Environmental and material tests (ENV) SECTOR

Product description:	Electromagnetic device (ESA) to be installed on vehicles for fuel saving, reduction of emission and increasing of engine power
Tested Models:	EQOPET

Test specification:	ISO 16750-3:2007
Application:	On customer request only the test listed in § 5
Remarks:	None

Applicant:	**iO-ENERGIES AG** Littauerboden, 1 - 6014 - Luzern - Switzerland		
Customer:	Same as Applicant		
Manufacturer:	Same as Applicant		
Purchase Order:	Email	**dated:**	2015-07-09
Order Confirmation:	CO 2015-0241-00	**dated:**	2015-07-10

Samples receiving date:	2015-07-30			
Tests date:	**from:**	2015-08-03	**to:**	2015-08-07

Test Laboratory **INTEK S.p.A. - Test and Measurement Division** Via Mazzini, 75 - 25086 Rezzato (BS) - Italy Tel. +39 030 2591857 Fax +39 030 2594351 url: http://www.intek.it e-mail: info@intek.it	**Test site** **INTEK S.p.A. - Test and Measurement Division** Via Breve - 25086 Rezzato (BS) - Italy **Test site for subcontracted tests** **Lab. Qualilab S.r.l.** Via Trento, 87, Capriano del Colle BS

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Rev.	*Date*	*Description*
00	2015-08-31	Formal issue

INDEX

1. PURPOSE....3
2. APPLICABLE DOCUMENTS....3
2.1 OTHERS DOCUMENTS....3
3. TEST SAMPLE IDENTIFICATION....4
3.1 DESCRIPTION....4
3.2 SAMPLES ORIGIN....5
4. TEST INFORMATIONS....6
4.1 CONDITIONS DURING THE TESTS....6
4.2 CONFIGURATION....6
4.3 CRITERIA ADOPTED FOR COMPLIANCE EVALUATION....7
5. TEST RESULTS....8
5.1 SAMPLES CORRELATION / TEST SEQUENCE....8
5.2 TEST METHOD DEVIATIONS....8
6. TESTS PERFORMED....9
6.1 VIBRATION - TEST VII - COMMERCIAL VEHICLE, SPRUNG MASSES - ISO 16750-3 § 4.1.2.7....9
7. TEST INSTRUMENTATION....12
7.1 INSTRUMENTATION ACCURACY....12
8. EUT DOCUMENTATION....12
9. ANNEXES LIST....12

1. PURPOSE

Purpose of this document is to contain results of the tests performed to verify correspondence of test samples, as identified and described in paragraph 3, to requirements of standards listed in paragraph 2.

2. APPLICABLE DOCUMENTS

On customer request, the tests have been performed in compliance with the standards listed below:

Standard	Title
ISO 16750-3:2007	Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 3: Mechanical loads
ISO 16750-1:2006	Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 3: General

Afterwards, the “applicable documents”, will be indicated without date and/or edition number and/or amendments.

2.1 OTHERS DOCUMENTS

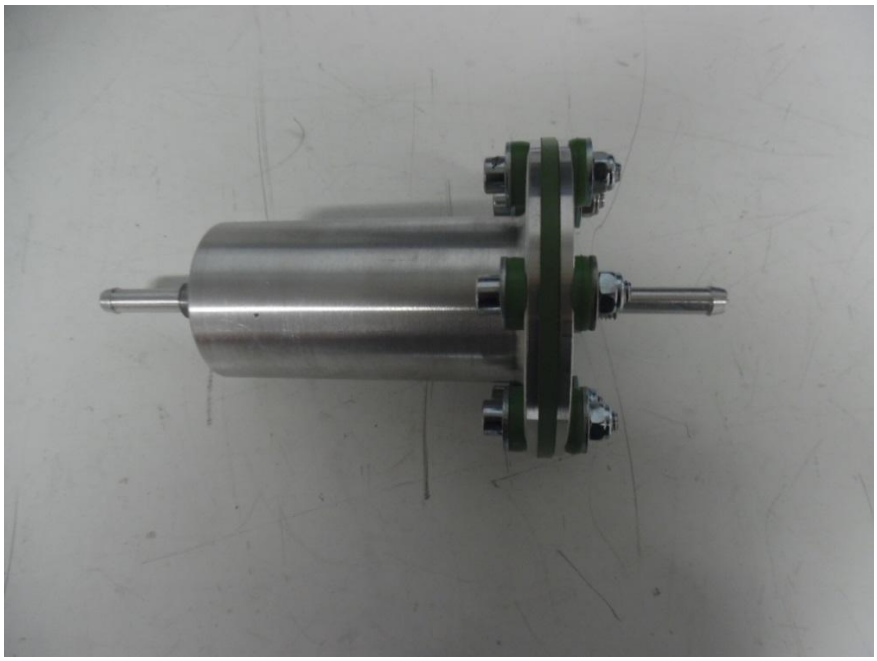
Document	Date	Rev.	Title
/	/	/	/

3. TEST SAMPLE IDENTIFICATION

Unless otherwise specified, the technical data stated in this paragraph are declared by the manufacturer or obtained from the product technical documentation.

