Report No. E15102.01

Test Report
Reliability

Product	MU Series
Name and address of the applicant	Multilux AS Sandavegen 19 3802 Bø i Telemark Norway
Name and address of the manufacturer	Multilux AS Sandavegen 19 3802 Bø i Telemark Norway
Model	MU1, MU2, MU3
Rating	IP66
Trademark	Multilux
Serial number	Test samples
Additional information	-
Tested according to	EN 62208 (2011) (IEC 62208 (2011)) EN 60529:1989 +A1:1999 + A2:2013 (IEC 60529:1989 + A1:2000 + A2:2013) EN 60068-2-6 (2008) (IEC 60068-2-6 Ed. 7.0 (2007)) EN 60068-2-1 (2007) (IEC 60068-2-1 Ed. 6.0 (2007)) EN 60068-2-2 (2007) (IEC 60068-2-1 Ed. 5.0 (2007)) EN 60068-2-14 (2009) (IEC 60068-2-14 Ed. 6.0 (2009)) EN 60068-2-27 (2009) (IEC 60068-2-27 Ed. 4.0 (2008)) EN 60068-2-30 (2005) (IEC 60068-2-30 Ed. 3.0 (2005))
Order number	284229
Tested in period	2015-04-28 - 2015-08-18
Issue date	2015-09-14
Name and address of the testing laboratory	**Nemko Group** Nemko AS Gaustadalléen 30, P.O.Box 73 Blindern, 0314 Oslo, Norway Telephone (+47) 22 96 03 30 Fax (+47) 22 96 05 50

ilac-MRA NORWEGIAN ACCREDITATION TEST 033

An accredited technical test executed under the Norwegian accreditation scheme

Prepared by [Jarle Skogland]	Approved by [Roger Berget]

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REVISIONS

Revision #	Date	Order #	Description
00	2015-09-08	284229	First issued
01	2015-09-14	284229	Added reference to standard 60068-2-27

GENERAL REMARKS

This report applies only to the sample(s) tested. It is the manufacturer's responsibility to assure the additional production units of this product are manufactured with identical electrical and mechanical components. The manufacturer is responsible to the Competent Authorities in Europe for any modifications made to the product, which result in non-compliance to the relevant regulations.

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Opinions expressed within this report regarding general assessments and qualifications for PASS or FAIL to the standards limits and requirements, are not part of the current accreditation. Neither is opinions expressed regarding model variants covered by the testing of this report.

CALIBRATION

All instruments used in the tests given in this test report are calibrated and traceable to national or international standards. Between calibrations all test set-ups are controlled and verified on a regular basis by periodic checks to ensure, with 95% confidence that the instruments remain within the calibrated levels.

MEASUREMENT UNCERTAINTY

Measurement uncertainties are calculated or considered for all instruments and instrument set-ups used during these tests.

Environmental chamber uncertainties are calculated according to IEC 60068-3-11.

Uncertainty figures are found in an appendix to this report.

Further information about measurement uncertainties is provided on request.

If not explicitly stated otherwise in the standard, the test is passed if the measurement value is equal to or below the limit line, regardless of the uncertainty of the measurement. If the measurement value is above the limit line, the test is not passed - ref. IECEE/CTL (Sec) 056/94 (CTL = Committee of Testing Laboratories).

The instrumentation accuracy is within limits agreed by the IECEE/CTL (ref. Nemko proc. TM-NO/301).

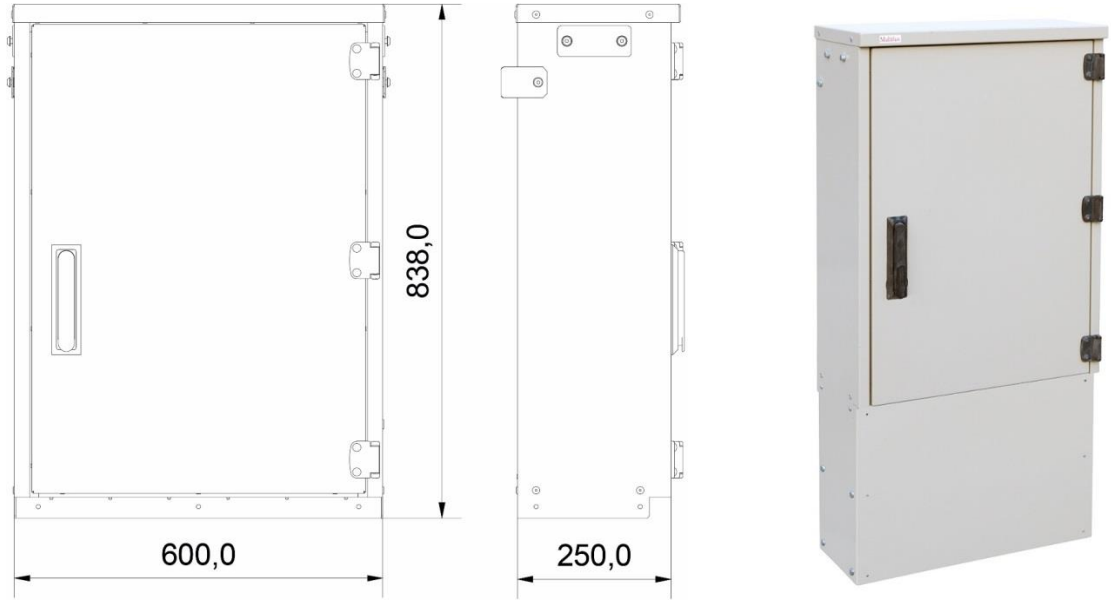
DESCRIPTION OF TESTED DEVICE (EUT)

PRODUCT DESCRIPTION

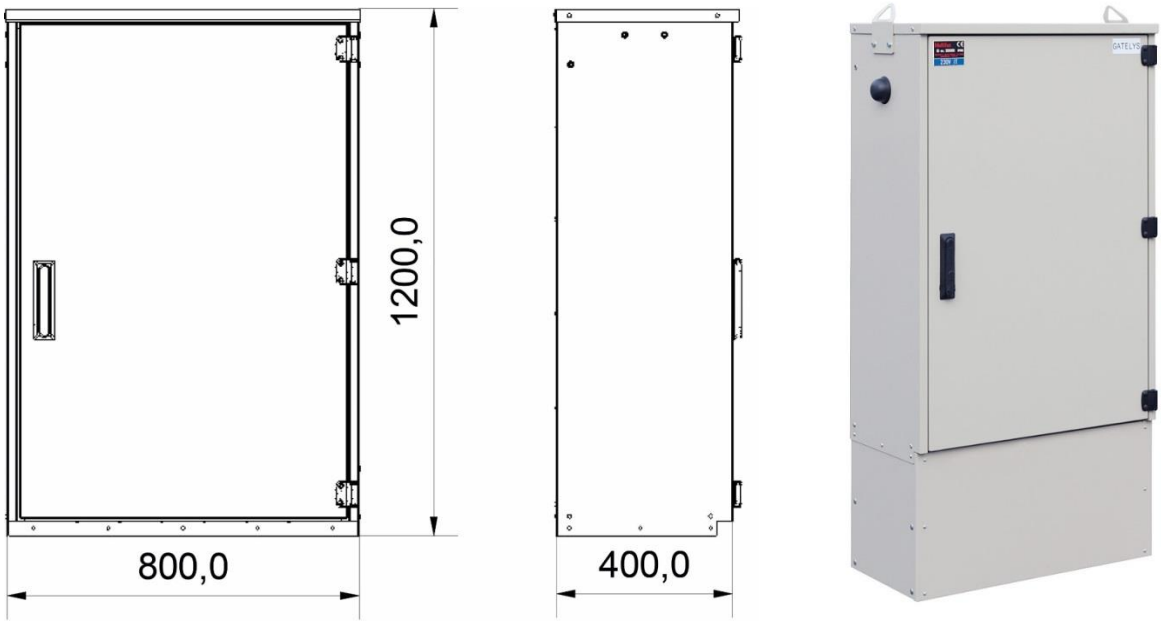
Multilux MU Series spark cabinets are manufactured with double walls for outdoor use, intended for street lights and other lighting purposes. The cabinet is made from seawater resistant aluminum and powder-coated with polyester in a light gray color (other colors on request). The cabinet door has three hinges and door handles with lock rod up and down. Plastic holder for documentation is located inside the door. The cabinet is available in three standard sizes: MU1 (800x600x250 mm), MU2 (1200x800x400 mm) and MU3 from (1600x800x400 mm) (1600x3600x400) and (1800x1200 / 1600x400). Other dimensions are on request. The cabinets have fixed or adjustable base. Fittings for strain relief also supplied according to specification.

