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# DELTA Test Report



TEST Reg. no. 19

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## Combined vibration and temperature test of CX4 Antennas

### Performed for AC Marine A/S

DANAK-19/14553 Revision B

Project no.: T209198

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including 1 annex

10 October 2014

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<b>Title</b>	Combined vibration and temperature test of CX4 Antennas
<b>Test objects</b>	2 pcs. CX4 Antennas Detailed information is given in Section 2. The test objects were received 5 September 2014.
<b>Report no.</b>	DANAK-19/14553 Revision B
<b>Project no.</b>	T209198
<b>Test period</b>	5 September 2014
<b>Client</b>	AC Marine A/S Pilehøj Vænge 8E 3460 Birkerød Denmark Tel.: +45 45 81 04 13
<b>Contact person</b>	Mr Christian Bøhme E-mail: chb@acmarine.dk
<b>Manufacturer</b>	AC Marine A/S
<b>Specifications</b>	IEC 60945: Fourth edition, 2002 “Maritime navigation and radio communication equipment and systems - General requirements - Methods of testing and required test results.” IEC 60945: Fourth edition, CORRIGENDUM 1, 2008 IEC 60068-2-53:2010, Test and guidance: Combined climatic (temperature/humidity) and dynamic (vibration/shock) tests
<b>Results</b>	No malfunctions were detected.
<b>Test personnel</b>	Olling Truelsen Dan Hansen

**Date** 10 October 2014

**Responsible**



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DELTA

This test report replaces previously issued test report DANAK-19/14553 Rev. A dated 8 October 2014. The changes in this report are:

- IEC 60068-2 updated to correct version throughout the test report.
- Page 8: Place of measurements of accelerometers corrected.
- Page 10: Curves corrected.

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## 1. Summary of test

### 1.1 Test requirements

The following tests were carried out as agreed with the client, in the Z-axis only. The antennas were mounted in a 45° angle, due to the limitations of the dimensions inside the climatic chamber and in order for the antennas to see more rough conditions than normal mounting when considering vertical vibration.

<b>Test</b>	<b>Test method</b>
Vibration - Resonance search	IEC 60068-2-6:2007
Vibration - Combined cold / vibration	IEC 60068-2-53:2010



## 2. Test objects

### 2.1 Test objects

#### Test object 2.1.1

Name of test object	Antenna 1
Model / type	CX4
Part no.	101-2001.00
Serial no.	S/N: 0001
Manufacturer	AC Marine
Supply voltage	N/A
Comments	Worst case tolerances

#### Test object 2.1.2

Name of test object	Antenna 2
Model / type	CX4
Part no.	101-2001.01
Serial no.	20140817S0213
Manufacturer	AC Marine
Supply voltage	N/A
Comments	Std. production model



Photo 1 Test objects – Antenna 1 to the left. Antenna 2 to the right.



### 3. General test conditions

#### 3.1 Functional test

A functional test was performed before and after the test. The functional test was carried out by the client.

#### 3.2 Standard environment

Normal environmental condition:

Temperature	:	15 °C - 35 °C
Humidity	:	25 %RH - 75 %RH
Air pressure	:	86 kPa - 106 kPa (860 mbar - 1060 mbar)
Power supply voltage	:	$U_{nom.} \pm 3 \%$



## 4. Test and results

### 4.1 Vibration - Resonance search

#### Specifications

IEC 60945, clause 8.7.

#### Test method

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

#### Severity and procedure

Frequency range	:	2 - 100 Hz	
Frequency / amplitude	:	2 - 13.2 Hz	: ±1 mm
		13.2 - 100 Hz	: ±0.7 g
Sweep rate	:	Max. 0.5 octave/min.	
Number of axes	:	1	

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.

#### Results

Only Z-axis exposure was performed as agreed with the client.

The table below shows the result of the resonance search.

Place of measurement	Axis	Frequency [Hz]	Amplification factor [Q]
Antenna 1	Z	11	37
		49	36
Antenna 2	Z	11	23
		42	4
		53	11

Measurement curves of the maximum amplification factors and resonance frequencies and definition of axes are enclosed below.