3.1 DESCRIPTION

Identification data of test samples are reported in the first page of this document.



Sample identification

Marking plate / markings

Manufacturing plant address:	Same as manufacturer
Type of unit:	☒ Prototype / Pre-series ☐ Series
Serial number:	Not present
HW revision:	Not declared
SW/FW revision:	Not applicable

3.1.1 TECHNICAL DATA

Power supply nominal voltage:	12 Vdc
Rated frequency:	/
Rated power / current:	/
Extreme environmental ranges:	-40°C …+90 °C
Dimensions:	/
Other:	/

3.1.2 CLASSIFICATION

Degree of enclosure protection:	/
Other:	/

3.1.3 ADDITIONAL INFORMATION

None

3.2 SAMPLES ORIGIN

The test samples are supplied by:			
☐ **Manufacturer**	☒ **Customer**	☐ **Applicant**	☐ _____
The beginning sampling is carried out by:			
☐ **Manufacturer**	☒ **Customer**	☐ **Applicant**	☐ _____

Received samples:	2	**Tested samples:**	1
Selection method of the laboratory:	☒ **Random taking**	☐ **N/A**	

4. TEST INFORMATIONS

4.1 CONDITIONS DURING THE TESTS

4.1.1 PERSONNEL PRESENT TO THE TESTS

Test performed by: ***Carsten Seyring (Qualilab S.r.l.)***

Other people present: ***Marco Zanfabro (ABC S.p.A.)***

4.1.2 MODIFICATIONS TO SAMPLES

Test samples were not modified during the tests.

4.1.3 ENVIRONMENTAL CONDITIONS

Test site environmental conditions are recorded during tests and they are shown on relevant paragraphs.
The measurement uncertainties are given with expanded uncertainty with a level of confidence of 95 % (k = 2).

4.1.4 CONVENTIONS

If applicable, on the right of each chapter or paragraph is written the number of the chapter or paragraph of reference Standard in the form: § number.

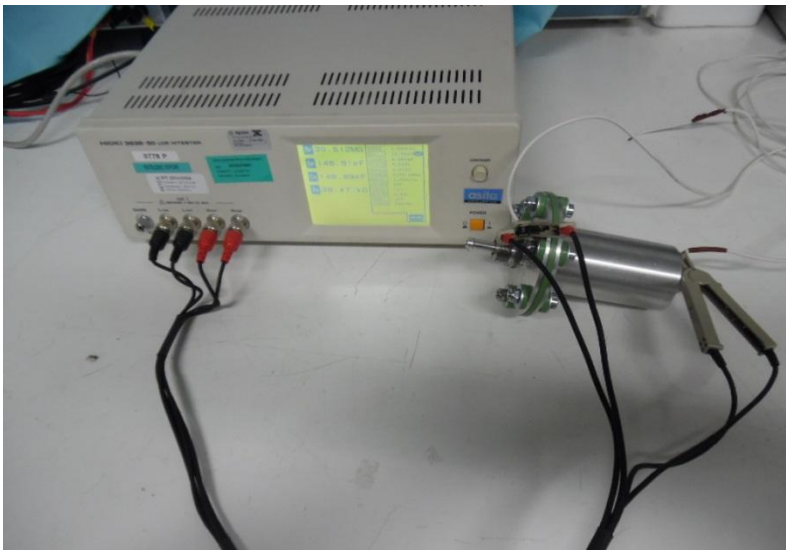
4.1.5 ABBREVIATIONS

N/A = Not Applicable
N/D = Not Declared
N/R = Not Required by the customer
F = Fail
P = Pass
TR = Test Report
EUT = Equipment Under Test
NCR = No Calibration Required
U_{LAB} = Laboratory Measurement Uncertainty

4.2 CONFIGURATION

During the tests the sample was configured following the methods and the procedures specified in the reference documents.

Before and at the end of the test, on the component without any fluid, the capacitance is measured by means of a LCR meter, as shown in fig. below:



