MECHANICAL TESTS ON
A OFP BASE PENETRATOR

Tests performed in August 2019

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<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
<th>Visa</th>
</tr>
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<tbody>
<tr>
<td>Written by</td>
<td>F. LABESSEDE</td>
<td>Operator</td>
</tr>
<tr>
<td>Approved by</td>
<td>A. CUCHET</td>
<td>Manager</td>
</tr>
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1. **ADMINISTRATIVE INFORMATIONS**

1.1. **ORDER GIVEN BY**
CPPM  
163, Avenue de Luminy – Case 902 -  
13288 MARSEILLE  
FRANCE

1.2. **OBJECT OF THE ORDER**
Mechanical tests on a penetrator base module OFP.

1.3. **ORDER NUMBER**
Order n° 0933L052760 of 18/07/2019.

1.4. **DATE AND SITE OF TESTS**
The tests have been performed at SOPAVIB laboratory on August 20\textsuperscript{th} 
& 21\textsuperscript{st} 2019.

1.5. **REPRESENTATIVES OF BOTH COMPANIES**
CPPM is represented by Mr. HENRY who ensures the co-ordination of tests.  
SOPAVIB is represented by Mr. LABESSEDE who ensures the execution of tests.

1.6. **RECORDS**

1.6.1. **File**
The technical files numbered 2E18734 are saved during 5 years. This period should be increased on a written customer request.

1.6.2. **Data**
Measurements performed during tests are saved on external disk during 5 years. This period should be increased on a written customer request.
2. MATERIAL SUBMITTED TO TEST

2.1. CPPM REFERENCES
The specimen submitted to tests is a Penetrator Base Module OFP.

2.2. SOPAVIB REFERENCE
The specimen submitted to test has been identified BC18734.

3. TEST FACILITIES AND MEASUREMENT EQUIPMENTS USED

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Denomination</th>
<th>Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>M109</td>
<td>Electrodynamics shaker (LDS, V8)</td>
<td>04/2020</td>
</tr>
<tr>
<td>M304</td>
<td>Digital control system (SIGNAL STAR)</td>
<td>01/2021</td>
</tr>
<tr>
<td>M317-56</td>
<td>Measurement accelerometer (P.C.B, M353B15)</td>
<td>01/2020</td>
</tr>
<tr>
<td>M317-58</td>
<td>Measurement accelerometer (P.C.B, M353B15)</td>
<td>07/2020</td>
</tr>
</tbody>
</table>
4. TEST PROGRAM

4.1. SCHEDULE
The test program is described below:

- Endurance sine test
- Shock test
- Bump test

4.2. SEVERITIES

4.2.1. Endurance sine test
Frequency bandwidth: .......... from 5 to 150 Hz
Amplitudes: ................................. 4mm pk-pk from 5 to 25Hz
............................................... 5g from 25 to 150Hz
Sweep speed: ................................ 1 oct/min
Number of axes:............................ 3
Duration: ..................................... 1 hour

4.2.2. Shock test
Waveform: ............................ half sine
Amplitude / duration: ....................... 15 g / 11 ms
Shock per axis:.............................. 3
Number of axes:............................. 6 (±X, ±Y, ±Z)

4.2.3. Bump test
Waveform: ............................ half sine
Amplitude / duration: ....................... 10 g / 16 ms
Shock per axis:.............................. 500
Number of axes:............................. 6 (±X, ±Y, ±Z)


5. **TEST CONDITIONS**

5.1. **TEST FACILITIES DESCRIPTION**
Tests are performed with an electrodynamic shaker referenced M109 controlled in real time by a digital control system referenced M304.

5.2. **ORIENTATION REFERENCE**
The specimen’s position is defined in relation to the axes of the tri-rectangular reference system shown on photograph n°1 on page 10.

5.3. **TEST FIXTURE**
The specimen is tested rigidly fixed on the moving part of the test facility with a test fixture furnished by CPPM.

5.4. **CONTROLS**
Visual and functional tests are performed by CPPM representative.

5.5. **METHODS**

5.5.1. **Sine vibration method**
Test parameters are described in paragraph 4
Specifications of the standard IEC 68.2.6 test Fc are respected.
Sine vibrations transmitted are defined by their amplitude of displacement (a) and their frequency (f).
The acceleration amplitude obtained is the following:

\[ \gamma = \frac{4 \pi^2 f^2 a}{g} \]

\( g \) : normalised acceleration gravity.  \( f \) in Hz,  \( a \) in m,  \( \gamma \) in g.

