)

Specification

IACS E10:2006, Section 19.

Test methods

CISPR 16-2-3:2006: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbance and immunity - Radiated disturbance measurements.

Severity and procedure

Bridge and deck zone.

Frequency range	:	0.15 - 2000 MHz		
Limits (quasi-peak)	:	0.15 - 0.30 MHz	:	80 - 52 dBµV/m
		0.30 - 30 MHz	:	52 - 34 dBµV/m
		30 - 2000 MHz	:	54 dBµV/m, except for
		156 - 165 MHz	:	24 dBµV/m

The electric field is measured with antennas at a distance of 3 m.

The measuring bandwidth is 200 Hz in the frequency range 10 kHz - 150 kHz, 9 kHz in the frequency range 150 kHz - 30 MHz and 120 kHz in the frequency range 30 MHz - 2000 MHz, except for the frequency range 156 MHz - 165 MHz where the measuring bandwidth is 9 kHz.

The test object is energised and in normal operational mode during the measurement.

2.30 Conducted emission (G4100 NOX/O2 Analyzing System)

Specification

IACS E10:2006, Test. No. 20.

Test methods

CISPR16-2-1:2008: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-1: Methods of measurement of disturbances and immunity - Conducted disturbance measurements

Severity and procedure

General power distribution zone.

Frequency range	:	0.01 - 30 MHz		
Limits (quasi-peak)	:	0.01 - 0.15 MHz	:	120 - 69 dBµV
		0.15 - 0.50 MHz	:	79 dBµV
		0.50 - 30 MHz	:	73 dBµV

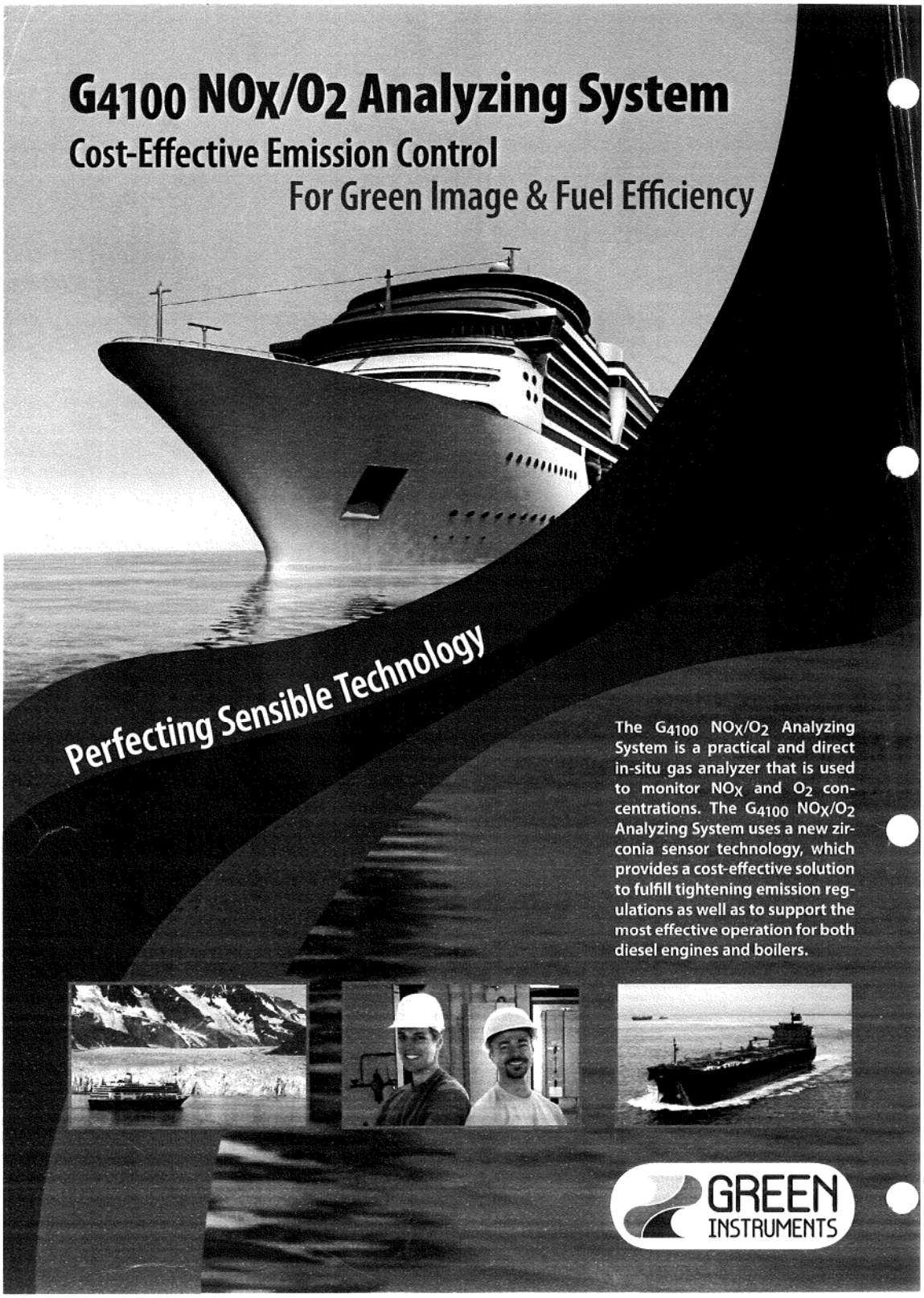
The radio frequency voltage is measured at the power supply terminals of the test object by a receiver through an artificial mains network.