Hardware identity and/or version: MU1, MU2, MU3 (MU-series)

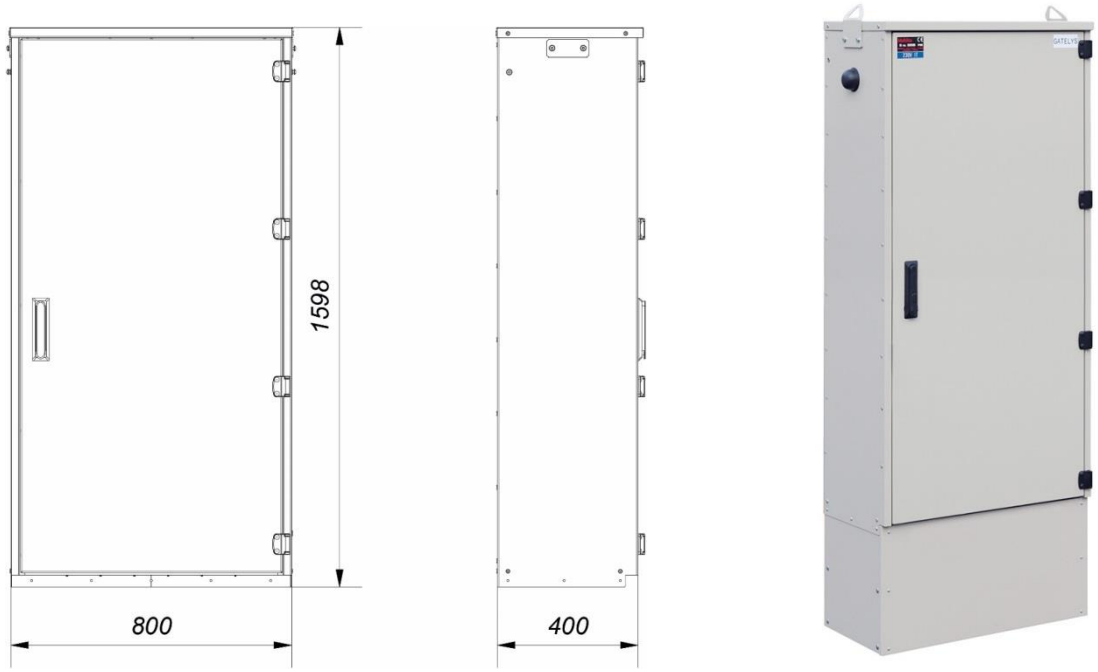
PRINCIPLE DIAGRAM – MU1



PRINCIPLE DIAGRAM – MU2



PRINCIPLE DIAGRAM – MU3



ADDITIONAL INFORMATION RELATED TO TESTING

In order to pass the tests, the EuT shall not gain mechanical damages, impaired functionality or unwanted ingress of foreign solid objects or water.

GENERAL TEST CONDITIONS

TEST LABORATORY

The following Nemko test sites have been utilized for the tests documented in this report:

	Site	
X	**GAUSTAD**	(Gaustadalleen 30, N-0314 Oslo, Norway)
	KJELLER	(Instituttveien 6, N-2007 Kjeller, Norway)
	SKAR	(Maridalsveien 621, N-0890 Oslo, Norway)

LABORATORY ACCREDITATIONS

NORWEGIAN ACCREDITATION TEST 033

Norsk Akkreditering – TEST 033
P17 – Environmental Tests

AMBIENT CONDITIONS

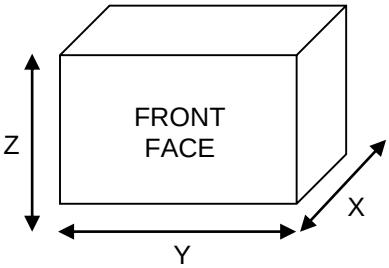
All tests and measurements were performed in a controlled environment suitable for the tests conducted.

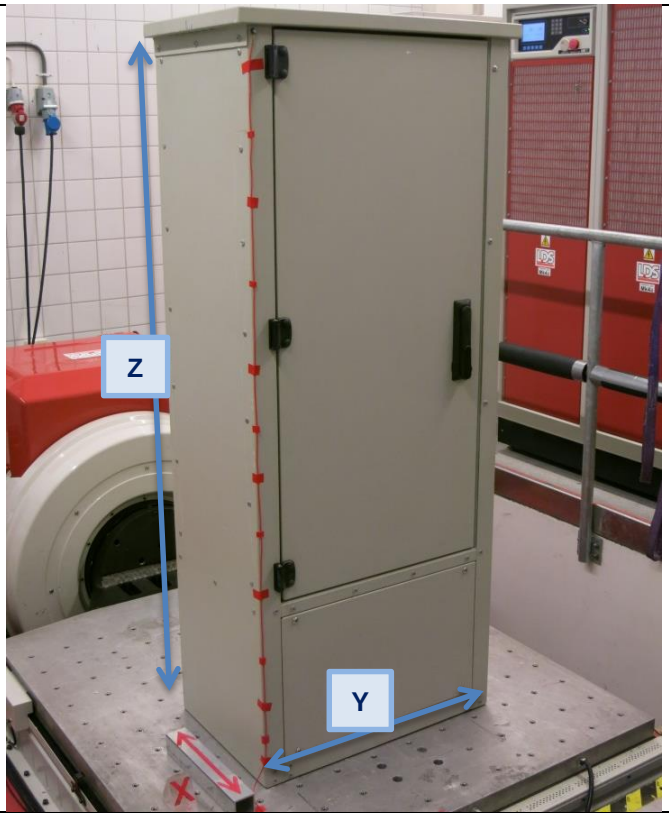
Normal ambient test conditions:

Ambient temperature:	20 - 23°C
Relative humidity:	20 - 50%RH
Atmospheric pressure:	98 - 102kPa

Note: The climatic conditions in the test areas are automatically controlled and recorded continuously.

DEFINITION OF AXIS CONVENTIONS





SUMMARY OF TESTING

APPLIED STANDARDS

- **EN 60068-2-1 (2007)**
  (IEC 60068-2-1 Ed. 6.0 (2007))
  Environmental testing - Part 2-1: Tests - Test A: Cold
- **EN 60068-2-2 (2007)**
  (IEC 60068-2-2 Ed. 5.0 (2007))
  Environmental testing - Part 2-2: Tests - Test B: Dry heat
- **EN 60068-2-30 (2005)**
  (IEC 60068-2-30 Ed. 3.0 (2005))
  Environmental testing -- Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)
- **EN 60068-2-14 (2009))**
  (IEC 60068-2-14 Ed. 6.0 (2009))
  Environmental testing – Part 2-14: Tests – Test N: Change of temperature
- **EN 60068-2-6 (2008)**
  (IEC 60068-2-6 Ed. 7.0 (2007))
  Basic environmental testing procedures – Part 2: Tests - Test Fc and guidance: Vibration (sinusoidal)
- **EN 60068-2-27 (2009)**
  (IEC 60068-2-27 Ed. 4.0 (2008))
  Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock
- **EN 60529:1989 +A1:1999 + A2:2013**
  IEC 60529:1989 +A1:2000 + A2:2013
  Degrees of protection provided by enclosures (IP Code)
- **EN 60068-2-11**

APPLIED TESTS

Test items	Test methods	MU series	Result
Cold	EN 60068-2-1 (2007) (IEC 60068-2-1 Ed. 6.0 (2007))	X	PASS
Dry heat	EN 60068-2-2 (2007) (IEC 60068-2-2 Ed. 5.0 (2007))	X	PASS
Damp heat	EN 60068-2-30 (2005) (IEC 60068-2-30 Ed. 3.0 (2005))	X	PASS
Change of temperature	EN 60068-2-14 (2009) (IEC 60068-2-14 Ed. 6.0 (2009))	X	PASS*
Vibration (sinusoidal)	EN 60068-2-6 (2008) (IEC 60068-2-6 Ed. 7.0 (2007))	X	PASS
Shock	EN 60068-2-27 (2009) (IEC 60068-2-27 Ed. 4.0 (2008))	X	PASS
Ingress Protection (IP66)	EN 60529:1989 +A1:1999 + A2:2013 IEC 60529:1989 +A1:2000 + A2:2013	X	PASS
Salt Mist	EN 60068-2-11 (1999) IEC 60068-2-11 (1981)	X	PASS

PASS : Tested and complied with the requirements
FAIL : Tested and failed the requirements
N/A : Test not relevant to this specimen (evaluated by the test laboratory)
– : Test not performed (instructed by the applicant)
* : An asterisk (*) placed after the verdict in the Result column indicates test items that are not within Nemko's scope of accreditation
# : A grid (#) placed after the verdict in the Result column indicates test items that are only partly covered by Nemko's scope of accreditation. Further information is detailed in the test section

DEVIATIONS AND EVALUATIONS

Product standards with dated references to basic standards may be modified by Nemko AS to test according to the newest edition of the basic standard. This may impact the compliance criteria or technical performance of the test, still this is considered to be adequate as long as the test is expected to confirm compliance to the intention of the product standard. The table above lists the edition of the basic standards used during testing.

