JAXA-RPR-MX16307
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MARTIAN MOONS EXPLORATION (MMX) MISSION

ENVIRONMENTAL DESIGN DATA AND TEST CONDITIONS

REVISION AND HISTORY PAGE

Status	Revision Number	Change Number	Description	Release Date

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1. INTRODUCTION

1.1. Purpose and scope of this document

This document (MMX-EDDTC) specifies environmental conditions, which are design conditions for Martian Moons Exploration (MMX) and its on-board component, as well as environmental tests to be performed.

In case of conflict, the MMX-I-IRD will take precedence over all other documents.

For any component that raises issues in satisfying the requirements, coordinate with the MMX system team.

1.2. Reference documents

See Section 7.

1.3. Notation

[TBD-Sys] [TBC-Sys]

The results of previous study for MMX or other projects are described as reference information for systems and the PI instrument. They will be established by system design in Phase A or beyond.

[TBD-Sys/PI] [TBC-Sys/PI]

The results of previous study for MMX or other projects are described as reference information for systems and the PI instrument. They will be established through coordination between the PI instrument and systems in Phase A or beyond.

[TBD-Doc] [TBC-Doc]

Information that can be described through coordination with design standards and other documents. (Phase A or beyond)

[TBD-Plan] [TBC-Plan]

Information determined after government approval of the project plan.

2. GENERAL INFORMATION

2.1. Standard metric system

Drawings, specifications, and engineering data shall use the International System (SI) metric standard.

- Dimensions in meters [m]
- Angles in degrees
- Temperatures in degrees Celsius [°C]
- Power / Heat in watts [W]
- Energy in joules [J]
- Mass in kilograms [kg]
- Magnetic field in tesla [T]
- Time in seconds [s]
- Electric current in amperes [A]
- Cleanness class define in FED-STD-209D (7.1. (1))

2.2. Classification of Component

This document broadly classifies component into the following two types:

(1) Internal on-board component

Internal on-board component is defined as component installed into a spacecraft and is not exposed to the space environment.

(2) Exposed on-board component

Exposed on-board component is defined as component installed outside of a spacecraft or component installed in a spacecraft, but has an opening for observation or is partially exposed to the space environment.

3. GROUND ENVIRONMENTAL CONDITIONS

Table 3-1 shows the environmental conditions for JAXA clean room, during transportation of spacecraft and for JAXA launch site.

Table 3-1 Summary of Ground Operation Environment

ITEM	JAXA Clean Room	Transport	Launch Site		
			Satellite Assembly Room	Fairing Integration Room	Inside of Fairing
Mechanical	N.A.	Ver. TBD-Sys g Hor. TBD-Sys g	Ver. TBD-Sys g Hor. TBD-Sys g	Ver. TBD-Sys g Hor. TBD-Sys g	Ver. TBD-Sys g Hor. TBD-Sys g
Temperature	15-30°C	-5-+30°C	22°C±3°C	21°C±3°C	10-25°C(±2°C)
Humidity	65% max	65% max	50%±10%	45%±5%	40-50%
Pressure	730-790 mmHg	973-1053 mmHg	730-790 mmHg	TBD-Doc	TBD-Doc
Cleanliness	100,000	100,000	100,000	100,000	50,000

After delivery to the JAXA for integration on the MMX, the components will be processed in a cleanliness environment equal class 100 000. PI shall not assume better cleanliness levels up to Launch.

4. ENVIRONMENTAL TEST CONDITIONS

4.1. Test Conditions for Component

4.1.1. Mechanical Environment Test for Component

The following mechanical environment tests shall be performed for component:

(1) Random vibration test

(2) Sinusoidal vibration test

(3) Pyrotechnic impact test

(4) Acoustic test (if necessary)

4.1.2. Mechanical Environment Test Criteria for Component

The QT/AT policies shown in Table 4.1.2-1 are applied to levels and durations of mechanical environment unit tests for component.

Table 4.1.2-1 Levels and Durations Applied to Mechanical Environment Unit Tests for EM/FM Component

Target	Definition	Random Vibration Test and Acoustic Test	Sinusoidal Vibration Test and Static Acceleration	Pyrotechnic Impact Test
EM	The EM defined here has mechanically identical design as the FM.	QT level 120 seconds [Rn]For 3 axes [Ac]Once	QT level For 3 axes 2oct/min (up/down) (5-100Hz)	AT level For 3 axes (+) twice (–) twice (total 12times) Or QT level For 3 axes (+) once (-) once (total 6times)

FM (not evaluated in EM)	The FM which has not been evaluated in EM means: ・The EM has not been fabricated. Although the EM mechanically equivalent to FM is available, the test (120seconds) at the QT level has not been cleared.	QT level 60 seconds [Rn]For3 axes [Ac]Once	QT level For 3 axes 4oct/min (up/down) (5-100Hz)	AT level For 3 axes (+) once (–) once (total 6times)
FM (evaluated in EM)	The FM which has been evaluated in EM means: The EM has been fabricated. Also, the test (120seconds) at the QT level has been cleared.	AT level 60 seconds [Rn]For 3 axes [Ac]Once	AT level For 3 axes 4oct/min (up/down) (5-100Hz)	AT level For 3 axes (+) once (–) once (total 6times)