The measuring bandwidth is 200 Hz in the frequency range 10 kHz - 150 kHz and 9 kHz in the frequency range 150 kHz - 30 MHz.

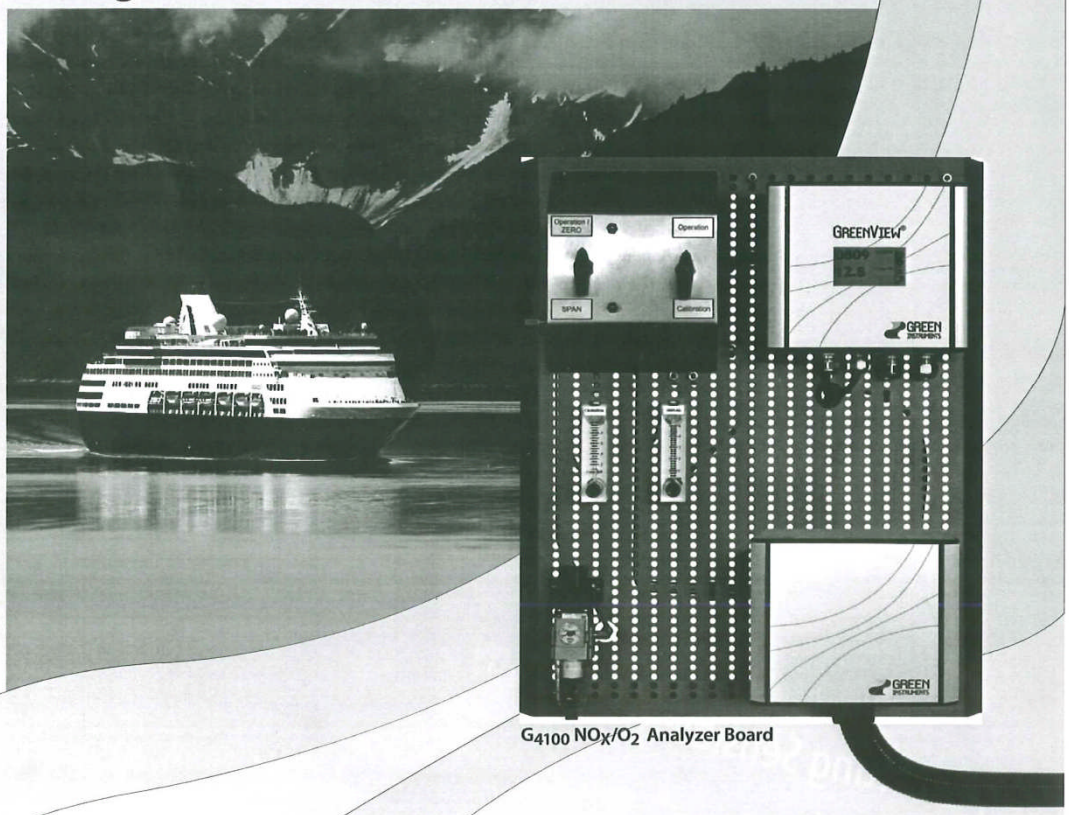
The test object is energised and in normal operational mode during the measurement.