Test Results

LOW TEMPERATURE

TEST DESCRIPTION

Method
EN 60068-2-1 (2007) (IEC 60068-2-1 (2007)) Test Ad: Cold for heat-dissipating specimen with gradual change of temperature.

Procedure
The testing was performed according to the above mentioned reference standard. The specimen was not operating during the exposure, except during the last hour when the specimen was started and subject to a functional test.

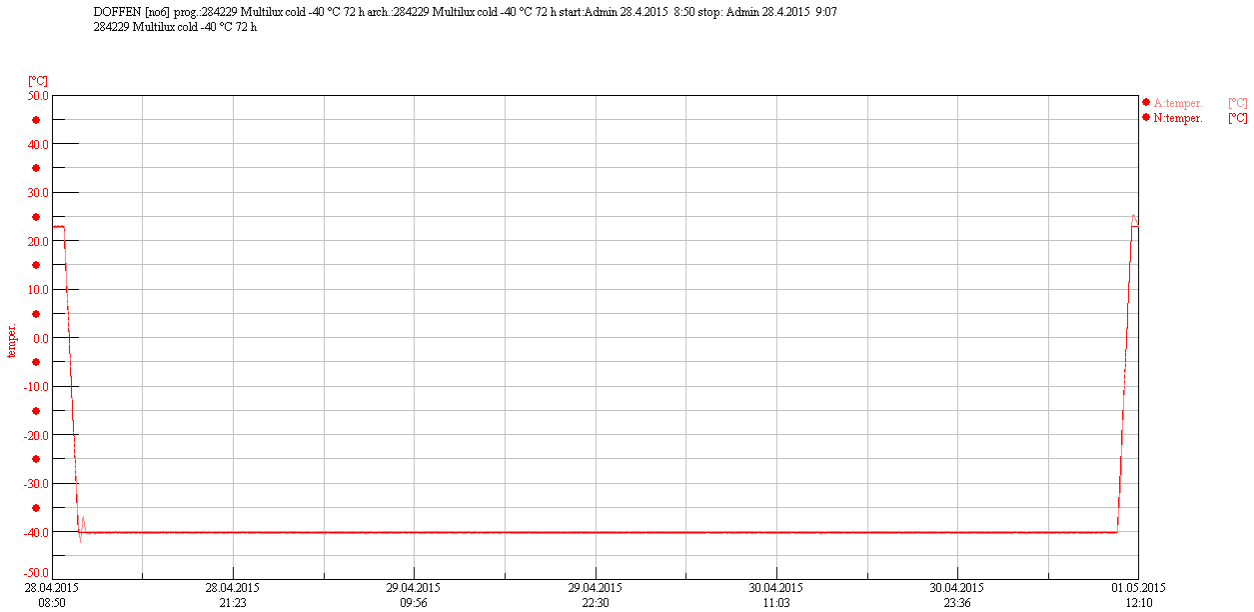
Preconditioning
None.

Instruments used during test
Instrument list: Climatic Chamber: Vötsch / VC 4100 (N-4343) (11/2015)

Comments
No recorded comments.

Severity		Conformity	
Temperature:	-40°C	Verdict:	PASS
Duration:	72 hrs	Test engineer:	André Bauge Forsmo

DETAILED TEST LOG



CONCLUSION
No operation errors were detected during or after the applied test(s)

DRY HEAT

TEST DESCRIPTION

Method
EN 60068-2-2 (2007) (IEC 60068-2-2 (2007))
Test Bb Dry heat for non heat-dissipating specimen with gradual change of temperature.

Procedure
The specimen was placed in a chamber at normal conditions. The temperature was then raised to and maintained at the test severity for a period of 168 h.

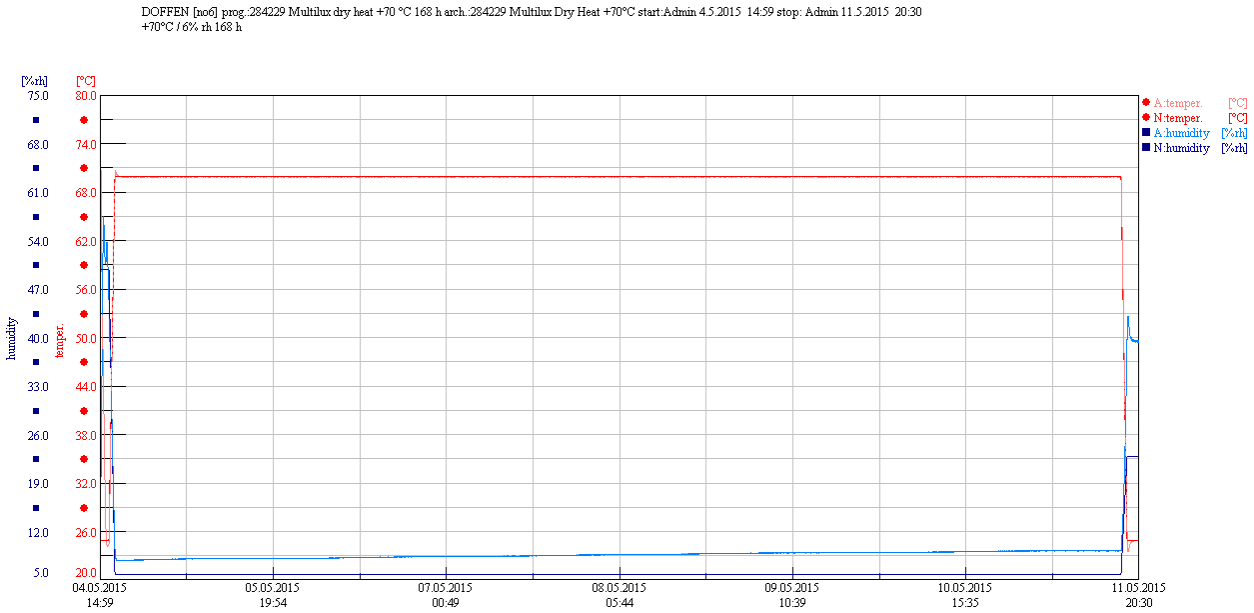
Instruments used during measurement

Instrument list: Climatic Chamber: Vötsch / VC 4100 (N-4343) (11/2015)

Comments
No comments.

Severity		Conformity	
Temperature:	+70ºC	Verdict:	PASS
Duration:	168 hours	Test engineer:	André Bauge Forsmo

DETAILED TEST LOG



CONCLUSION

No malfunction was observed during the exposure, the function of the specimen was found OK during the last hour of the exposure and after recovery.

DAMP HEAT

TEST DESCRIPTION

Method
EN 60068-2-30 (2007) (IEC 60068-2-30 (2007))
Test Db: Damp heat cyclic (12 + 12 hours' cycle), Variant 1

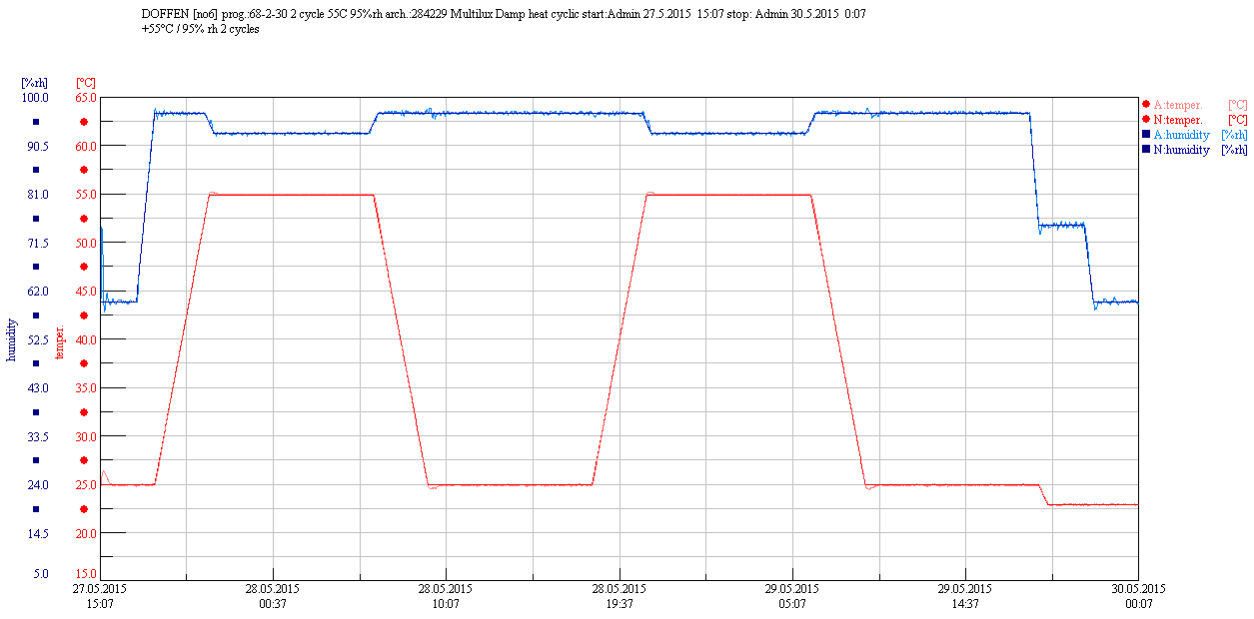
Procedure
An initial measurement of insulation resistance was performed.
The test chamber was pre-conditioned to 25ºC and 95%RH. The specimen was placed inside the test chamber. The chamber conditions were raised to +55ºC and 93% RH over a period of 3 hours. From the time stable test conditions were obtained, the specimen was subject to the conditions for the duration specified under Conditions. The test cycle was repeated as specified under Conditions.