Note *1) QT: Qualification Test, *2) AT: Acceptance Test,

Random/Acoustic: QT level = AT levels + 3 dB, Sinusoidal: QT level = AT levels x 1.25,

Impact: QT level = AT level + 3dB

4.1.3. Mechanical Environment Test Tolerances for Component

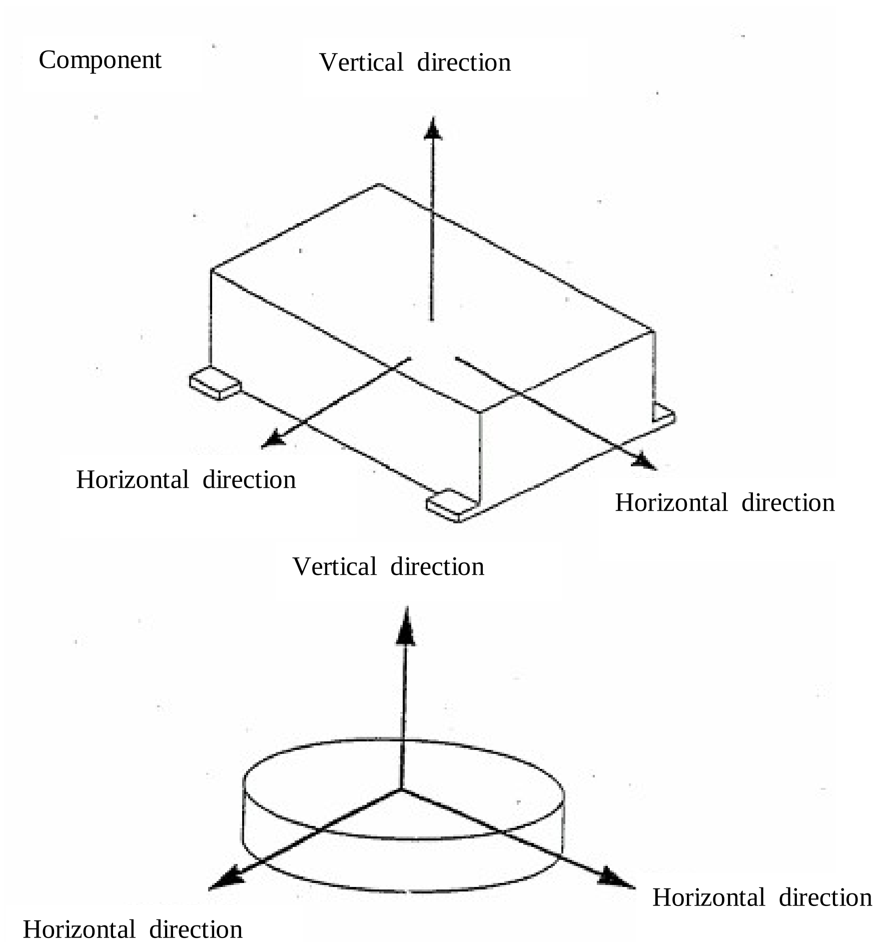
Table 4.1.3-1 shows mechanical environment test tolerances for component in the mechanical environment test criteria specified in Table 4.1.2-1. If these conditions cannot be satisfied, consult with the MMX system team.

Table 4.1.3-1 Test Tolerances

	Random	Sinusoidal	Pyrotechnic Impact	Acoustic (if necessary)
Level	PSD ± 3 dB Grms ± 1.5 dB	±10%	SRS Acceleration: +50%, –10%	TBD-Sys
Frequency	±2% or ±1 Hz, whichever is greater			
Duration	+10%–0% (NA for Pyrotechnic Impact)			

4.1.4. Definitions of Axes

Figure 4.1.4-1 shows the definitions of axes.



Note: The in-plane direction of the component mounting surface shall be the horizontal direction.

Figure 4.1.4-1 Definitions of Axes for Component

4.1.5. Mechanical Environment Test Levels for Component

4.1.5.1. Random Vibration (AT)

(1) Out-of-Plate Direction (TBC-Sys/PI)

Frequency (Hz)	SPL
20 - 70	+6 dB/oct
70 - 260	0.25 G2/Hz
260 - 400	-6 dB/oct
400 - 1000	0.115 G2/Hz
1000 - 2000	-8 dB/oct
Overall	13.96 Grms

(2) In Plate Direction (TBC-Sys/PI)

Frequency (Hz)	SPL
20 - 100	+6 dB/oct
100 - 1000	0.1 G2/Hz
1000 - 2000	-8 dB/oct
Overall	10.04 Grms

Note) the components should endure this level for 60 seconds.

4.1.5.2. Sinusoidal Vibration (AT)

(1) All Direction: 5 to 100Hz 20 G (TBC-Sys/PI)

Note) Excitation is applied with a 2 octave/min sweep rate in up and down direction.

4.1.5.3. Static Acceleration (AT)

(1) All Direction : 20 G (TBC-Sys/PI)

Note) Sinusoidal vibration test is substitutable thereto.

4.1.5.4. Pyrotechnic Impact Test Levels (AT)

Frequency (Hz)	SRS
100 - 2800	+9 dB/oct (TBC-Sys/PI)
2800 - 4000	1300 Gsrs (TBC-Sys/PI)

Note 1) If these conditions cannot be satisfied, consult with the MMX system team.