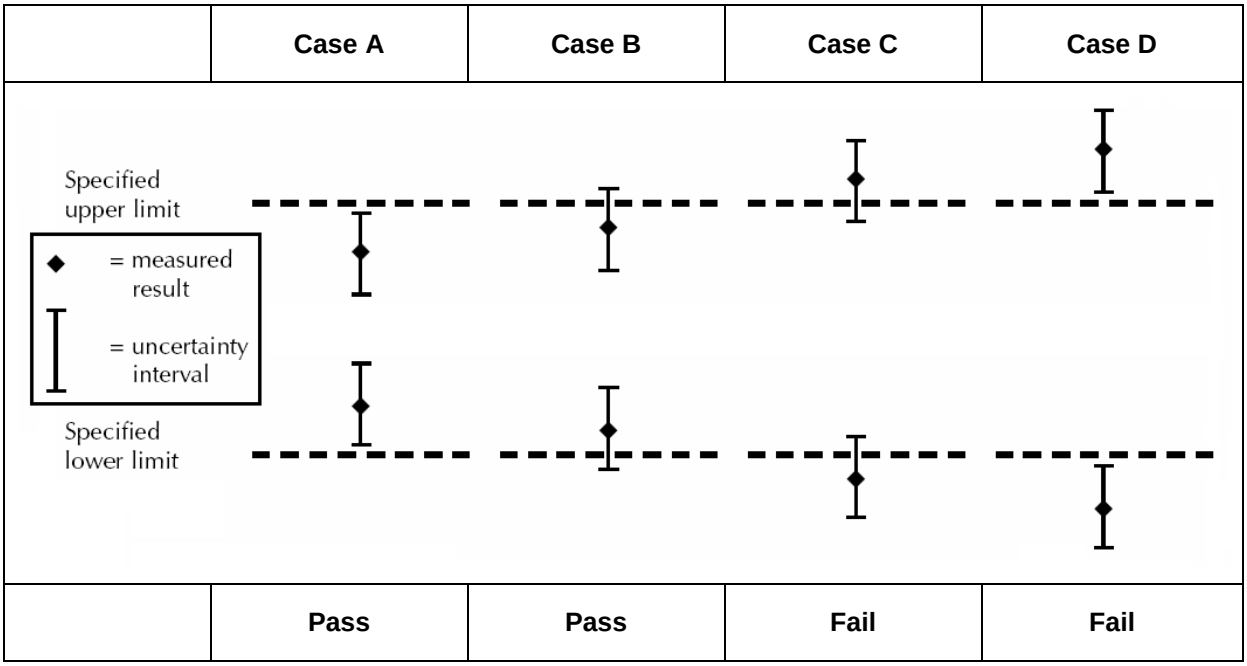
4.3 CRITERIA ADOPTED FOR COMPLIANCE EVALUATION

If applicable for compliance evaluation of test results, the Laboratory adopts the following criteria:

- Reference standard specifies uncertainty for measurements:
  - measurements uncertainty permitted;
  - instruments accuracy;
  - application of measurements uncertainty to the measured values;

  in this case the measurement complies with the requirement if the measured value is within the limits, or with the correction due to the Laboratory uncertainty.

- Reference standard doesn't specify uncertainty for measurements:
  Calculate uncertainty for measurement and compare the measured result with uncertainty band to defined acceptable limit. The measurement complies with the requirement if the probability it being within the limit is at least 50 % (see following figure):



5. TEST RESULTS

Ref. § TR	Test / Verification	§ Standard ISO 16750-3	Result (ref. § 4.3)	Notes
6.1	Vibration - Test VII - Commercial vehicle, sprung masses	§ 4.1.2.7	***N/A***	***/***

Notes: /

5.1 SAMPLES CORRELATION / TEST SEQUENCE

The samples were sequentially subjected to the tests described in the following paragraphs.

5.2 TEST METHOD DEVIATIONS

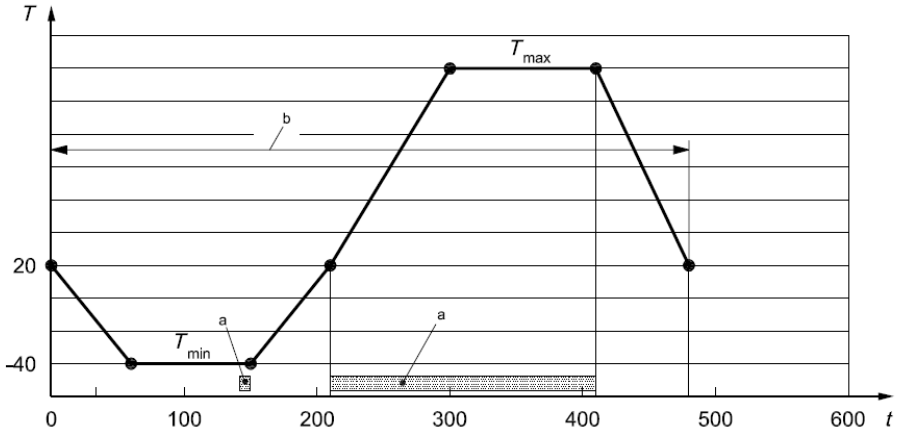
Test methods described in the reference document were adopted without any deviation.