Instruments used during measurement
Instrument list: Climatic Chamber: Vötsch / VC 4100 (N-4343) (11/2015)

Comments
No recorded comments.

Severity		Conformity	
Temperature:	+55°C	Verdict:	PASS
Humidity:	93% rh	Test engineer:	André Bauge Forsmo
Duration:	48 hours / 2 cycles		

DETAILED TEST LOG



CONCLUSION
No operation errors were detected during or after the applied test(s)

CHANGE OF TEMPERATURE

TEST DESCRIPTION

Method
EN 60068-2-14 (2009) (IEC 60068-2-14 (2009))
Test Nb: Change of temperature with specified rate of change

Procedure
This test determines the ability of components, equipment or other articles to withstand and/or functionduring changes of ambient temperature.
The specimen shall be either in the unpacked, switched-off, ready for use state, or as otherwise specified in the relevant specification.
The specimen is exposed to changes of temperature in air by exposure in a chamber to prescribed temperatures varied at a controlled rate. During this exposure the performance of the specimen may be monitored.

The chamber for this test shall be so designed that in the working space where the specimen under test is placed a temperature cycle can be performed in such a manner that:

a) The low temperature required for the test can be maintained,
b) The high temperature required for the test can be maintained,
c) The change rate required for the test from low temperature to high temperature or vice versa can be performed at the required rate of change

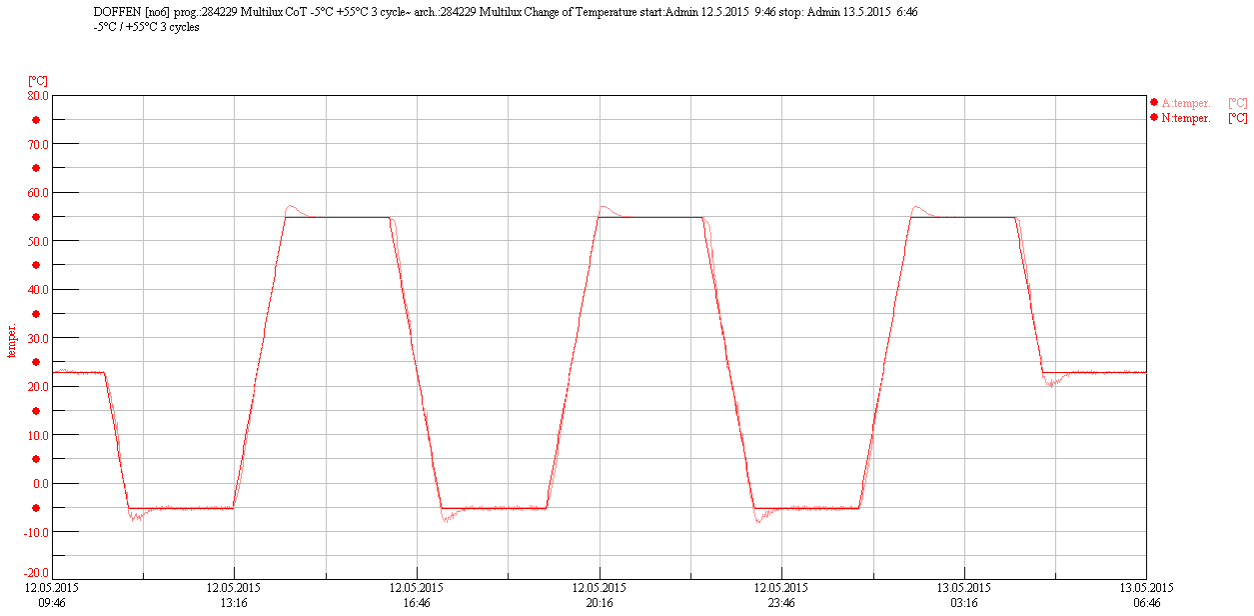
Instruments used during measurement

Instrument list: Climatic Chamber: Vötsch / VC 4100 (N-4343) (11/2015)

Comments
No comments.

Severity		**Conformity**	
Temperature:	-5°C / +55ºC	Verdict:	PASS
Duration:	21 hours / 3 cycles	Test engineer:	André Bauge Forsmo

DETAILED TEST LOG



CONCLUSION

No operation errors were detected during or after the applied test(s)

SALT MIST/CORROSION

TEST DESCRIPTION

Method
EN 60068-2-11 (1999)
Test Ka: Salt mist (sodium chloride solution)

Reference
IEC 62208 (2011) (EN 62208 (2011)) § 9.13.2.2

Procedure
The temperature of the test chamber shall be maintained at 35 ± 2°C

The relevant specification shall prescribe one of the following conditioning durations: 16 h, 24 h, 48 h (2 days), 96 h (4 days), 168 h (1 week), 336 h (2 weeks), 672 h (4 weeks).

At the completion of the test the specimens were washed in running tap water, rinsed in distilled water and the subjected to air blast to remove droplets of water.

Instruments used during test

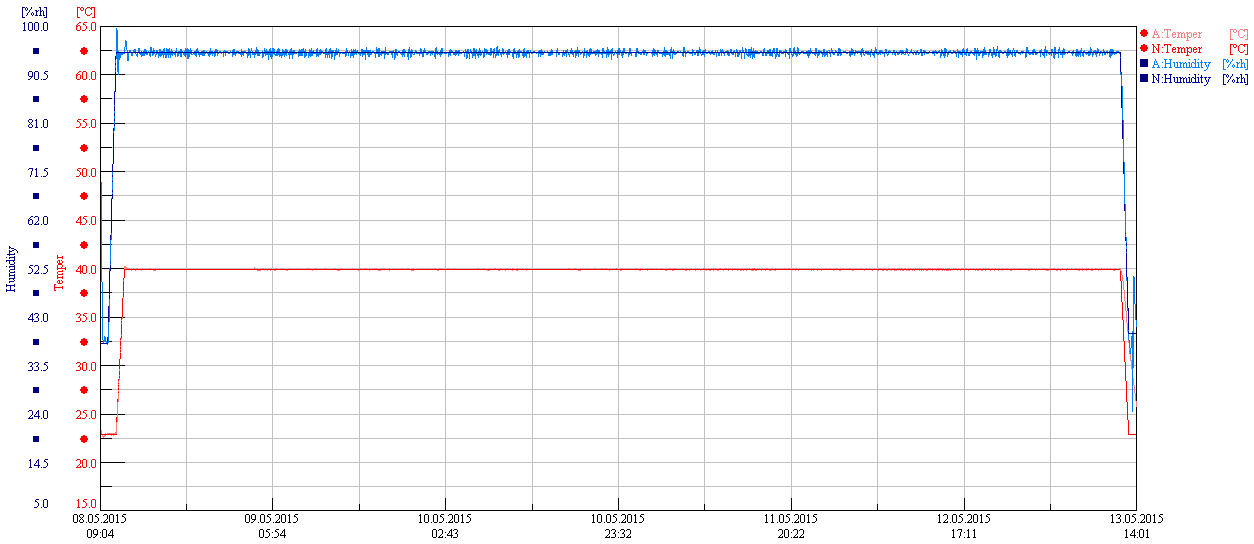
Instrument list:	Salt Spray Chamber: Weiss / S1000 (N-2184) (07/2015) Climatic Chamber: Vötsch / HCV 4057-5/S (N-4345) (11/2015)

Severity		**Conformity**	
Duration:	24 days	Verdict:	PASS
Number of cycles:	2 cycles	Test engineer:	André Bauge Forsmo
Cycle duration:	12 days		Espen Eriksen
Cycle:	Duration in salt spray: 7 days in temperature 35°C ± 10°C. Duration in humidity: 5 days in temperature 40°C ± 2°C humidity 95% RH		
Salt compound:	1 kg NaCl dissolved in 19 litre of demineralized water		