Note 2) These values are for Q = 10

4.1.6. Thermal Vacuum Test

(1) This test is intended for the verification of the quality required for component (FM) and is basically required for all component regardless of temperature environment of on-board locations. However, if this test may cause to degrade or damage the component due to the component's characteristics, test levels shall be established separately after careful coordination between the overall MMX system and subsystem teams.

(2) Basically, component shall be operating during the temperature test, including during the reading of temperature changes. However, if this test method may degrade or damage the component due to the component's characteristics, test methods shall be established separately after careful coordination.

(3) Both the upper limit and the lower limit shall be verified for input power supply voltages at operation check points specified for this test. Voltage ranges are specified in the Electrical Design Criteria.

(4) Temperature ranges are defined as follows:

・Acceptance Test (AT)

AT temperature range shall be the allowable temperature range of component obtained by adding "test condition tolerance" and "AT margin (+/- 5℃)".

・Qualification Test (QT) / Proto Flight Test (PFT)

QT temperature range shall be AT temperature range obtained by adding "QT margin (+/- 5℃)"

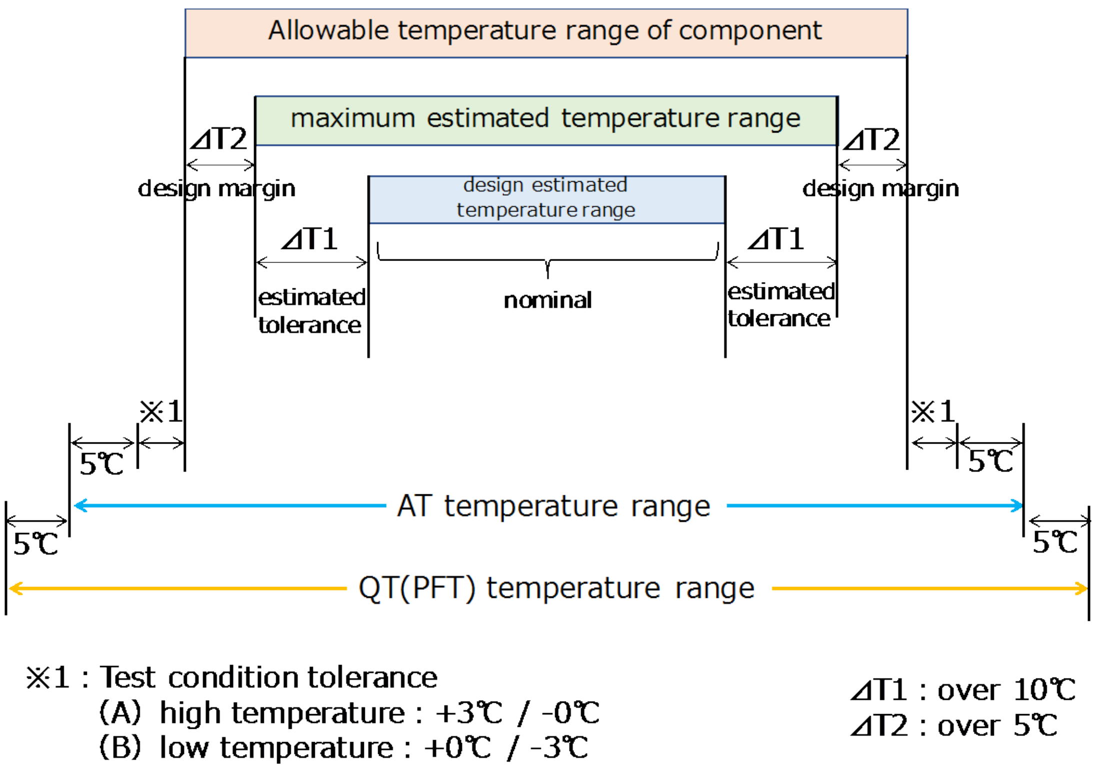


Figure 4.1.6-1 Various temperature range (QT(PFT), AT)

In principle, the performance maintenance temperature range for component shall be from the low limit to the high limit temperature (-30 - +60°C ; TBD-Sys).

However, if there is a request from MMX system team for expansion of temperature ranges or from the subsystem team for change of temperature ranges, temperature ranges shall be decided after coordination between the MMX system team and the subsystem team.

(5) The test condition tolerance should be as follows

A Solar irradiation intensity：

(A) In-plane uniformity：±5% of the average value

(B) Out-of-plane uniformity：±10% of the average value

B Infrared irradiation intensity：±5%

C Test item temperature configuration：

(A) high temperature：+3℃ / -0℃

(B) low temperature：+0℃ / -3℃

(6) Figure 4.1.6-2 shows the test temperature profiles. More than 8 thermal cycles in total shall be performed.