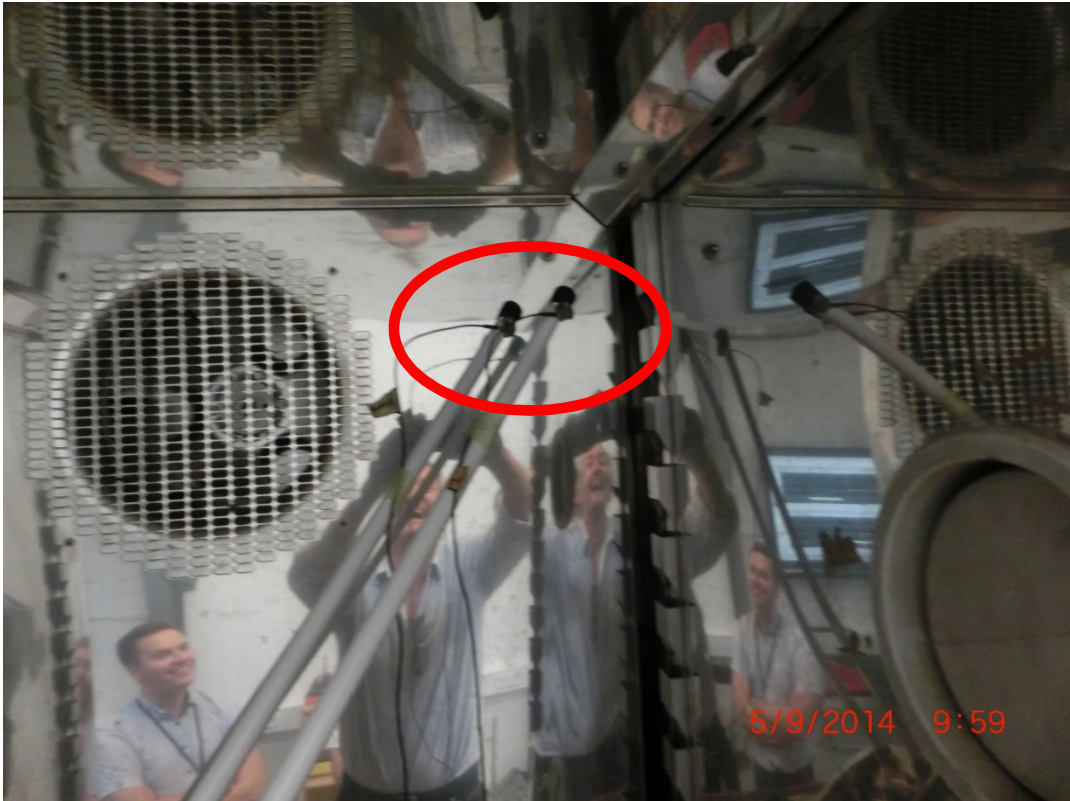


Photo 2 Vibration, resonance search, mounting of accelerometer.