DETAILED TEST LOG

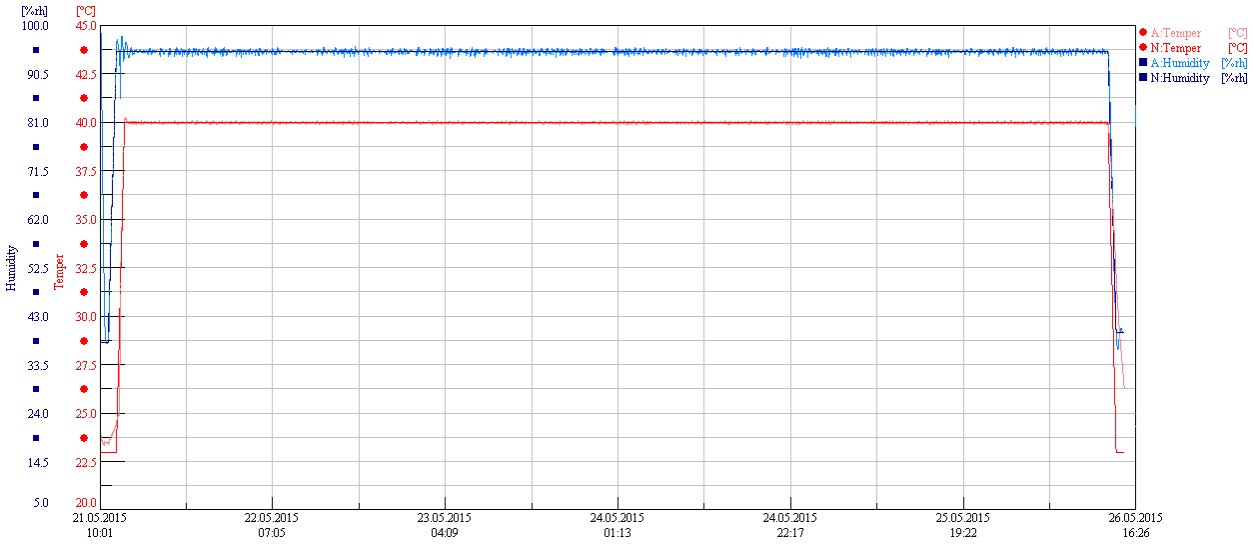
First cycle in Humidity

HOBBS [no1] prog.:Multilux SaltMist +40°C 95%rh cyclic 5~ arch.:284229 Multilux Damp heat 40°C 9% RH fi~ start:Admin 8.5.2015 9:04 stop: Admin 13.5.2015 14:01
EN 62208 Damp Heat before salt mist



Second cycle in Humidity

HOBBS [no1] prog.:Multilux SaltMist +40°C 95%rh cyclic 5~ arch.:284229 Multilux Damp heat 40°C 9% RH se~ start:Admin 21.5.2015 10:01 stop: Admin 26.5.2015 15:01
EN 62208 Damp Heat intermediate salt



OBSERVATIONS

No corrosion damages were observed after the applied test.

VIBRATION (SINUSOIDAL WITH RESONANCE SEARCH)

TEST DESCRIPTION

Method
EN 60068-2-6 (2008) Test Fc: Vibration (sinusoidal)

State of the specimens during conditioning
The specimen was mounted by its normal means of attachment in accordance with the manufacturer's instructions to a rigid fixture.

Resonance search
Frequency sweeps were carried out in three mutually perpendicular planes, X, Y and Z.

Endurance test
Sweep cycles.

Intermediate Measurements
None, observation only.

Final measurements
After the tests a functional test was carried out.

Requirements
Performance deterioration and/or mechanical damage lead to failure of the test.

Instruments used during measurement

Instrument list:
Accelerometer: PCB / 352C33 (N-4483) (07/2016)
Accelerometer: Dytran / 3225M23 (N-4434) (08/2016)
Shaker: LDS / V9-440 HBT 1220 C M10 RSP (N-4642.01) (N/A)
Power Amplifier: LDS / SPA176K Mk4a (N-4642.02) (N/A)
Vibration controller: LDS Dactron / LAS 200 (N-1455.02) (2012-12)

Comments
No recorded comments.

Severity

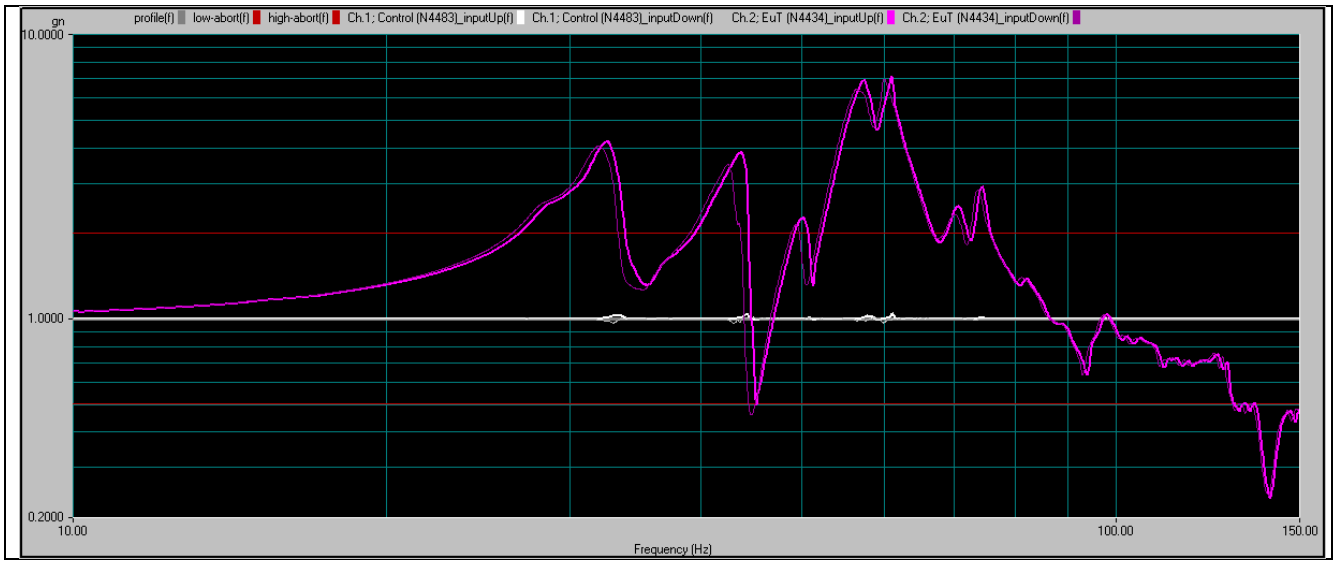
Frequency range:	10Hz – 150Hz
Amplitude:	10Hz – 150Hz : ± 1.0gn
Sweep rate:	1 octave/min
Number of axes:	3 mutually perpendicular axes
Sweep cycles:	10 (20 sweeps)
Amplification criteria:	Not spesified

Conformity

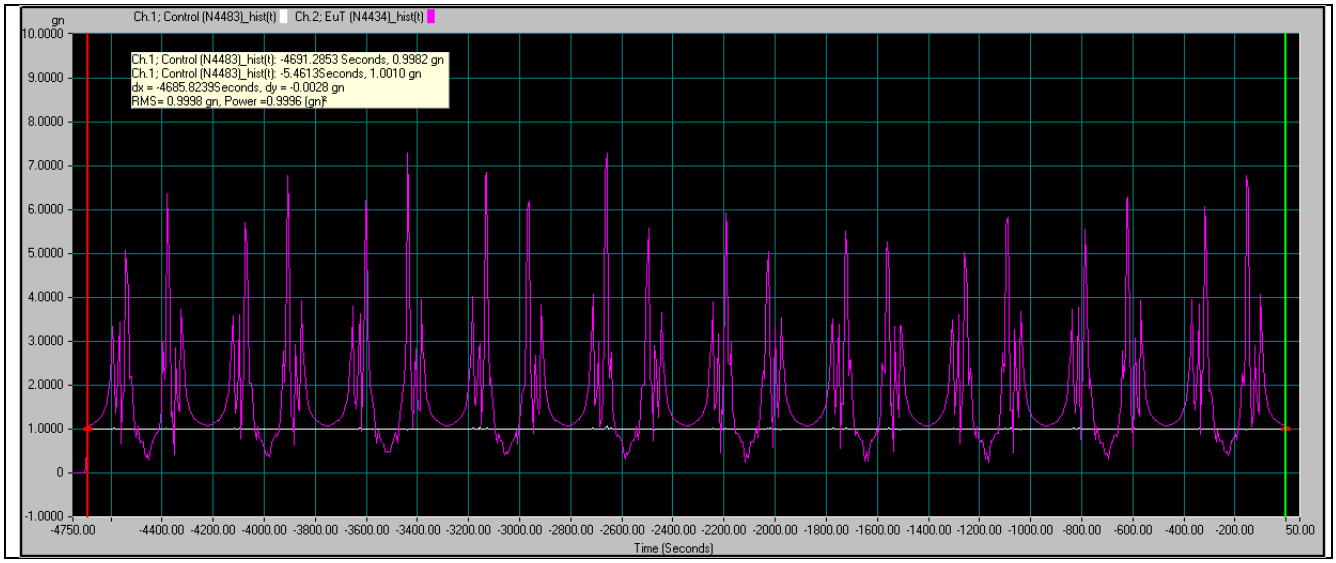
Verdict:	PASS
Test engineer:	Jarle Skogland

CONCLUSION
No operation errors or damages were detected during or after the endurance tests.