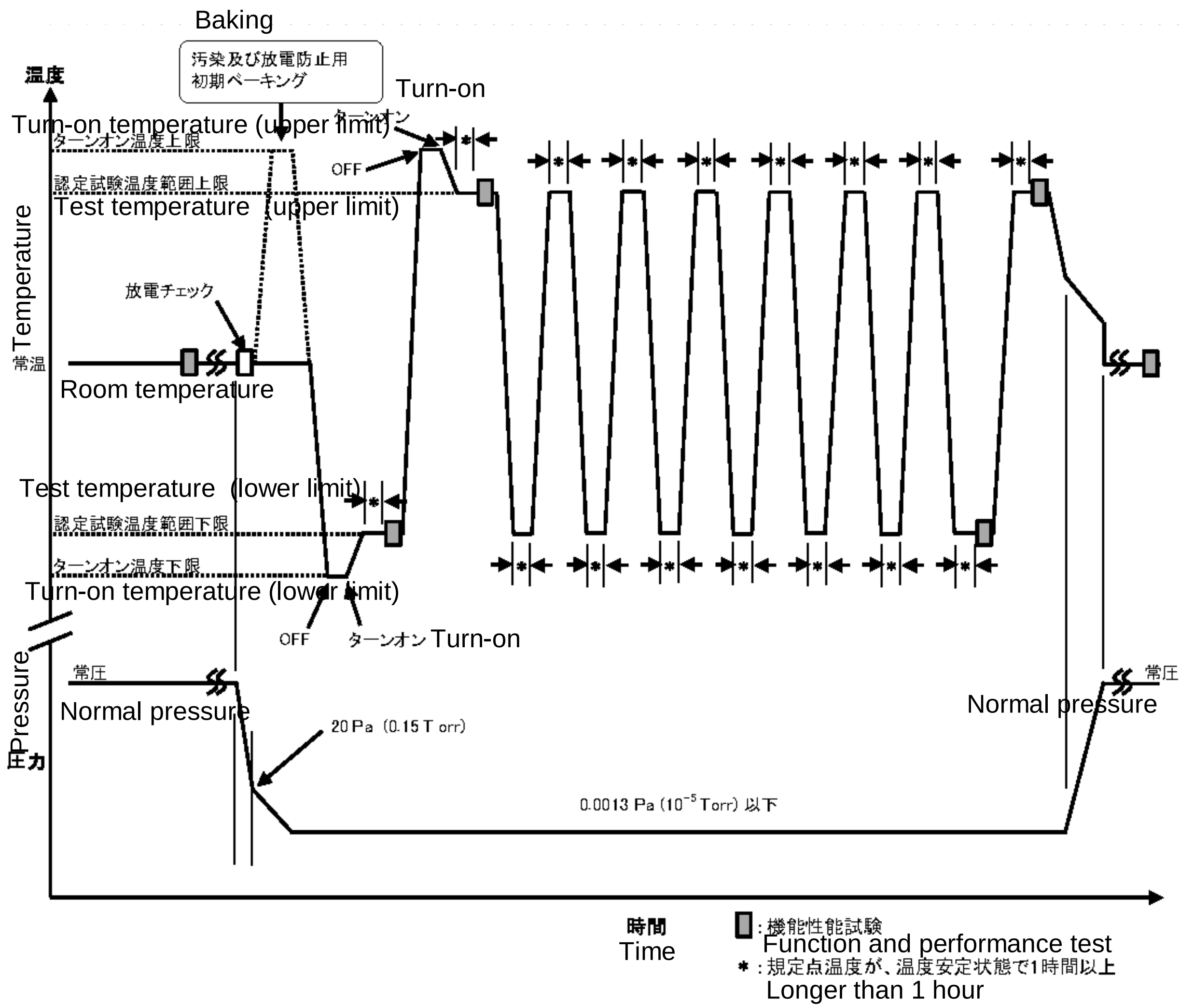


Figure 4.1.6-2 Component Thermal Vacuum Test Levels

4.2. System Environmental Test Conditions

4.2.1. System Mechanical Environment Tests

A spacecraft system shall perform the following mechanical environment tests:

(1) Sinusoidal vibration test

(2) Pyrotechnic impact test (TBD-Sys)

(3) Acoustic test

(4) Quasi-Static load test (if necessary)

4.2.2. System Thermal Environment Tests

A spacecraft system shall perform the following thermal environment tests:

(1) This test is intended to check the quality required for spacecraft systems (FM) and is basically required for all component regardless of temperature environment of on-board locations. However, if this test may degrade or damage the component due to the component's characteristics, test levels shall be established separately after careful coordination.

(2) Basically, component shall be operating during the temperature test, including during the reading of temperature changes. However, if this test method may degrade or damage component due to the component's characteristics, test methods shall be established separately after careful coordination.

(3) Temperature ranges are TBD-Sys.

(4) More than 4 thermal cycles in total shall be performed as system test.

5. ENVIRONMENTAL CONDITIONS DURING LAUNCH

5.1. Air-conditioning Environment in Nose Fairings before Launch

See Table 3-1 (Fairing).

5.2. Quasi-static Acceleration of Satellites during Launch

See Table 5.2-1.

Table 5.2-1 Quasi-static Acceleration

Event	Axis Direction	Axis Orthogonal Direction
Lift off	-3.2 G	+/- 2.0 G
MECO	-5.0 G to +1.0 G	+/- 1.2 G

5.3. Vibration and Impact Environments

5.3.1. Vibration and Impact Environments of Component

Vibration and impact environments of component are equivalent to the AT levels in 4.1.1.

5.3.2. Vibration and Impact Environments of Satellite

Vibration and impact environments of spacecraft are equivalent to the AT levels in 4.2.1.