Annex 1

Product sheet, G_{4100} NO_X/O_2 Analyzing System


G4100 NOX/O2 Analyzing System
Cost-Effective Emission Control
For Green Image & Fuel Efficiency
Perfecting Sensible Technology
The G4100 NOX/O2 Analyzing System is a practical and direct in-situ gas analyzer that is used to monitor NOX and O2 concentrations. The G4100 NOX/O2 Analyzing System uses a new zirconia sensor technology, which provides a cost-effective solution to fulfill tightening emission regulations as well as to support the most effective operation for both diesel engines and boilers.
GREEN
INSTRUMENTS

Strengthen Your Green Credentials



G_{4100} NO_X/O_2 Analyzer Board

Monitoring NO_X Emissions

Two factors drive the current development towards emission monitoring: Tightening environmental regulations from both regional and international authorities and the concern for showing environmental responsibility.

More stringent regulations have especially increased the need for NO_X reduction. Various after-treatment technologies including selective catalytic reduction (SCR) and exhaust re-circulation (EGR) are used for NO_X reduction. These systems require simple, reliable, and cost effective NOx monitoring solutions.

G_{4100} NO_X/O_2 Analyzing System

The G_{4100} NO_X/O_2 Analyzing System is a practical and direct in-situ gas analyzer for monitoring of NO_X and O_2 concentrations in emission gas. This system provides a cost-effective solution to help fulfilling tightening emission regulations as well as supporting the most effective operation for all types of combustions processes.

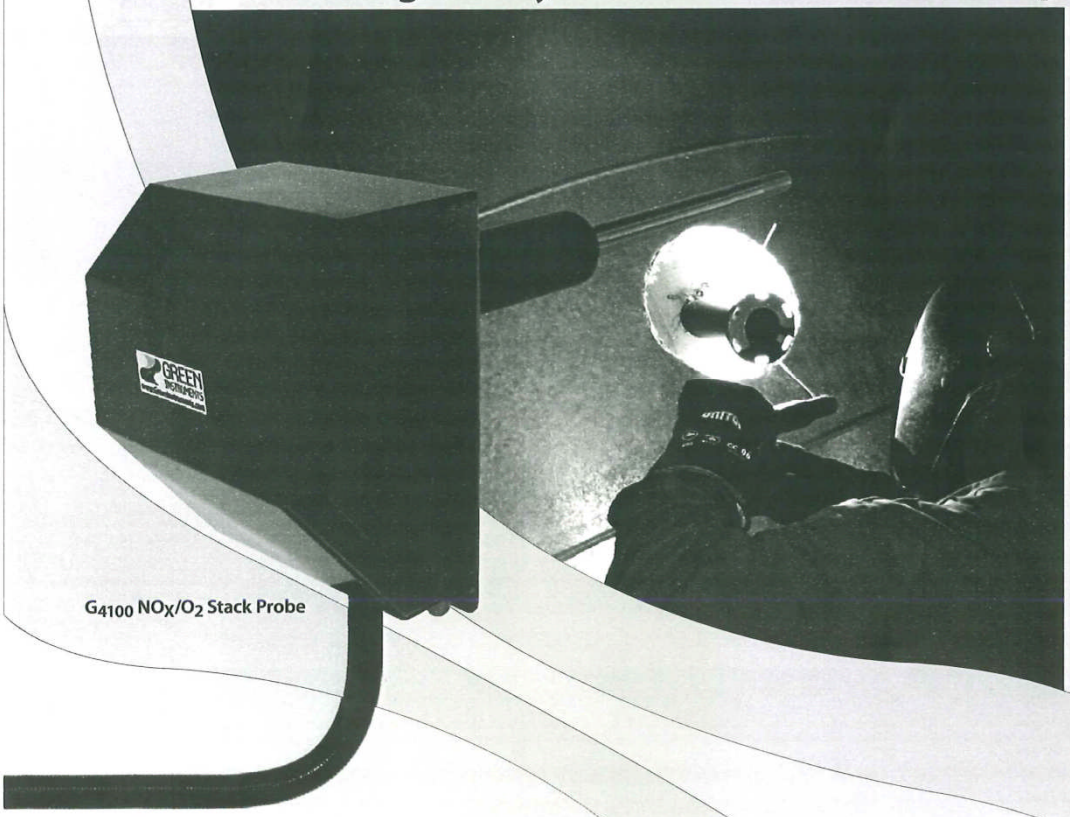
Continuously monitoring of NO_X emissions can be used to

Key Features

Lloyd's Register TYPE APPROVAL

- **Strengthens your green image**
- **Complies with tightening emission regulations**
- **Checks engine performance**
- **Provides data for SCR/combustion optimization**
- **In-situ and direct monitoring**
- **Highly reliable true wet measurement of NOx and O_2 in flue gas**
- **No sample lines, sample system, or converters**
- **Plug'n'play — easy installation and integration**
- **Easy operation with LCD touch screen**
- **Automatic back flushing and purging of the probe**
- **Analog outputs and data transmission via Ethernet**
- **Low total cost of ownership**
- **Worldwide customer support via service partners**

Plug'N'Play = Low Cost of Ownership



G_{4100} NO_X/O_2 Stack Probe

control various after-treatment technologies by using the real time NOx data that is generated by the G_{4100} NO_X/O_2 Analyzing System.