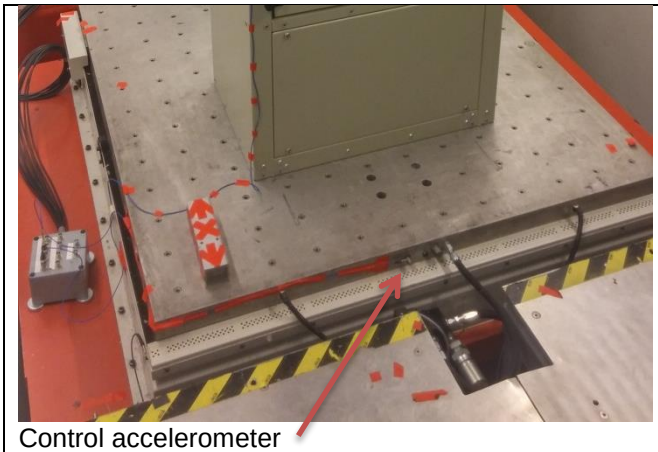
X axis



Sweep profile (last cycle)



Time log

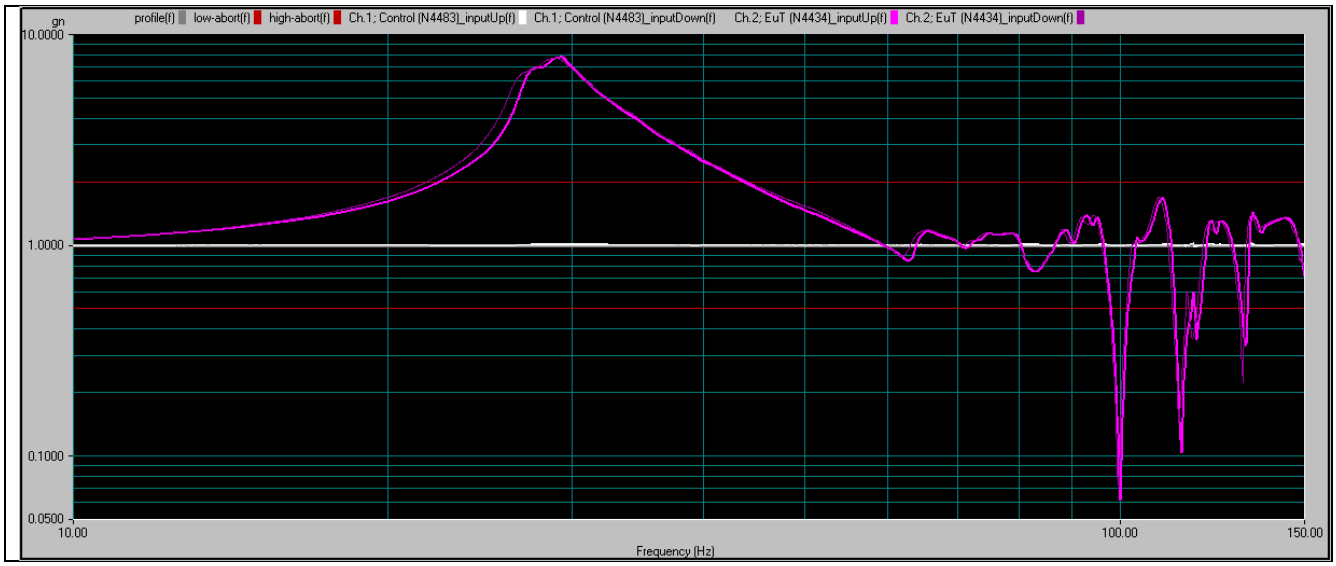


Control accelerometer

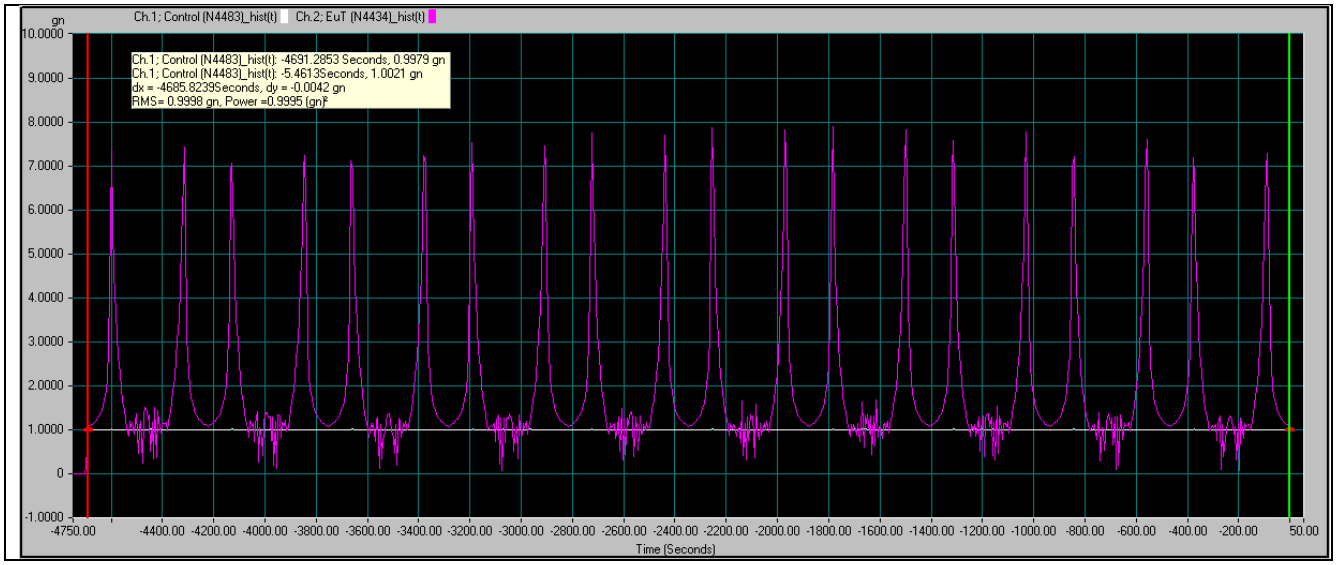
EuT accelerometer.

Accelerometer positions

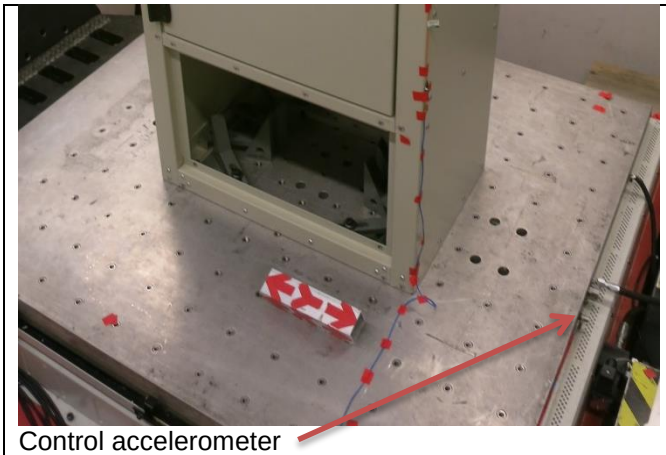
Y axis



Sweep profile (last cycle)