6. TESTS PERFORMED

6.1 VIBRATION - TEST VII - COMMERCIAL VEHICLE, SPRUNG MASSES - ISO 16750-3 § 4.1.2.7

6.1.1 DESCRIPTION

The test was performed in conformity to § 4.1.2.7 of the ISO 16750-3 standard reference.
The vibration test methods specified consider various levels of vibration severities applicable to on-board electrical and electronic equipment. It is recommended that vehicle manufacturer and supplier choose the test method, the environmental temperature and vibration parameters depending on the specific mounting location.
The specified values apply to direct mounting in defined mounting locations. The use of a bracket for mounting can result in higher or lower loads. If the device under test (DUT) is used in the vehicle with a bracket, then all vibration and mechanical shock testing shall be done with this bracket.
Carry out the vibration test with the DUT suitably mounted on a vibration table. The mounting method(s) used shall be noted in the test report. Carry out the frequency variation by logarithmic sweeping of 0,5 octave/minute for sinusoidal tests and the sinusoidal part of sine on random tests. The objective of the recommended vibration tests is to avoid malfunctions and breakage mainly due to fatigue in the field. Testing for wear has special requirements and is not covered in this part of ISO 16750.
Loads outside the designated test frequency ranges shall be considered separately.
Application of the weighted average control method in accordance with IEC 60068-2-64 shall be agreed upon.
Subject the DUT during the vibration test to the temperature cycle in accordance with IEC 60068-2-14, with electric operation in accordance with Figure 1. Alternatively, a test at constant temperature may be agreed between customer and supplier.
Operate the DUT electrically as indicated in Figure 1 at T_{min} (short functional test after the DUT has reached T_{min} completely). This functional test shall be as short as possible, i.e. only long enough to check the proper performance of the DUT. This minimizes self-heating of the DUT. Additional electrical operation of the DUT takes place between 210 min and 410 min of the cycle (see Figure 1).
Additional drying of test chamber air is not permitted.
Because in the vehicle vibration stress can occur together with extremely low or high temperatures, this interaction between mechanical and temperature stress is simulated in the test, too. The failure mechanism is, for example, a plastic part of a system/component that mellows due to the high temperature and cannot withstand the acceleration under this condition.



Key

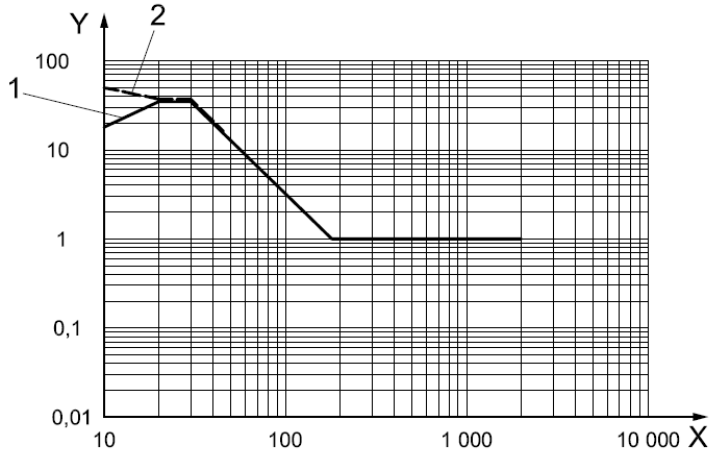
T temperature, °C
t time, min
a Operating mode 3.2 in accordance with ISO 16750-1.
b One cycle.

Figure 1 — Temperature profile for the vibration test

Temperature versus time for the vibration test

Duration [min]	Temperature °C
0	20
60	-40
150	-40
210	20
300	Tmax (90)
410	Tmax (90)
480	20

This test checks the DUT for malfunctions and breakage caused by vibration.
Vibration on sprung masses is random vibration induced by rough-road driving. The main failure to be identified by this test is breakage due to fatigue.
Perform the test in accordance with IEC 60068-2-64, random vibration, using a test duration of 32 h for each plane of the DUT.
The PSD versus frequency is illustrated to in Figure 11 and Tables 12 and 13.



Key
X frequency, Hz
Y power spectral density, $(m/s^2)^2/Hz$
1 standard random test profile
2 additional profile in case of $f_n < 30$ Hz

Values for PSD and frequency

Frequency [Hz]	PSD $[(m/s^2)^2/Hz$
10	18
20	36
30	36
180	1
2000	1

Acceptance criteria:
Breakage shall not occur.
As defined in ISO 16750-1, functional status class A is required during operating mode 3.2, and functional status class C during periods with other operating modes.
Moreover, before and at the end of the test, the capacitance is measured, as shown in § 4.2 of this test report, and, at the end of the test of any axis, the residual voltage is measured between supply terminals.