5.4. Acoustic Environment

Acoustic environmental levels during the flight of a rocket are equivalent to AT levels.

5.5. Heat Flux during Flight

(1) Inside fairing (from liftoff to fairing separation)

The maximum heat flux of internal surface of the payload fairing: Less than 1000 W/m^2

(2) After fairing separation

The maximum free molecular heat flux: Less than 1135 W/m^2.

5.6. Internal Pressure Changes of Fairings during Flight

See Figure 5.6-1.

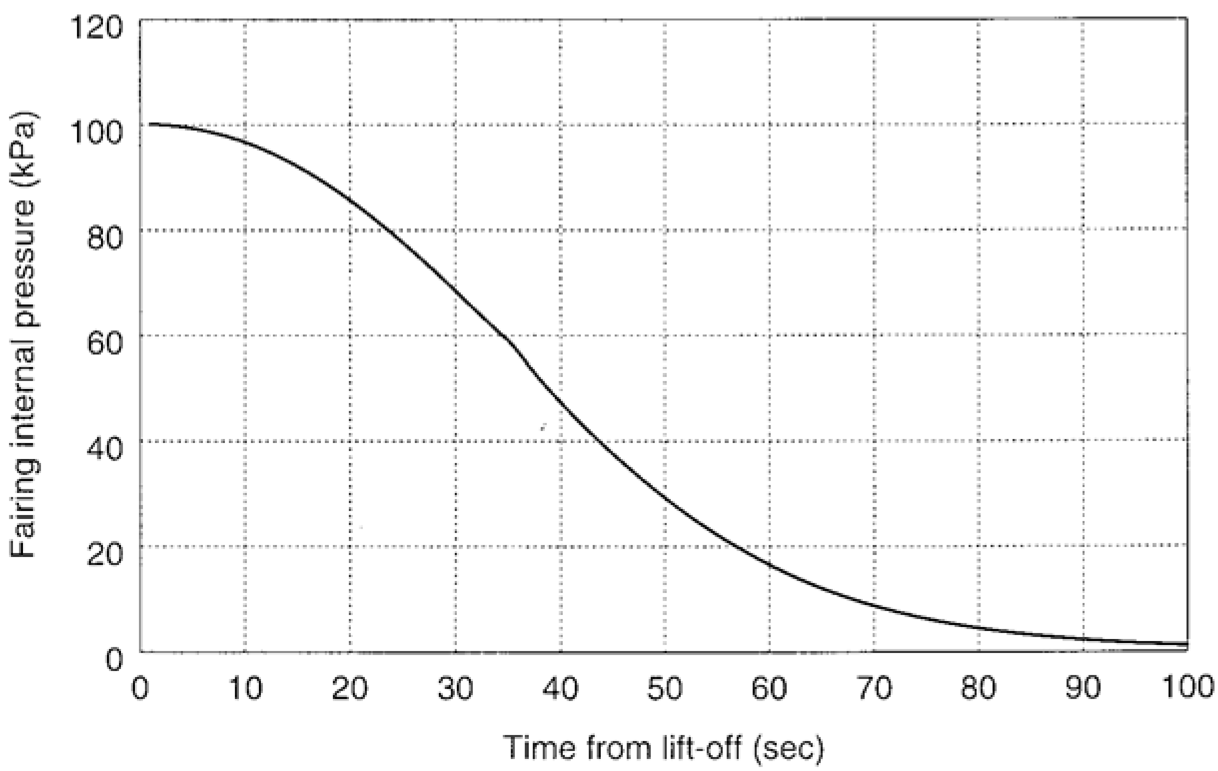


Figure 5.6-1 Fairing internal pressure changes during flight

6. SPACE ENVIRONMENT CONDITIONS

6.1. Thermal environment

6.1.1. Parameter

6.1.1.1. Interplanetary Flight

Thermal environment during interplanetary flight is as follows.

- Distance from the Sun: 1 to 1.67 AU
- Solar Intensity: 492 to 1,366 W/m^2
- Direction of the Sun: Can be any direction (Exposure of the –Z panel may be restricted, TBD-Sys)
- Duration of Sun shading: 0 second
- Albedo from Mars: N/A
- Albedo from Phobos: N/A
- Infrared Radiant Intensity from Mars: N/A
- Infrared Radiant Intensity from Phobos: N/A
- Duration of Sun shading by Mars: N/A

6.1.1.2. Mars Orbit

Thermal environment during mars orbit is as follows.

- Distance from the Sun: 1.381 to 1.666 AU
- Solar Intensity: 492 to 716 W/m^2
- Direction of the Sun: Can be any direction (Exposure of the –Z panel may be restricted, TBD-Sys)
- Duration of Sun shading: 3600 seconds
- Albedo from Mars (Max): 0.22 to 0.5
- Albedo from Mars (Min): 0.17 to 0.4
- Albedo from Phobos: 0.02 to 0.05
- Infrared Radiant Intensity from Mars: 150K to 300K (*)
- Infrared Radiant Intensity from Phobos: 80K to 330K (*)

(*) Equivalent blackbody temperature

6.1.1.3. Quasi-satellite Orbit

- The Distance from the Sun: 1.381 to 1.666 AU
- Solar Intensity: 492 to 716 W/m^2
- Direction of the Sun: Can be any direction (Exposure of the –Z panel may be restricted, TBD-Sys)
- Duration of Sun shading: 4800 sec (on 80 x 160 km QSO)
  9900 sec (on 50 x 100 km QSO)
  8900 sec (on 20 x 25 km QSO)
- Albedo from Mars (Max): 0.22 to 0.5

- Albedo from Mars (Min): 0.17 to 0.4
- Albedo from Phobos: 0.02 to 0.05
- Infrared Radiant Intensity from Mars: 150K to 300K (*)
- Infrared Radiant Intensity from Phobos: 80K to 330K (*)

(*) Equivalent blackbody temperature

6.1.1.4. Landing on Phobos

Thermal environment during the landing on Phobos is as follows.