Time log

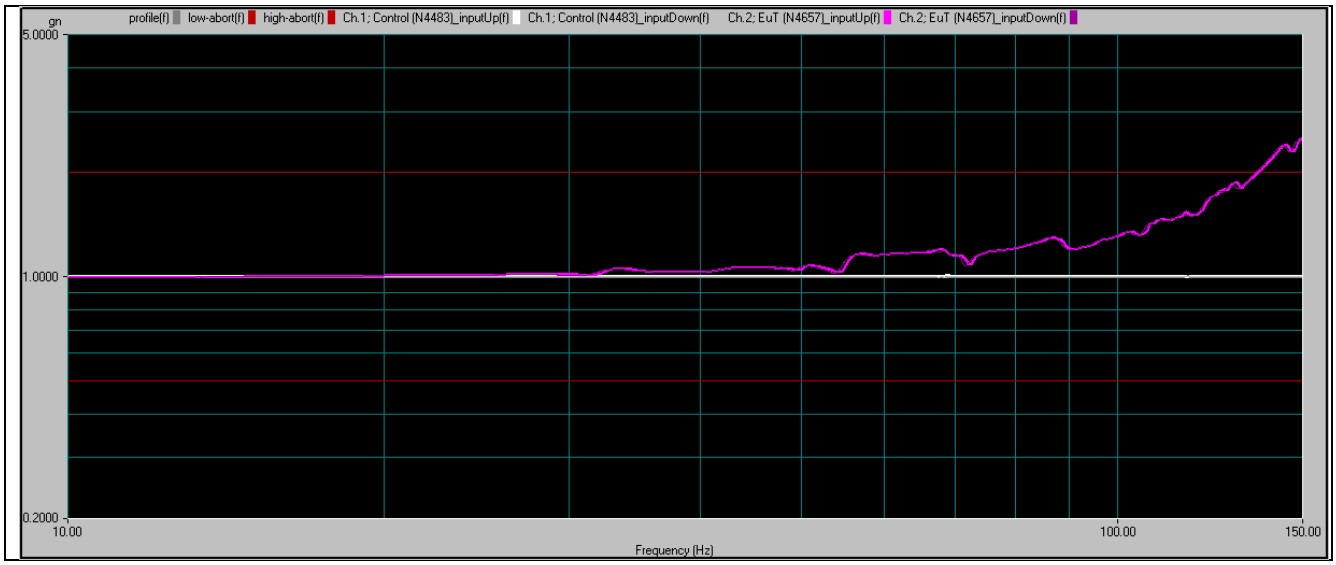


Control accelerometer

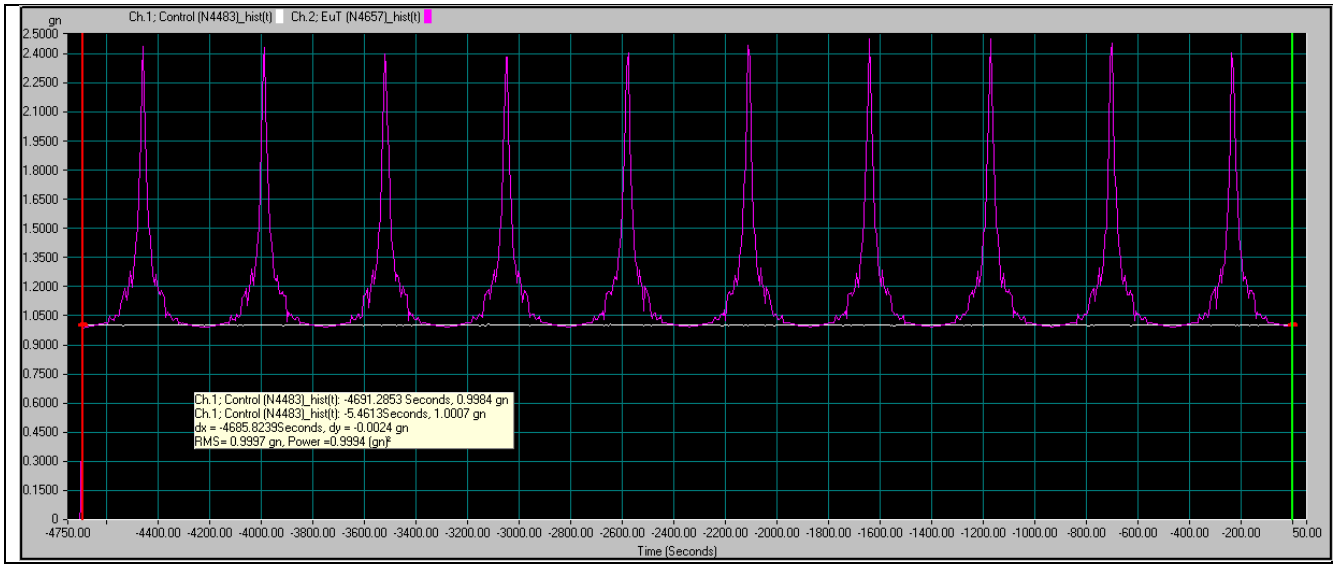
EuT accelerometer.

Accelerometer positions

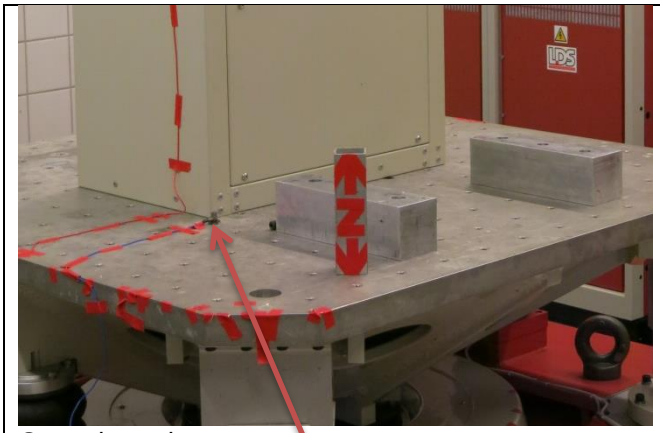
Z axis



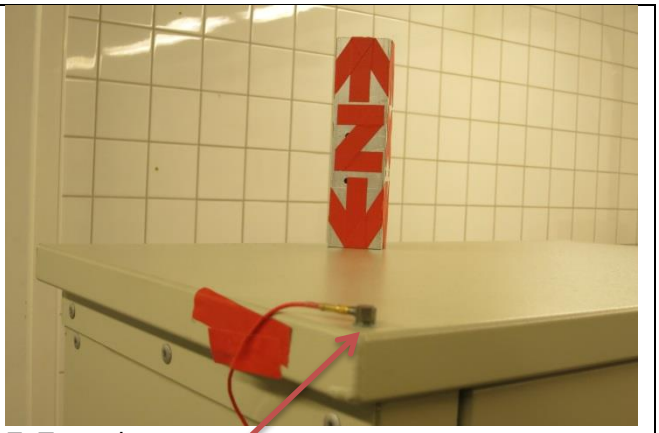
Sweep profile (last cycle)



Time log



Control accelerometer



EuT accelerometer.

Accelerometer positions

SHOCK

TEST DESCRIPTION

Method
EN 60068-2-27 (2008) Test Fc: Vibration (sinusoidal)

State of the specimens during conditioning
The specimen was mounted by its normal means of attachment in accordance with the manufacturer's instructions to a rigid fixture.

Intermediate Measurements
None, observation only.

Final measurements
After the tests a functional test was carried out.

Requirements
Performance deterioration and/or mechanical damage lead to failure of the test.

Instruments used during measurement

Instrument list:
Accelerometer: PCB / 352C33 (N4483) (07/2015)
Accelerometer: PCB / 352C33 (N4484) (07/2015)
Shaker: LDS / V9-440 HBT 1220 C M10 RSP (N-4642.01) (N/A)
Power Amplifier: LDS / SPA176K Mk4a (N-4642.02) (N/A)
Vibration controller: LDS Dactron / LAS 200 (N-1455.02) (02/2015)
Vibration controller software: 8.1.001

Comments
No recorded comments.

Severity

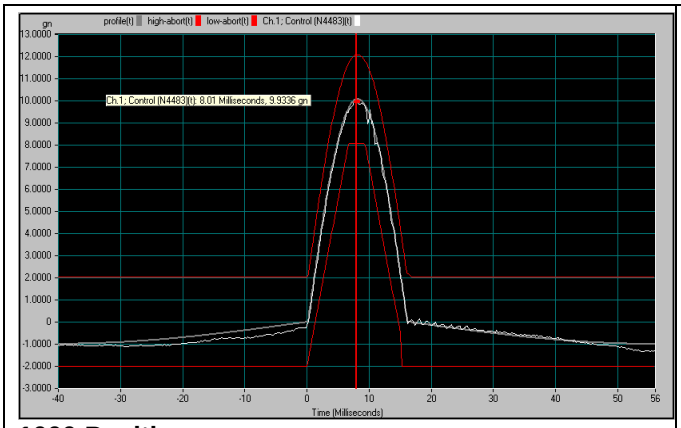
Pulse type:	Half sine
Pulse width	16ms
Amplitude:	10 g_n
Duration:	1000 positive, 1000 negative.
Number of axes:	3 mutually perpendicular axis

Conformity

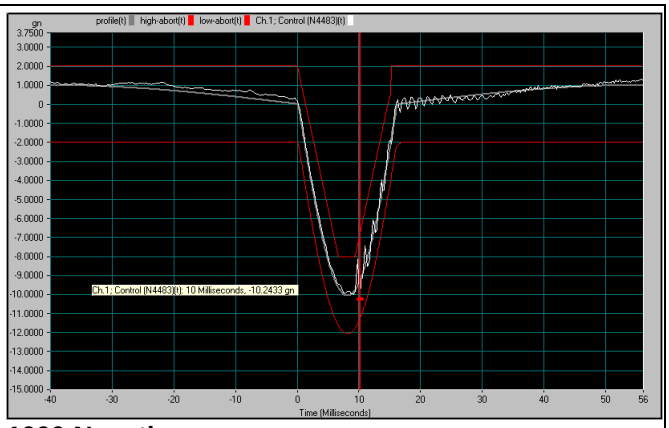
Verdict:	PASS
Test engineer:	Jarle Skogland

CONCLUSION
No operation errors or damages were detected during or after the endurance tests.

