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Langagervej 6, 9220
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QUALIFICATION CERTIFICATE

NanoPower P60

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Revision: 1.0
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Release Table:

Action	Name	Function	Signature	Date
Prepared / Owned by:	Sebastian Andersen	Junior Engineer	SEAN	29/09/2020
Verified / Reviewed by:	Lars Vestergaard	Technology Manager	LAV	08-11-2021
Approved by:	Brian Madsen	Senior Test Manager	BRMA	09-11-2021

Document Change Log

Revision	Date	Name	Description
1.0	09-11-2021	SEAN	Initial release

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1. Introduction

1.1 Purpose

This document describes the environmental qualification tests carried out on the following product:

- *103071 - NanoPower P60 system*

which product consists of the following sub-products

- *200283 – NanoPower P60 Dock*
- *200314 – NanoPower P60 PDU*
- *200331 – NanoPower P60 ACU*

In the following sections, the tests and the corresponding test results are described.

1.2 References Standards

Table 1 presents the tests included in the Qualification Program with reference to ECSS documentation.

Table 1: Reference Standards

Test		ECSS/ESCC Reference
Structural and Mechanical	**Random Vibration**	ECSS-E-ST-10-03C
	Sinusoidal Vibration	ECSS-E-ST-10-03C
	Mechanical Shock	ECSS-E-ST-10-03C
	Quasi static	ECSS-E-ST-10-03C
Thermal	**Thermal Ambient**	ECSS-E-ST-10-03C
	Thermal Vacuum	ECSS-E-ST-10-03C
Radiation TID		ESCC 22900
Thermal Stress		ECSS-Q-ST-70-38C

2. Qualification tests

It is hereby certified that the product mentioned above has been subjected to the tests executed in relation to the standards mentions in section 1.2

2.1 Structural and Mechanical tests

Sinusoidal Vibration		
Sine Sweep Vibration	Frequency [Hz]	Level [g]
	5-8	20mm peak-peak
	8-100	4,5
Sweep rate: 2 Octaves per minute		

Random Vibration		
Sine Sweep Vibration	Frequency [Hz]	ASD Level [g^2/Hz]
	20	0,026
	20-50	0,16
	50-800	0,16
	800-2000	0,026
	2000	0,026
	Overall	14,1G rms
Duration: 120 Seconds on each axis		

Mechanical shock			
Mechanical shock	Type	Duration [ms]	Level [g]
	Half sine	2	70G
No. of pulses in X,Y,Z axis: 1 pr. axis			

Mechanical Quasi-Static			
Sine Burst	Frequency [Hz]	Cycles	Level[g]
	15	19	10G
No. of burst: 8 ($\approx 10sec$)			

Remarks: None

2.2 Thermal Vacuum Test

Thermal Vacuum Qualification levels		
Temperature range: -5℃ to +50℃		
Pressure level: < 1.0 x 10^{-5} mbar		
Number of Cycles: 12		
Thermal Vacuum Test	CFT	Temperature [℃]
	1	22
	2	50
	3	-5
	4	50
	5	15
	6	-5
	7	35
	8	-5
	9	50
	10	-5
	11	8
	12	22

Thermal Vacuum Qualification levels		
Temperature range: -20℃ to +35℃		
Pressure level: < 1.0 x 10^{-5} mbar		
Number of Cycles: 11		
Thermal Vacuum Test	CFT	Temperature [℃]
	1	20
	2	35
	3	-20
	4	35
	5	-20
	6	35
	7	-20
	8	35
	9	-20
	10	35
	11	-20

Remarks: None

2.3 Thermal Stress Test

Thermal Stress		
Temperature Range:		
Action	Temperature [℃]	Duration [Minutes]
Heat	100	$(10℃/min)$
Dwell	100	15
Cool	-55	$(10℃/min)$
Dwell	-55	15
Repeat	-	-
Repeats: 500 cycles		

Remarks: None

2.4 Radiation TID Tests

For the following sub-products

- *200283 – NanoPower P60 Dock*

Total Ionizing Dose	
Dose Rate:	Standard: 24,6kRad/hour
Dose	10 kRad (SI)
Annealing	>24 hours, 25degC
Aging	168 hours, 85degC

- *200314 – NanoPower P60 PDU*
- *200331 – NanoPower P60 ACU*

Total Ionizing Dose	
Dose Rate:	Standard: 24,6kRad/hour
Dose	20 kRad (SI)
Annealing	>24 hours, 25degC
Aging	168 hours, 85degC

Remarks: None

2.5 Flight Heritage

The NanoPower P60 system is TRL 9 and has extensive flight heritage including GomSpace missions like GOMX1 and GOMX3 as well as many customer missions.

3. Conclusion

The NanoPower P60 system is tested according to the above-mentioned conditions and is fully functional and have the expected performance.

This certificate ensures that performance, test condition and test equipment are according to GomSpace quality.