- Distance from the Sun: 1.381 to 1.666 AU
- Solar Intensity: 492 to 716 W/m^2
- Direction of the Sun: Can be any direction (Exposure of the –Z panel may be restricted, TBD-Sys)
- Duration of Sun shading: 14000 sec (at latitude +0 deg)
  15100 sec (at latitude +15 deg)
  16500 sec (at latitude +30 deg)
- Albedo from Mars (Max): 0.22 to 0.5
- Albedo from Mars (Min): 0.17 to 0.4
- Albedo from Phobos: 0.02 to 0.05
- Infrared Radiant Intensity from Mars: 150K to 300K (*)
- Infrared Radiant Intensity from Phobos: 80K to 330K (*)

(*) Equivalent blackbody temperature

6.1.1.5. Vicinity of Deimos

Thermal environment during the vicinity of Deimos is as follows.

- Distance from the Sun: 1.381 to 1.666 AU
- Solar Intensity: 492 to 716 W/m^2
- Direction of the Sun: Can be all direction (Exposure of the –Z panel may be restricted, TBD-Sys)
- Duration of Sun shading: 8000 seconds (on 100 x 200 km Deimos QSO)
- Albedo from Mars (Max): 0.22 to 0.5
- Albedo from Mars (Min): 0.17 to 0.4
- Albedo from Deimos: TBD-Sys
- Infrared Radiant Intensity from Mars: 150K to 300K (*)
- Infrared Radiant Intensity from Deimos: 80K to 330K (*)

(*) Equivalent blackbody temperature

6.2. Radiation environment

6.2.1. General Information

RDM (Radiation Design Margin) should be 1.00 in case that the resistance data to radiation is acquired with using parts that are produced in the same lot as the parts for flight model. Otherwise, RDM should be 1.25 (TBD-sys). Note that these values are for the purpose of evaluating a variation of resistance to radiation between the production lot, not indicating the uncertainty of the radiation environment.

6.2.2. Solar proton integral fluence

Preliminary assumptions for fluence analysis are as follows:

- Distance from the Sun: 1 AU (constant during the whole phase)
- Solar maximum during the whole phase
- Radiation design margin (RDM): 1 and 1.25 (TBD-sys. See 6.2.1.).
- Solar particle flux models: JPL91 (with a 90% confidence level)
- Environment around Earth and Mars: TBD-sys

Radiation environment (total ionizing doze) during the mission is shown in Table 6.2.2-1.

Table 6.2.2-1 Solar proton integral fluence

Proton Energy	Without RDM□	With RDM□ (x1.25)
[MeV]	[cm^{-2}]	[cm^{-2}]
1.00E-01	1.03E+12	1.29E+12
1.10E-01	1.01E+12	1.26E+12
1.20E-01	9.96E+11	1.25E+12
1.40E-01	9.64E+11	1.21E+12
1.60E-01	9.35E+11	1.17E+12
1.80E-01	9.09E+11	1.14E+12
2.00E-01	8.85E+11	1.11E+12
2.20E-01	8.63E+11	1.08E+12
2.50E-01	8.32E+11	1.04E+12
2.80E-01	8.04E+11	1.01E+12
3.20E-01	7.71E+11	9.64E+11
3.50E-01	7.48E+11	9.35E+11
4.00E-01	7.13E+11	8.91E+11
4.50E-01	6.82E+11	8.53E+11
5.00E-01	6.53E+11	8.16E+11
5.50E-01	6.28E+11	7.85E+11
6.30E-01	5.90E+11	7.38E+11
7.10E-01	5.58E+11	6.98E+11
8.00E-01	5.25E+11	6.56E+11
9.00E-01	4.93E+11	6.16E+11
1.00E+00	4.64E+11	5.80E+11
1.10E+00	4.38E+11	5.48E+11
1.20E+00	4.15E+11	5.19E+11
1.40E+00	3.75E+11	4.69E+11
1.60E+00	3.40E+11	4.25E+11
1.80E+00	3.11E+11	3.89E+11
2.00E+00	2.86E+11	3.58E+11
2.20E+00	2.64E+11	3.30E+11
2.50E+00	2.35E+11	2.94E+11
2.80E+00	2.11E+11	2.64E+11
3.20E+00	1.84E+11	2.30E+11
3.50E+00	1.67E+11	2.09E+11
4.00E+00	1.44E+11	1.80E+11
4.50E+00	1.29E+11	1.61E+11
5.00E+00	1.17E+11	1.46E+11
5.50E+00	1.06E+11	1.33E+11
6.30E+00	9.13E+10	1.14E+11
7.10E+00	7.95E+10	9.94E+10
8.00E+00	6.87E+10	8.59E+10
9.00E+00	5.89E+10	7.36E+10
1.00E+01	5.09E+10	6.36E+10
1.10E+01	4.72E+10	5.90E+10
1.20E+01	4.38E+10	5.48E+10
1.40E+01	3.81E+10	4.76E+10
1.60E+01	3.35E+10	4.19E+10
1.80E+01	2.97E+10	3.71E+10
2.00E+01	2.64E+10	3.30E+10
2.20E+01	2.37E+10	2.96E+10
2.50E+01	2.03E+10	2.54E+10
2.80E+01	1.75E+10	2.19E+10
3.20E+01	1.49E+10	1.86E+10
3.50E+01	1.35E+10	1.69E+10
4.00E+01	1.16E+10	1.45E+10
4.50E+01	1.00E+10	1.25E+10
5.00E+01	8.72E+09	1.09E+10
5.50E+01	7.64E+09	9.55E+09
6.30E+01	6.26E+09	7.83E+09
7.10E+01	5.18E+09	6.48E+09
8.00E+01	4.24E+09	5.30E+09
9.00E+01	3.43E+09	4.29E+09
1.00E+02	2.80E+09	3.50E+09
1.10E+02	2.31E+09	2.89E+09
1.20E+02	1.92E+09	2.40E+09
1.40E+02	1.35E+09	1.69E+09
1.60E+02	9.63E+08	1.20E+09
1.80E+02	7.01E+08	8.76E+08
2.00E+02	5.16E+08	6.45E+08
2.20E+02	3.85E+08	4.81E+08
2.50E+02	2.52E+08	3.15E+08
2.80E+02	1.68E+08	2.10E+08
3.20E+02	1.00E+08	1.25E+08
3.50E+02	6.87E+07	8.59E+07
4.00E+02	3.75E+07	4.69E+07
4.50E+02	2.09E+07	2.61E+07
5.00E+02	1.19E+07	1.49E+07