The G_{4100} NO_X/O_2 Analyzing System is also designed to meet the challenging requirements for monitoring the inlets and outlets of selective catalytic reduction systems (SCR) on all types of combustion sources.

The G_{4100} provides real time measurements of NO_X in ppm and O_2 in % and it is designed to withstand a rugged environment. It can be used both for marine and land based applications.

Easy Zirconia Technology

The G_{4100} uses a zirconium oxide (ZrO2) sensor with multiple diffusion cells specifically for NO_X measurement. This sensor is small and robust and can be installed directly on the stack without special protection. This technology allows real-time measurement of NO_X/O_2 on wet basis at high temperatures. It avoids sampling systems, coolers and converters with all their disadvantages.

The simple plug'n'play design makes it easy and cost-effective to install, operate, and maintain the analyzing system. The G_{4100} NO_X/O_2 Analyzing System consists of an ejector probe that is connected to the analyzer board.

Easy Reporting with G_{49xx}

As an optional extension to the G_{4100}, Green Instruments offers you the G49xx Visualization & Reporting Family which is a modular system that provides tailor made solutions. The requirements for emissions reporting and data system integration are different from application to application.

The following main modules are available:

G_{4900} Recording & Visualization System: Data logging and recording capacity for the G_{4100}.

G_{4901} Reporting System: relevant for approval by flag state and/or class.

Data from the G_{1000} Smoke Density Monitor can easily be integrated into the G_{49xx} Family.

Specifications - G4100

Lloyd's Register TYPE APPROVAL

Analyzer

Measurement range	NO_X: 0 to 1500 ppm (F.S.) - O_2: 0 to 21% (F.S.)
Repeatability	Better than 1.0% of F.S. for both NO_X and O_2
Accuracy	Better than 2.0% of F.S. for both NO_X and O_2
Response time	90% of F.S. in less than 30 sec.
Power supply	100...230 V AC, 50...60 Hz or 24 V DC. Consumption max. 40 VA
Ambient temperature	0°C to 55°C
Interface	Touch screen 71 × 39 mm with trend graph display
Analog output signal	2 x 4...20 mA range selectable (for NO_X and O_2). Load output (max.): 20 mA/ 600 Ω / 24 VDC
System interface	Analog 4...20 mA (optional: Ethernet)
Relays	4 relays , volt free, 5A 24 VDC/VAC
Analyzer casing	Aluminum casing IP67

Analyzer board with connections

Dimensions / Weight	H×W×D: 600×500×150 (wall mounted) / approx. 10 kg (without umbilical cord)
Test gas inlet	Max. 2 bar - 1/8" BSP connection
Span NO_X Gas	Known concentration of NO_X in N_2 in the range of 50...1500 ppm with 0.0% O_2
Air supply reduction regulator	Incl. 25µm filter - max. 8 bar - 1/8" BSP connection
Zero NO_X Gas – Air supply	Instrument air with 0 ppm NO_X and 20.9% O_2. Quality according to ISO 8573-1.4.4.4. Consumption up to 5 l/min

Ejector Probe

Sensor technology	Heated zirconia type sensor
Sample temperature	0°C to 500°C
Probe length/socket	Insert length: app. 250-300 mm - for duct diameters 290-2800 mm
Calibration air flow	App. 2 l/min
Ejector air flow at 1 bar	App. 2 l/min ≈ Vacuum 80 mm H_2O - adjustable if more suction is needed
Dimensions / Weight	H×W×D: 285×180×600 mm / approx. 5 kg (without umbilical cord)
Umbilical cord	3.0 m length in 28 mm nylon conduit

Optional Equipment

G_{4900} Recording & Visualization System
G_{4901} Reporting System
G_{4902} Extended Visualization & Reporting System
Test gas bottle case with span NO_X gas bottle and regulator
Ambient air sensor module
GPS module

Specifications subject to changes without notice

GREEN INSTRUMENTS

GREEN INSTRUMENTS A/S • www.greeninstruments.com
Erhvervsparken 29 • DK-9700 Brønderslev • Denmark
Tel.: +45 96 45 45 00 • Fax: +45 96 45 45 01

ISO 9001 BUREAU VERITAS Certification