Control is made at two points, on the maximum filtered signal of reference sensors located close to the specimen fixations.
5.5.2. **Shock and bump test method**

Test parameters are described in paragraph 4.

Prescriptions of the standard EN 68-2-27 are respected.

Half sine shocks are defined by their acceleration peak $\Gamma$ in g and their duration $D$ in ms as shown on the following scheme.

The test sequence is described below:
1 shock at –12 dB, 1 shock at –9 dB, 1 shock at –6 dB, 1 shock at –3 dB, X shocks at 0 dB

Control is made on the filtered signal of one reference sensor located close to the specimen fixations.

![Half Sine Pulse Diagram](image)

5.5.3. **Data handling**

Signals given by the accelerometric channels are filtered and directly analysed by the digital control system.

During sine vibration test:
- Acquisition is performed on the signal filtered at excitation frequency.
- Curves in appendix represent the acceleration level $\gamma$ (in g) versus frequency.

During shock and bump test:
- Acquisition is performed on the signal filtered up to 500 Hz.
- Curves in appendix represent the acceleration level $\gamma$ (in g) versus time.
6. TEST PROGRESS

<table>
<thead>
<tr>
<th>Date, time</th>
<th>Axis</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/08/19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 14h00      | X    | Endurance sine test  
Check: No visual damage. Normal work after test. |
| 15h40      | Y    | Shock test: 15g / 11ms (3 positives and 3 negatives)  
Check: No visual damage. Normal work after test. |
| 15h50      |      | Bump test: 10g / 16ms (500 positives and 500 negatives)  
Check: No visual damage. Normal work after test. |
| 16h35      |      | Endurance sine test  
Check: No visual damage. Normal work after test. |
| 21/08/19   |      |              |
| 10h00      | X    | Shock test: 15g / 11ms (3 positives and 3 negatives)  
Check: No visual damage. Normal work after test. |
| 10h05      |      | Bump test: 10g / 16ms (500 positives and 500 negatives)  
Check: No visual damage. Normal work after test. |
| 11h30      |      | Endurance sine test  
Check: No visual damage. Normal work after test. |
| 13h30      | Z    | Shock test: 15g / 11ms (3 positives and 3 negatives)  
Check: No visual damage. Normal work after test. |
| 13h35      |      | Bump test: 10g / 16ms (500 positives and 500 negatives)  
Check: No visual damage. Normal work after test. |
7. TEST RESULTS

7.1. RESPECT TO STANDARD PRESCRIPTIONS.

Tests have been fully performed in accordance with standards prescriptions.

7.2. ACCELEROMETRICS MEASUREMENTS

Curve n°1: .........................Control accelerometer of the sine tests
Curves n°2 and 3: ..............Control accelerometer during shock tests (15g/11ms).
Curves n°4 and 5: ..............Control accelerometer during bump tests (10g/16ms).

7.3. CONTROLS

Controls are performed by CPPM representative.
Photograph n° 1: General views during test
APPENDIX

Accelerometric measurements................................................................. Curves n° 1 to 5
Curve n° 1

Test ref.: 2E18734
Specimen: OFP BASE PENETRATOR
Axes: X, Y, Z
Date: 20/08/19
Title: Sine tests
Function: FFT

CONTROL + LIMITS

Curve n° 2

Test ref.: 2E18734
Specimen: OFP BASE PENETRATOR
Axes: X, Y, Z
Date: 20/08/19
Title: Shock test (15g/11ms)
Function: g(t)

CONTROL + LIMITS
**Curve n° 3**

**Test ref.** : 2E18734  
**Specimen** : OFP BASE PENETRATOR  
**Axes** : X, Y, Z  
**Date** : 20/08/19  
**Title** : Shock test (15g/11ms)  
**Function** : g(t)

**CONTROL + LIMITS**

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**Curve n° 4**

**Test ref.** : 2E18734  
**Specimen** : OFP BASE PENETRATOR  
**Axes** : X, Y, Z  
**Date** : 20/08/19  
**Title** : Bump test (10g/16ms)  
**Function** : g(t)

**CONTROL + LIMITS**
Curve n° 5

Test ref. : 2E18734  Specimen : OFP BASE PENETRATOR  Axes: X, Y, Z
Date : 20/08/19  Title : Bump test (10g/16ms)  Function : g(t)

CONTROL + LIMITS