6.2.3. Total ionizing dose

Preliminary assumptions for radiation environment analysis (total ionizing doze) are as follows:

- Distance from the Sun: 1 AU (constant during the whole phase)
- Solar maximum during the whole phase
- Radiation design margin (RDM): 1 and 1.25 (TBD-sys. See 6.2.1.).
- Solar particle flux models: JPL91 (with a 90% confidence level)
- Environment around Earth and Mars: TBD-sys

Radiation environment (total ionizing doze) during the mission is shown in Table 6.2.3-1.

Table 6.2.3-1 Dose-depth curve.

Aluminium Absorber Thickness (solid sphere model)	Without RDM□	With RDM□ (x1.25)
[mm]	[rad(Si)]	[rad(Si)]
0.05	4.30E+05	5.38E+05
0.10	2.13E+05	2.66E+05
0.20	1.09E+05	1.36E+05
0.30	7.36E+04	9.20E+04
0.40	5.38E+04	6.73E+04
0.50	4.07E+04	5.09E+04
0.60	3.08E+04	3.85E+04
0.80	2.21E+04	2.76E+04
1.00	1.87E+04	2.34E+04
1.50	1.33E+04	1.66E+04
2.00	1.02E+04	1.28E+04
2.50	8.22E+03	1.03E+04
3.00	6.81E+03	8.51E+03
4.00	4.84E+03	6.05E+03
5.00	3.72E+03	4.65E+03
6.00	3.14E+03	3.93E+03
7.00	2.73E+03	3.41E+03
8.00	2.40E+03	3.00E+03
9.00	2.16E+03	2.70E+03
10.00	1.93E+03	2.41E+03
12.00	1.61E+03	2.01E+03
14.00	1.36E+03	1.70E+03
16.00	1.17E+03	1.46E+03
18.00	1.03E+03	1.29E+03
20.00	9.08E+02	1.14E+03

6.2.4. LET Spectrum

Preliminary assumptions for radiation environment analysis (LET spectrum) are as follows:

- Model: CREME96
- Cosmic ray maximum during the whole phase
- Atomic number: 1-92
- Radiation design margin (RDM): 1 (TBD-sys. See 6.2.1.).
- Environment around Earth and Mars: TBD-sys

LET Spectra during the mission is shown in Figure 6.2.4-1 and Table 6.2.4-1.

