KM3NeT Template For Item Qualification Procedure

KM3NeT_QUAL_2020_001_v2

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CPPM

Abstract

This document describes the qualification tests procedure to be applied to the new ORCA AC/DC converter for the KM3NeT project.

Recipients

The KM3NeT PSC, The KM3Net Power working group

Document Status

Revision	Date	Comment	Reviewed by	Approved by
			XX	YY

Revision History

Revision	Date	Description
Draft	05/02/2020	First draft
V0	14/02/2020	Distributed to the working group
V1	17/02/2020	Stephane comments included
V2	27/02/2020	Add pictures of mechanical support
V3	01/07/2020	New procedure for second set of qualification

1 Table of Contents

2 Documentation

2.1 Abbreviations

Abbreviation	Description
DU	Detection Unit
DOM	Digital Optical Module
...	.....

2.2 Reference Documents

Abbreviation	Title	Reference
RD1	KM3NeT TDR	KM3NeT_DS_TDR
RD2	KM3NeT CRD	KM3NeT_DS_CDR
RD3	KM3NeT Qualification Plan	KM3NeT_QUAL_2018_001
RD4	KM3NeT Qualification Procedures	KM3NeT_QUAL_2018_002
RD5	…	

3 Introduction

This document describes the qualification stress tests foreseen on the new ORCA AC/DC converter that is housed in the base module. It will be the support for the Test Readiness Review (TRR) that should be held before to start the qualification processes.

A first set of stress test was already applied following the first TRR (on 20/02/2020) that ended up with damaged on the UUT. This new test procedure is a relaxed one to better match the UUT characteristics.

The PBS of the UUT is **3.2.2.3.3.1/FR/3.12**

4 Quality and organisational issues

4.1.1 Status of NCR-DCR-Waiver of the item under test

To be done

4.1.2 List of people committed

Stéphane Théraube as responsible of the product
Laurence Caillat as LQS of CPPM
Jérôme Laurence as mechanical technician (design of the support)
Rosanna Coccimano as the responsible of the power of the detector
Sylvain Henry as responsible of the qualification

5 Definition of the qualification tests

5.1 Vibrations & Shocks

5.1.1 Objectives and expected results

The goal is to check the capability of the material to stand a vibratory environment (due to transportation, handling and deployment) without suffering unacceptable of performance or structure degradations.

Shock tests are performed to provide a degree of confidence that materiel can physically and functionally withstand the relatively infrequent, non-repetitive shocks encountered in handling, transportation, and service environments.
The expected result is no degradation of the functional parameter, no visual degradation of the UUT and no alteration of the safety

5.1.2 Material configuration

5.1.2.1 Unit under test (UUT)

The UUT is the new AC/DC converter housed in the ORCA base module
The PBS of the UUT is **3.2.2.3.3.1/FR**
The precise UPI is not yet defined
The UUT is the one that has been stress tested in March 2020 at SOPAVIB and ended up with the break of the transfo support. In the meantime, this product was slightly mechanically reinforced and refurbished by the provider.

Figure 1: the new AC/DC converter

5.1.2.2 Test equipment

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

5.1.2.3 Mechanical support equipment

The UUT will be mounted on the end tape of the base module container as in the real case. For the need of the test, this end tape will not mounted on the cylinder but fixed (in the same horizontal position) on the test plate. The test plate is specially adapted to match the vibrations and shocks pot.