6.1.2 ENVIRONMENTAL CONDITIONS OF THE TEST SITE

Temperature: 23 °C ± 2 °C Relative Humidity: 50 % ± 5 % Atm. pressure.: 1010 mbar ± 20 mbar

6.1.3 SUMMARY OF RESULTS

Annex N.	Fig. N.	Sample N.	Description	Result	Notes
01	1…6	1	At the end of the test there are no visible damage on the sample. See below for the measured values.	***N/A***	***/***

Notes: ***/***

Capacitance measured before the test: 173,71 pF;
Capacitance measured at the end of the test: 174,12 pF;
Voltage measured between supply terminal after vibration on longitudinal axis: 612 mV
Voltage measured between supply terminal after vibration on vertical axis: 631 mV
Voltage measured between supply terminal after vibration on transversal axis: 629 mV

6.1.4 MEASUREMENT UNCERTAINTY

Measurements uncertainties:

Measure	Uncertainty U
Feedback accelerometer	2,2 %
Sample accelerometer	0,97 %
Impedance	0,1 %
Voltage	1 %

Values of expanded uncertainty are given with a level of confidence of 95 % (k = 2).

7. TEST INSTRUMENTATION

Ref. § TR	Description	Manufacturer	Model	Intek ID	Last Calibration	Calibration due
6.1	LCR meter	Hioki	3532-50	0778 P	2013-09	2015-09
6.1	DC Power supply	E.S. ROLAND	PST-3010	0743 N	NCR	NCR
6.1	DC Power supply	JO power	ALP-3005M	1069 N	NCR	NCR
6.1	Digital multimeter	Fluke	87III	0417 P	2015-05	2016-05

Ref. § TR	Description	Manufacturer	Model	Qualilab ID	Last Calibration	Calibration due
6.1	Vibration bench	LDS	V830-335	QL-IN-028	NCR	NCR
6.1	Accelerometer	DYTRAN	3055B2	QL-IN-030	2015-03	2017-03

7.1 INSTRUMENTATION ACCURACY

If reference standard doesn't specify otherwise, accuracy of used instrumentation for the tests is in accordance to the limits indicated in the IEC document - CTL Decision Sheet DSH251B 2009 Developed by WG4-WG1 "Measurements accuracy".

8. EUT DOCUMENTATION

Not available.

If the complete product documentation isn't available, there is no guarantee about reproducibility in future of the results of the tests performed.

9. ANNEXES LIST

Annex N.	Description
01	Photographs and graphics of the test.

End of test report.