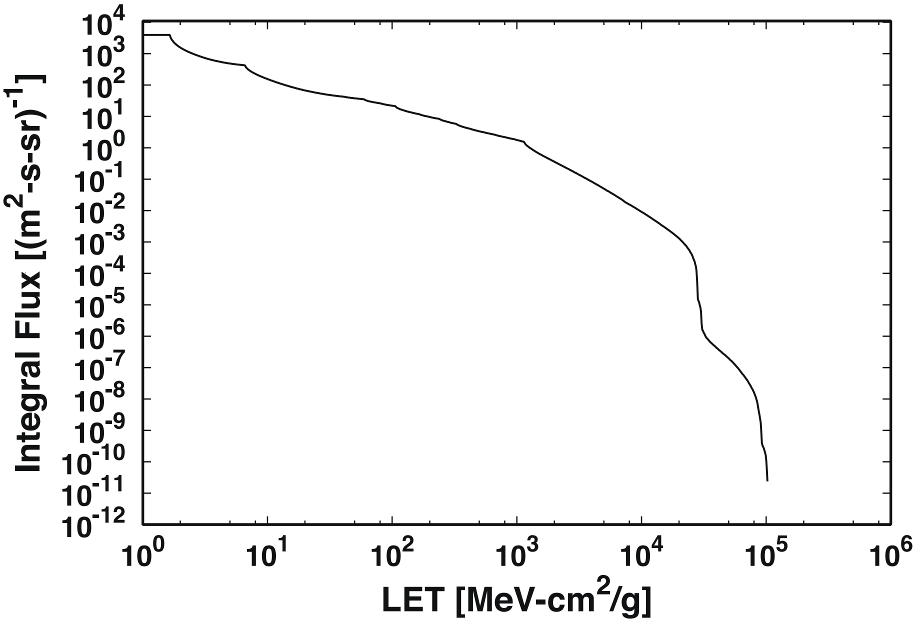


Figure 6.2.4-1 Galactic cosmic ray LET spectrum

Table 6.2.4-1 Galactic cosmic ray LET spectrum

LET	Integral Flux	LET	Integral Flux
[MeV-cm^2/g]	[(m^2-s-sr)$^{-1}$]	[MeV-cm^2/g]	[(m^2-s-sr)$^{-1}$]
1.00E+00	3.93E+03	3.30E+02	5.61E+00
1.12E+00	3.93E+03	3.70E+02	4.66E+00
1.26E+00	3.93E+03	4.16E+02	4.10E+00
1.42E+00	3.93E+03	4.67E+02	3.60E+00
1.59E+00	3.93E+03	5.24E+02	3.23E+00
1.79E+00	2.23E+03	5.89E+02	2.91E+00
2.01E+00	1.55E+03	6.61E+02	2.63E+00
2.25E+00	1.21E+03	7.43E+02	2.34E+00
2.53E+00	9.89E+02	8.34E+02	2.10E+00
2.84E+00	8.33E+02	9.36E+02	1.90E+00
3.19E+00	7.17E+02	1.05E+03	1.70E+00
3.58E+00	6.30E+02	1.18E+03	1.27E+00
4.02E+00	5.66E+02	1.33E+03	9.01E-01
4.52E+00	5.17E+02	1.49E+03	6.73E-01
5.07E+00	4.80E+02	1.67E+03	5.23E-01
5.69E+00	4.52E+02	1.88E+03	4.11E-01
6.39E+00	4.31E+02	2.11E+03	3.24E-01
7.18E+00	2.90E+02	2.37E+03	2.55E-01
8.06E+00	2.23E+02	2.66E+03	2.01E-01
9.06E+00	1.82E+02	2.99E+03	1.57E-01
1.02E+01	1.51E+02	3.35E+03	1.22E-01
1.14E+01	1.28E+02	3.77E+03	9.51E-02
1.28E+01	1.10E+02	4.23E+03	7.34E-02
1.44E+01	9.55E+01	4.75E+03	5.63E-02
1.62E+01	8.34E+01	5.33E+03	4.29E-02
1.82E+01	7.38E+01	5.99E+03	3.25E-02
2.04E+01	6.61E+01	6.72E+03	2.44E-02
2.29E+01	6.01E+01	7.55E+03	1.79E-02
2.57E+01	5.51E+01	8.48E+03	1.37E-02
2.89E+01	5.08E+01	9.52E+03	1.03E-02
3.24E+01	4.75E+01	1.07E+04	7.80E-03
3.64E+01	4.48E+01	1.20E+04	5.73E-03
4.09E+01	4.25E+01	1.35E+04	4.22E-03
4.59E+01	3.95E+01	1.51E+04	3.05E-03
5.16E+01	3.74E+01	1.70E+04	2.20E-03
5.79E+01	3.56E+01	1.91E+04	1.53E-03
6.50E+01	3.05E+01	2.14E+04	9.84E-04
7.30E+01	2.78E+01	2.41E+04	5.59E-04
8.20E+01	2.56E+01	2.70E+04	1.92E-04
9.21E+01	2.31E+01	3.04E+04	2.56E-06
1.03E+02	2.16E+01	3.41E+04	7.91E-07
1.16E+02	1.70E+01	3.83E+04	5.01E-07
1.30E+02	1.47E+01	4.30E+04	3.33E-07
1.46E+02	1.30E+01	4.83E+04	2.25E-07
1.64E+02	1.18E+01	5.42E+04	1.45E-07
1.85E+02	1.03E+01	6.09E+04	8.54E-08
2.07E+02	9.29E+00	6.84E+04	4.70E-08
2.33E+02	8.49E+00	7.68E+04	2.22E-08
2.61E+02	7.19E+00	8.62E+04	5.60E-09
2.94E+02	6.34E+00	9.68E+04	2.36E-10

7. DOCUMENTS

7.1. Applicable documents

N/A

7.2. Reference documents

N/A

8. ACRONYMS

MMX	Martian Moons Exploration
FM	Flight model
ISAS	Institute of Space and Astronautical Science
JAXA	Japan Aerospace Exploration Agency
LET	Linear energy transfer
PI	Principal investigator
SRS	Shock response spectrum