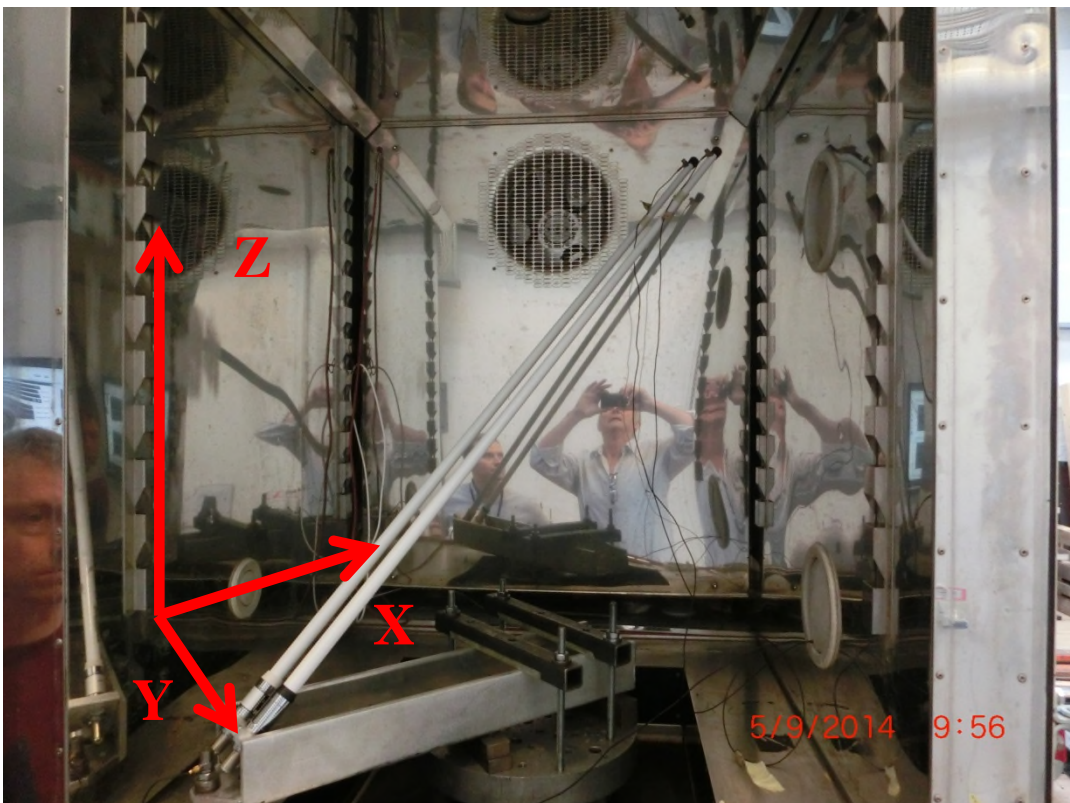
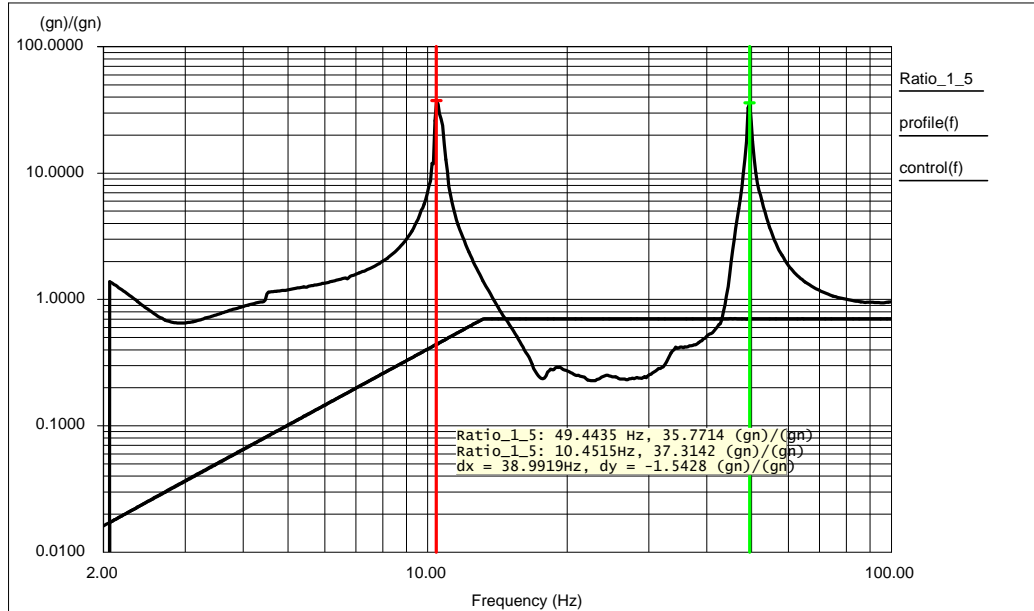
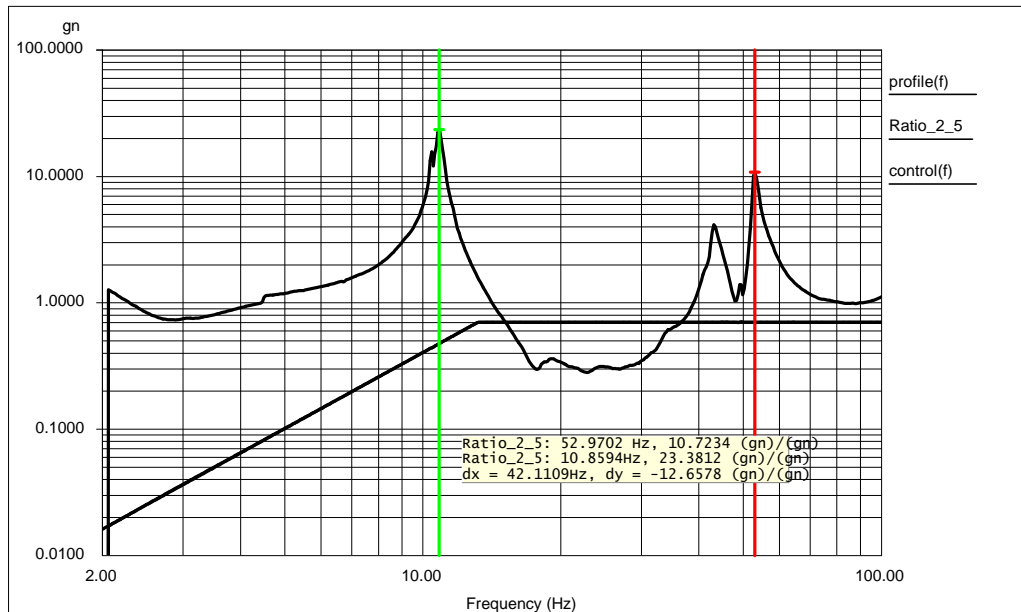


Photo 3 Vibration, resonance search, definition of axes.