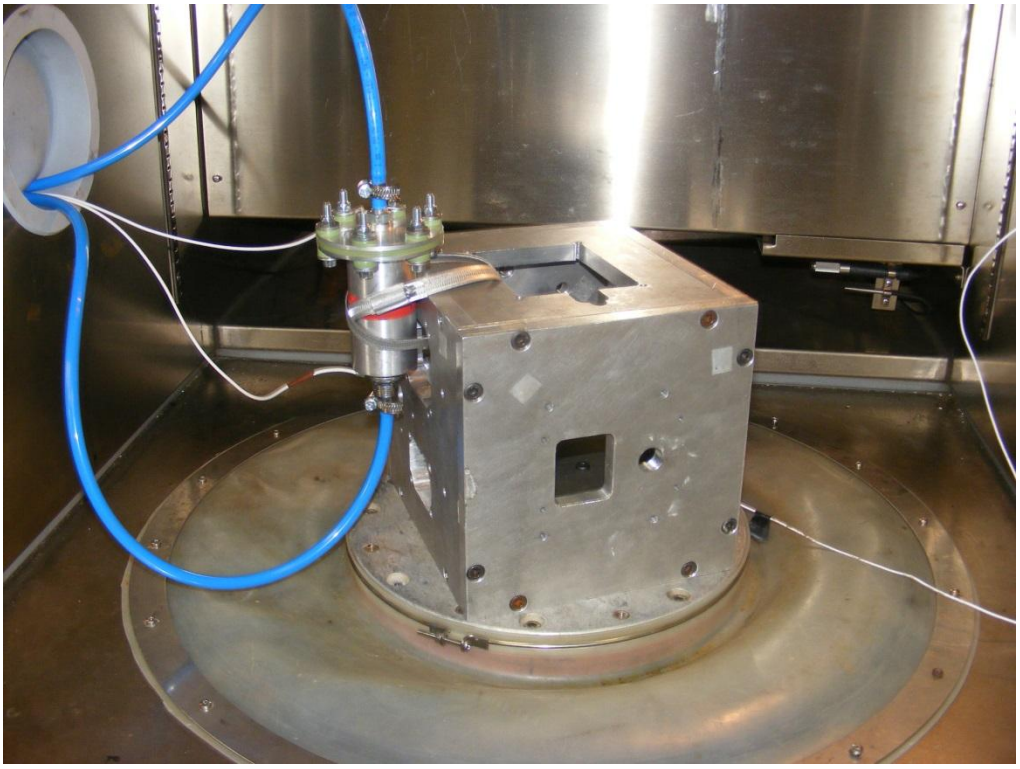


Fig. 1. - Test set-up for vibration test on longitudinal axis

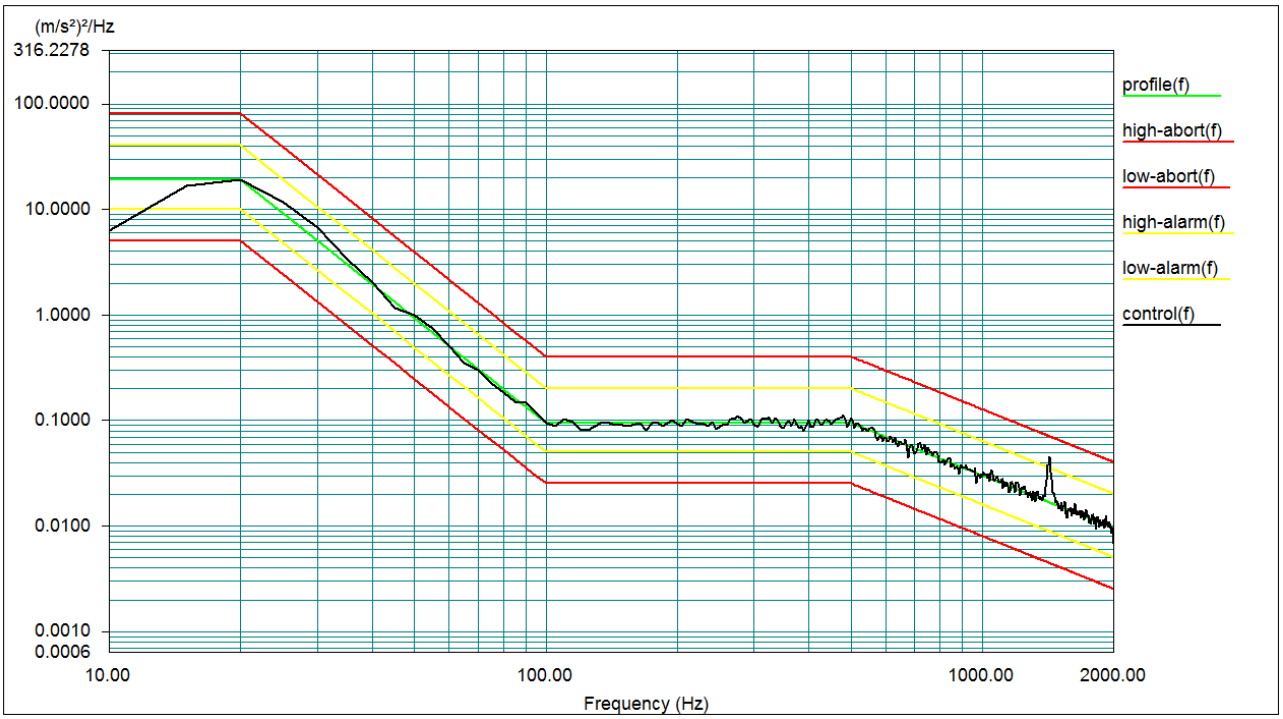


Fig. 2. - Test graphic for vibration test on longitudinal axis