Shock in X-axis

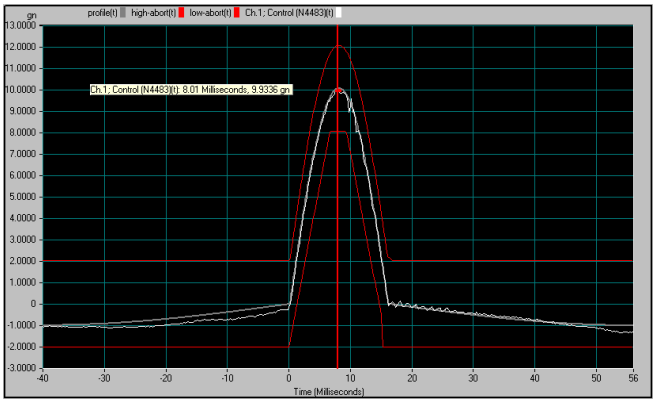


1000 Positive

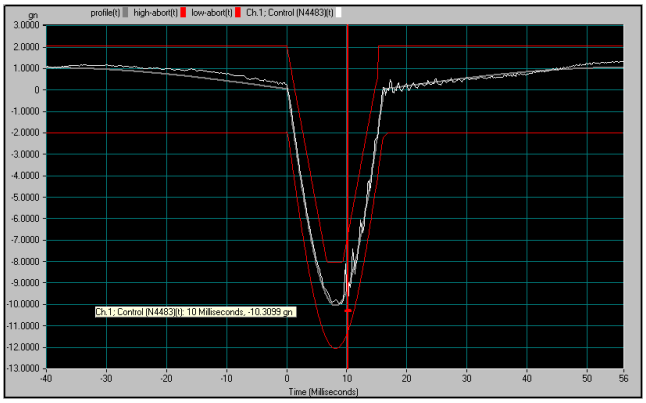


1000 Negative

Shock in Y-axis

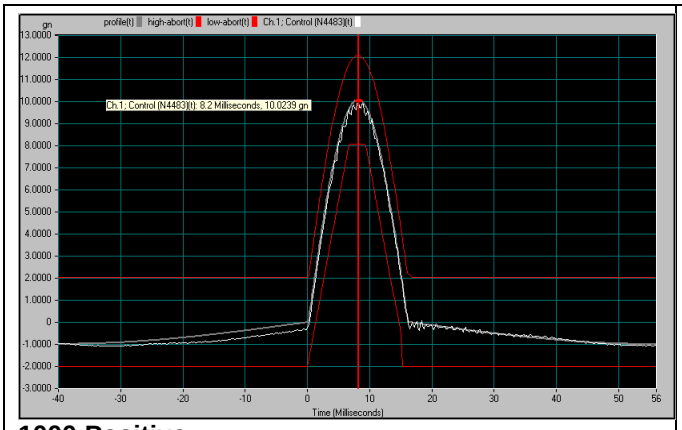


1000 Positive

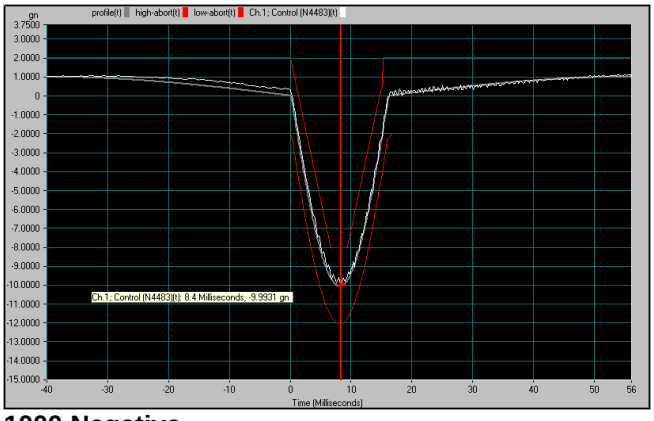


1000 Negative

Shock in Z-axis



1000 Positive



1000 Negative

INGRESS PROTECTION (IP)

TEST DESCRIPTION

Method
IEC/EN 60529 Ed.2.1 (2001) Degrees of protection provided by enclosures (IP Code)

Procedure
IP6X:

- The EUT was placed in the dust chamber and connected to a vacuum pump. The suction connection is made through a drilled hole in the enclosure.
- The depression is adjusted to 2 kPa (20mbar).
- The test time is calculated by comparing the extraction rate with the internal volume of the enclosure.

After the test the EuT were subjected to a functional test before it was inspected for ingress of talcum powder.

IPX6:

- The EUT was placed on a turntable and sprayed from all direction in minimum 3 minutes.
- The nozzle diameter was 12,5mm
- The distance from the nozzle to the EuT was 3m.
- The water flow was adjusted to 100l / min.

After the tests the EuTs were subjected to a functional test before it was inspected for ingress of water.

Instruments used during test

Instrument list:
Dust chamber, ESPEC / EDC-27 (N-4690) (10/2015)
Water jet hose nozzle 12,5mm, Artec (N-4543.04)
Flow meter, ABB (N-4012) (01/2016)
Stop watch, Sport Timer (N-4582) (07/2015)

Comments

Severity	
IP numeral:	**IP6X**
Depression	2 kPa
Test time IP6X	8h
IP numeral:	**IPX6**
Nozzle diameter IPX6	12,5mm
Distance from nozzle to EuT:	3m
Water flow IPX6	100l / min.
Test time IPX6	3 minutes and 48 seconds

Conformity	
Verdict:	PASS
Test engineer(s):	Finn Tore Jørgensen

Annexes

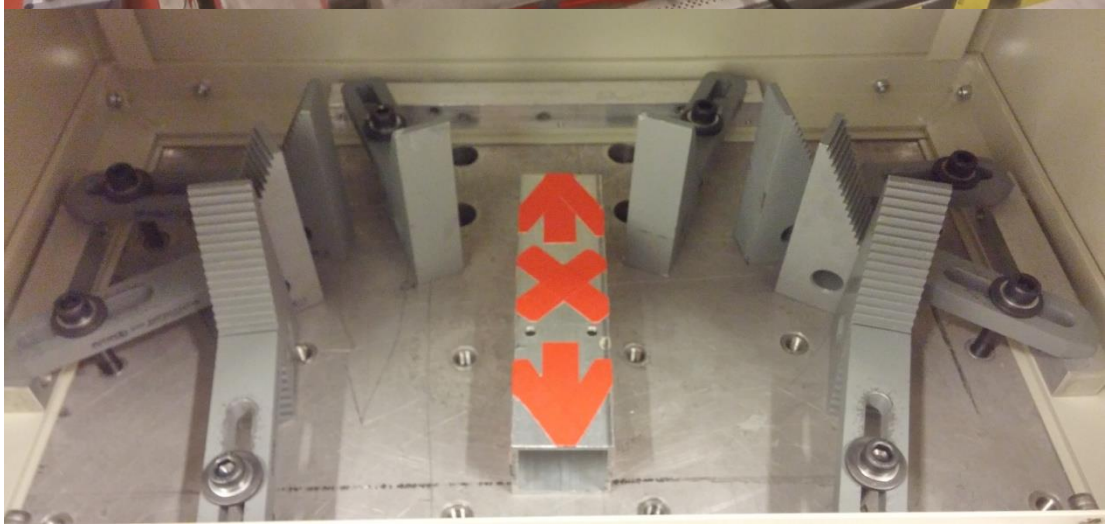
UNCERTAINTY FIGURES

Measurement	Uncertainty
Acoustic Noise	± 1 dB
Vibration	± 5.6 % (acceleration) ± 0.01% (frequency)
Temperature	± 2.5K
Humidity	± 6 %Rh
Voltage	± 1.5 %
Frequency	± 0.2 %

The instruments specified are subject to periodic calibrations and internal controls. This ensure, with a 95 percent confidence level, that the instruments remain within the calibrated levels.

PHOTOS

Notes: Test set-up for Climatic tests



Notes: Test set-up for Vibration tets in X axis

Notes: Test set-up for Vibration tets in Y axis

Notes: Test set-up for Vibration tets Z axis

Notes: Test set-up for Salt Mist test

Notes: Test set-up for Ingress Protection (IP) tests