Curve 1 Resonance search, Z-axis Antenna 1.



Curve 2 Resonance search, Z-axis - Antenna 2.



## 4.2 Vibration - Endurance sinusoidal at -55 °C

### Specification

IEC 60945, clause 8.7.

### Test method

IEC 60068-2-53:2010, Test and guidance: Combined climatic (temperature/humidity) and dynamic (vibration/shock) tests

### Severity and procedure

Frequency range	:	2 - 100 Hz
Frequency / amplitude	:	2 - 13.2 Hz : ±1 mm
		13.2 - 100 Hz : ±0.7 g
Procedure	:	Dwell on found resonances.
Dwell conditions	:	Q ≥ 5 : 120 minutes at each resonance frequency
		Q < 5 : 120 minutes 30 Hz
Number of axes	:	3 mutually perpendicular
Temperature	:	-55 °C

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

The test objects are de-energised during the entire exposure.

### Results

Only Z-axis exposure was performed on fundamental frequency as agreed with the client.

Based on the results from the resonance search, the following endurance conditions were performed:

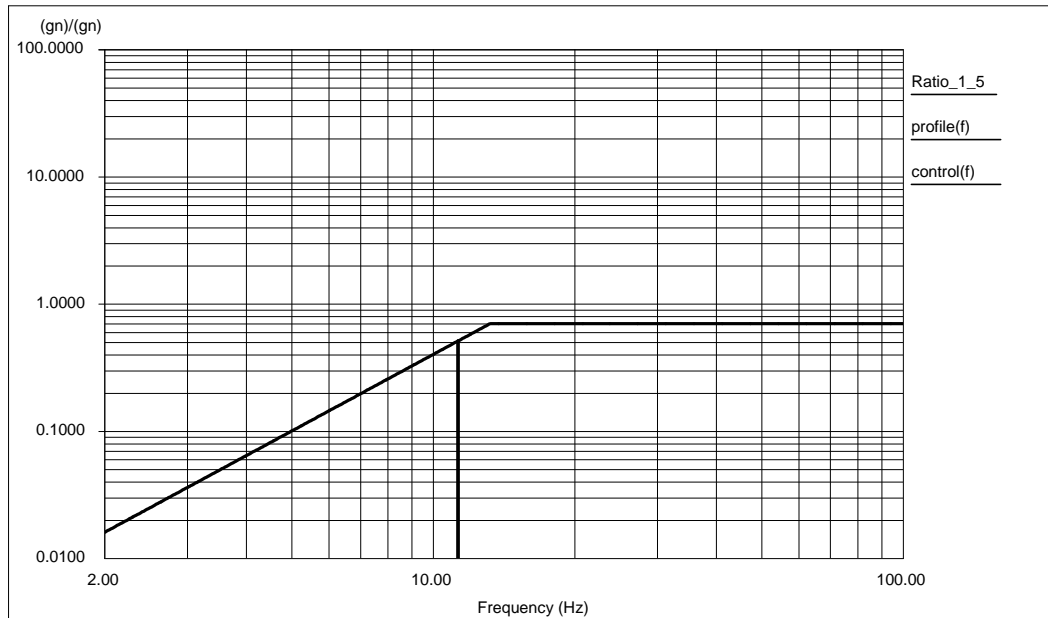
Axis	Frequency	Duration
Z	11 Hz	120 Min

No malfunction was observed during the exposure and the function of the test objects was OK after the endurance exposure according to the client.

Exposure curves and definition of axes are enclosed below.

No damage was observed at the visual inspection performed after the exposures.





Curve 3 Endurance vibration, Z-axis.

**Annex 1**  
**List of instruments**



## List of instruments

NO.	DESCRIPTION	MANUFACTURER	TYPE NO.
EVFGT-50	EL.DYN SHAKER	LING DYNAMICS	V875-440 LS
96 / 1019464	ACCELEROMETER	BRÜEL & KJÆR	4371
71a / 2035921	ACCELEROMETER	BRÜEL & KJÆR	4393
73 / 1823239	ACCELEROMETER	BRÜEL & KJÆR	4393
22575	ACC. PRE-AMP.	BRÜEL & KJÆR	2626
22630	ACC. PRE-AMP. 4-CHAN.	BRÜEL & KJÆR	2692
43236	VIBR. CONTROLLER	LDS DACTRON	LAS 200
EVFGT-17	CLIMATIC CHAMBER VKV600	WEISS TECHNIK	WT 11-600