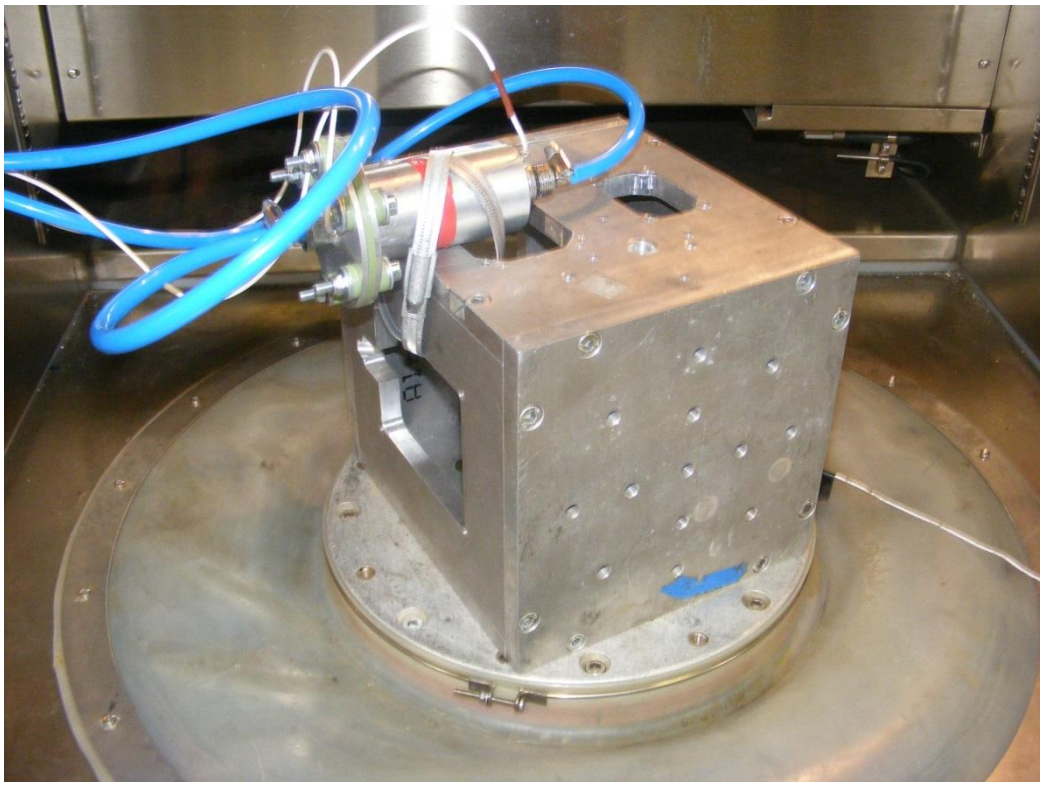


Fig. 3. - Test set-up for vibration test on vertical axis

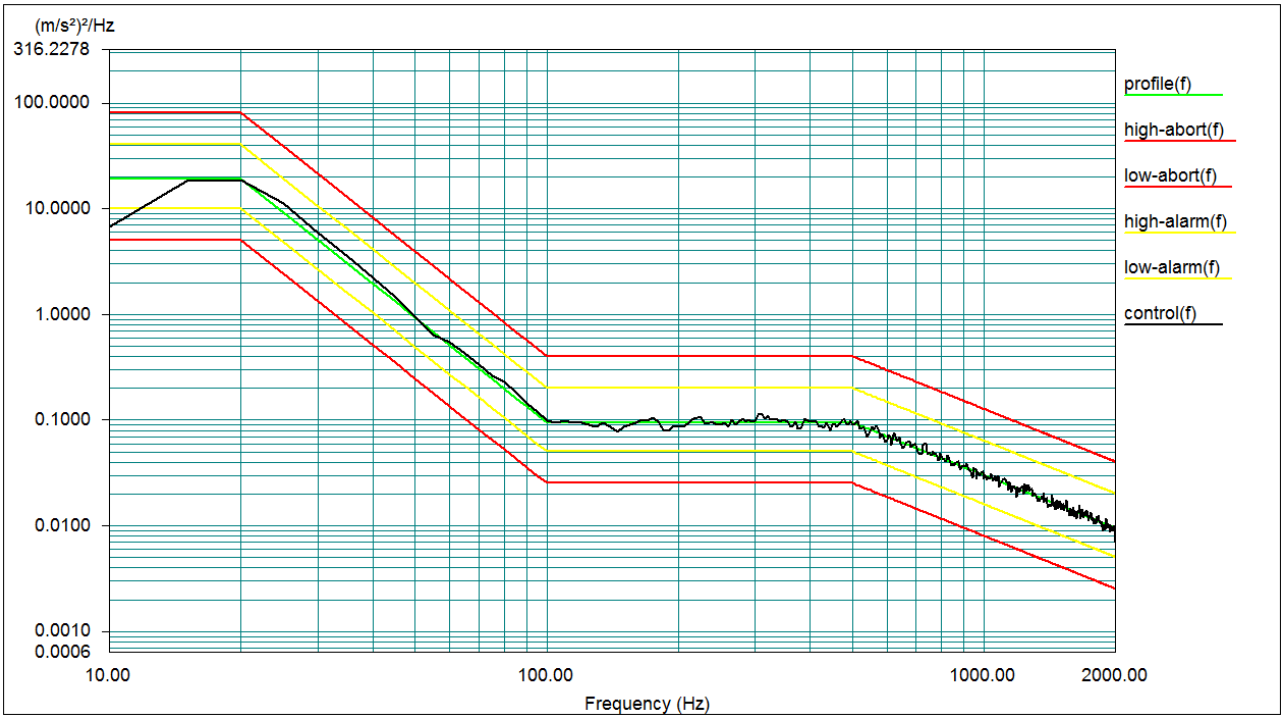


Fig. 4. - Test graphic for vibration test on vertical axis