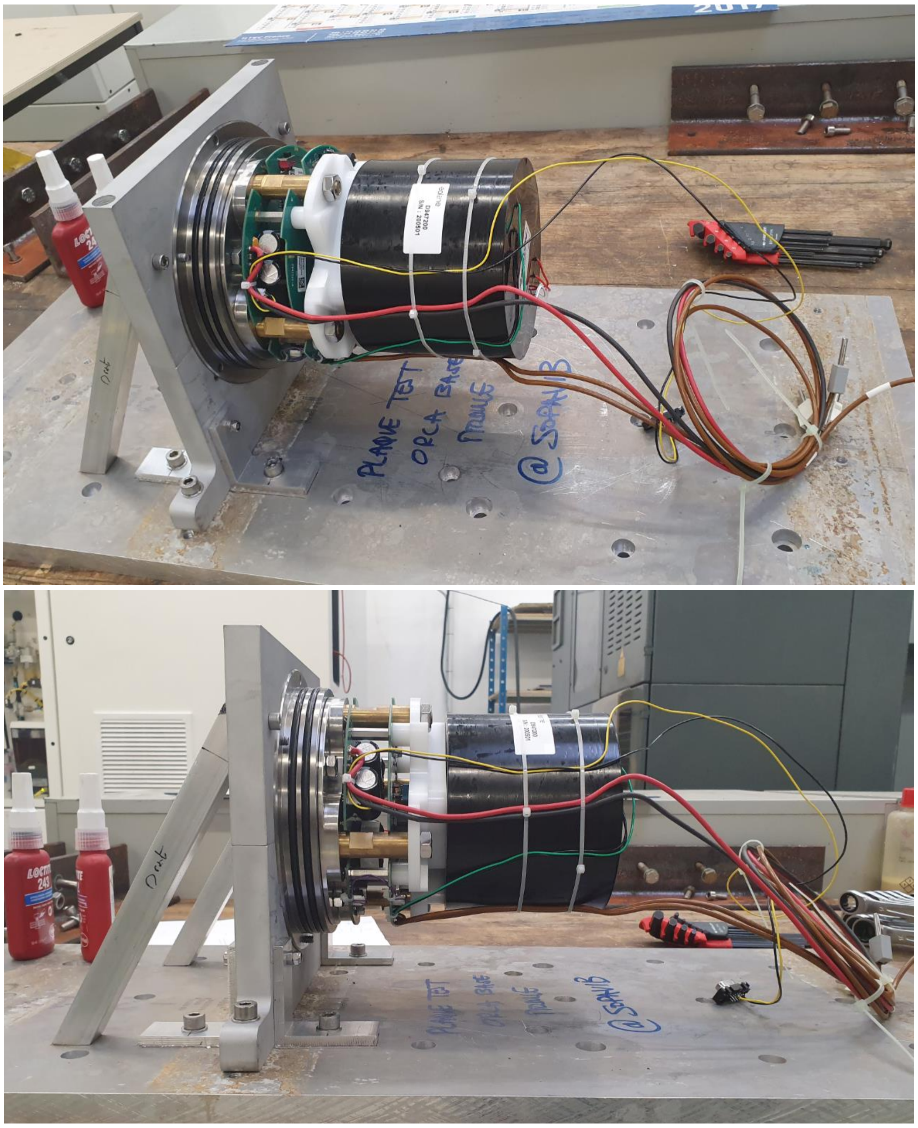

Figure 2: mechanical support

Then, the UUT will not be closed in any container that will facilitate the visual inspection during and between each stress tests.

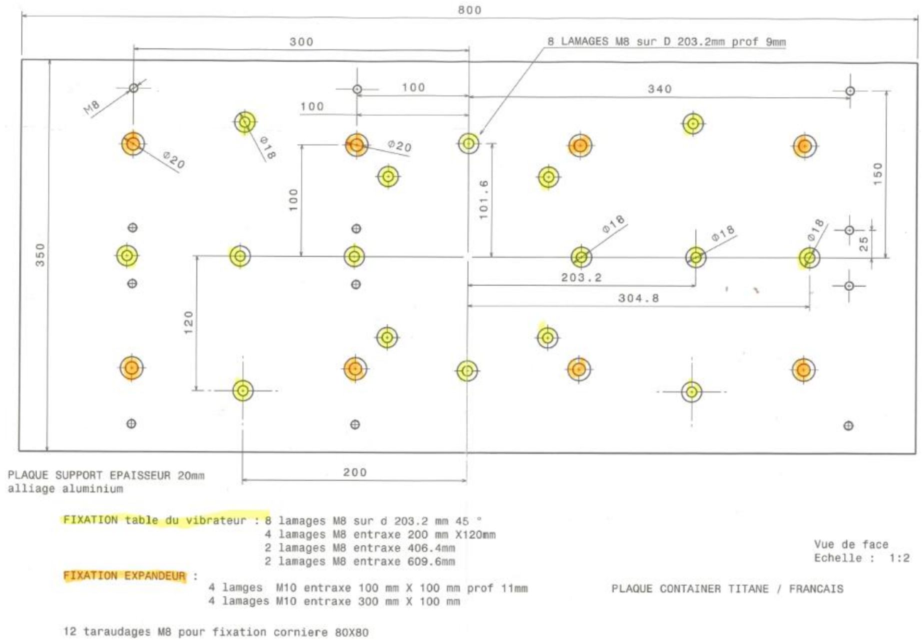

Figure 3: drawing of the interface plate

5.1.3 Test and monitoring of the material

The UUT will be tests before and after the test at SOPAVIB

This is because a test of the UUT would imply safety requirements that are difficult to meet at SOPAVIB and because the 400 VAC input power source is difficult to move.

Moreover, the monitoring of the UUT at SOPAVIB during the tests would require the presence of people that cannot be available at this date.

The test that will be perform at CPPM before and after the stress tests will be as described:

- Input power source 400 VAC (tuned at nominal tension 400 Vrms)
- Passive loads of 13 W ± 1 % @ 385 Vdc (Arcol HS100 11K F), 148 W ± 5 % @ 385 Vdc (CGS - TE Connectivity HSC300 1K0 J) and 218 W ± 5 % @ 385 Vdc (CGS - TE Connectivity HSC300 680R J)
- Analysis of the input and output power parameters with 2 Wattmeters Metrix PX110 (power factor, power, voltage, current)
- Check of the correct operation of the input timer (10 s, 30 s, 60 s)
- Access to the monitoring parameters with a computer (temperature, input current, input voltage, output voltage)

5.1.4 Pass/fail criteria

The functional parameters of the UUT must be within the indicated range for each of the 3 resistances load used:

Load 13,5 W	Load 148 W	Load 218 W
Pout = 207.6 – 229.5 W Uout = 385 V dc Iout = 0.54 – 0.60 A dc	Pout = 141.2 - 156 W Uout = 385 V dc Iout = 0,37 - 0,41 A dc	Pout = 13.3 – 13.6 W Uout = 385 V dc Iout = 0.35 A dc

Efficiency = > 0.9 Power factor = > 0.95	Efficiency = > 0.9 Power factor = > 0.95	Efficiency = > 0.5 Power factor = > 0.24

Remark: before the stress test it was not possible to establish a RS232 communication with the AC/DC

Moreover the visual inspection should no reveal any damage

5.1.5 Test procedure

- The vibration procedure (to be applied on each of the 3 axis) is the following:

	Frequency range	Amplitude and acceleration	Sweep speed	Duration	Number of cycles
Critical frequencies search[a]	5 Hz to 16 Hz 16 Hz to 150 Hz	amp. = ±1 mm acc.= 10 m/s²	1 oct/min		1
Frequency sweep [b]	5 Hz to 16 Hz 16 Hz to 150 Hz	amp. = ±1 mm acc.= 10 m/s²	1 oct/min	1h	
Fixed frequency tests [c]	5 Hz to 16 Hz 16 Hz to 150 Hz	amp. = ±1 mm acc.= 10 m/s²		1h	

Table 2: simplified vibration test procedure

- Step (a): search for possible resonance frequencies
- Step (b): If no resonance frequency detected
- Step (c): On the 3 main resonance frequencies (from 5 to 16Hz → amp.= ±1mm and from 16 to 150Hz → acc. = 1G)

- The shock and bump test procedure is the following:

	Number of shocks	Number of axis	Description
"Hard" shocks	3	6 (±X, ±Y, ±Z)	acc.= 10 G duration=11ms Wave form : half sine
"Soft" shocks	100	6 (±X, ±Y, ±Z)	acc.= 5G duration=30ms Wave form : half sine

Table 4: mechanical shocks test procedure

Remark: according to the ongoing exchange with EOLANE we could proceed in the usual order (Vibrations and shocks on the same axis and change axis) or separate all 3 axis vibrations and then all3 axis shocks.

5.1.6 Tests organization

The tests will be followed at SOPAVIB by a mechanical technician of CPPM whole role will be to check the integrity of the UUT (including the mechanical support) and take pictures after each test session

Schedule	Tests performed	Team @ SOPAVIB
Day1 (28/07/2020)	Vibrations and shocks	Sylvain Henry
Day2 (29/07/2020)	Vibrations and shocks	Sylvain Henry

5.2 Climatic

For this test program of the UUT is it proposed not to apply here the climatic stress because such test because the UUT provider will apply it on the second prototype unit with even broader temperature range than the ones recommended in the KM3NeT procedure guideline (from 0°C to 60°C instead of from RT to 60°C)