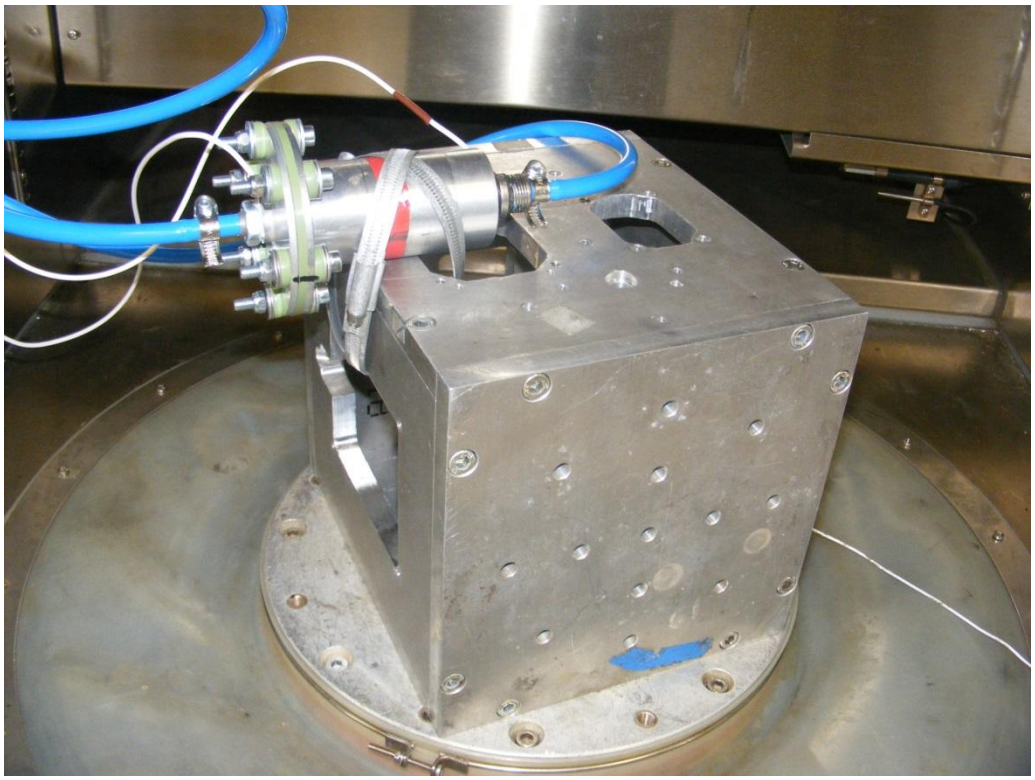


Fig. 5. - Test set-up for vibration test on transversal axis

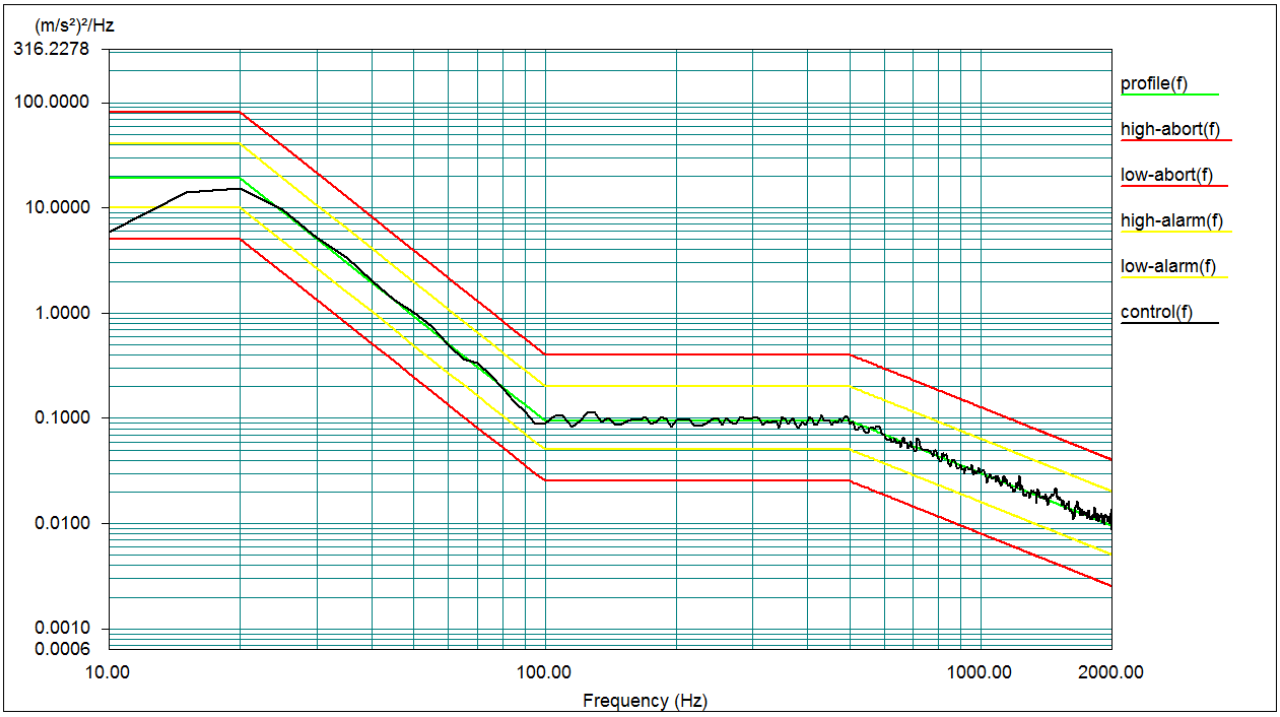


Fig. 6. - Test graphic for vibration test on transversal axis