MEDLI2
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Attachment 1: Nominal Specifications for the MEDLI2 Space Qualified Low-Pressure Transducers

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1 Nominal specifications for the space qualified low-pressure transducers are provided below.

2 APPLICABLE DOCUMENTS:

It is anticipated that the following applicable documents will apply.

AS4395 rev-B	Fitting End, Flared, Tube Connection, Design Standard
ANSI/ASME-Y14.100	Engineering Drawing Practices
ANSI/NCSL Z540.3-2006	American National Standard for Calibration of Measurement and Test Equipment
MIL-M-38510 rev-J	General Specification for Microcircuit
MIL-P-27401 rev-D	Propellant, Pressurization Agent, Nitrogen
MIL-P-27407 rev-C	Propellant, Pressurization Agent, Helium
MIL-STD-45662 rev-A	Calibration System Requirements
MIL-T-27 rev-E	General Specification for Transformers and Inductors
MSFC-HDBK-527 rev-F	Materials Selection List for Space Hardware Systems
MSFC-SPEC-522 rev-B	Design Criteria for Controlling Stress Corrosion Cracking
NHB 5300.4(1B)	Quality Program Provisions for Aeronautical and Space Contractors
NHB 5300.4 (3A-2)	Requirements for Soldered Electrical Connections
NPPL	NASA Preferred Parts List

3 Transducer Constraints

3.1 Configuration

The pressure transducer should be hermetically sealed and provide embedded electronics for an amplified output. Two Resistive Temperature Device (RTD)/s should also be embedded within the transducers; one to monitor the diaphragm temperature and one to monitor the temperatures seen by the active electronics. Each pressure transducer should be of welded construction with one (1) port for absolute pressure sensing that is connected to a flared tube fitting as discussed in section 3.1.4. In addition, the pressure sensor should be capable of being mated to an integral sensor mounting system of adequate strength similar to the specifications shown in Figure 1.

3.1.1 Mechanical:

3.1.1.1 Dimensions

It is anticipated that the maximum dimensions of the pressure gage would not exceed (4.5 in) L x (3.5 in) H x (3.0 in) W.

3.1.1.2 Integral Mounting:

The pressure transducers should have the capability of integrating with a mechanical mounting bracket similar to the 3-point configuration as shown in Figure 1.

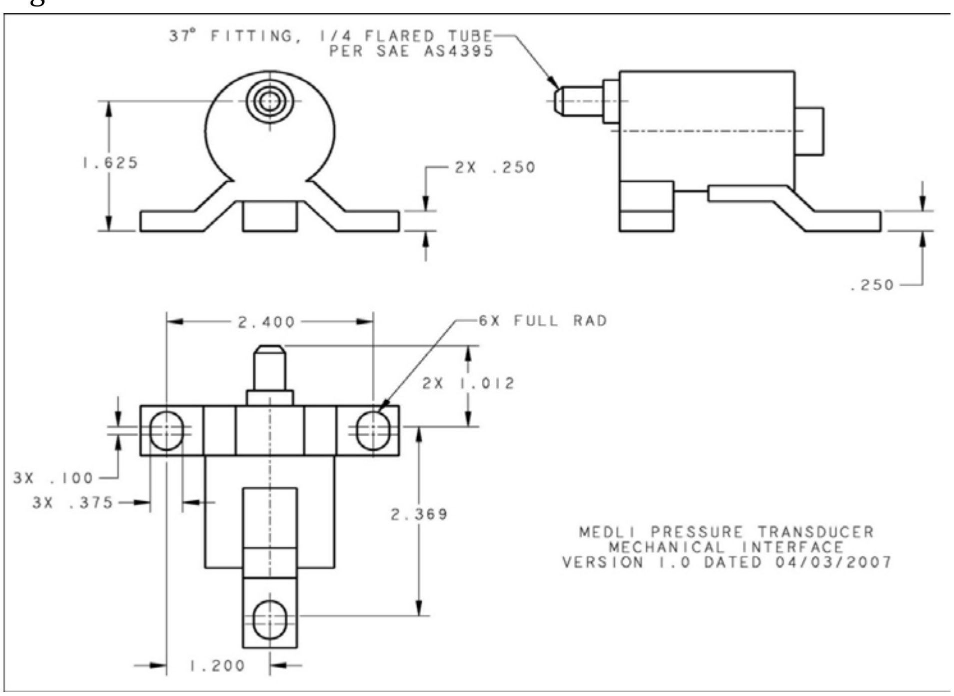

Figure 1: MEDLI Mechanical Interface

3.1.2 Mass:

The mass of the pressure sensor should be less than 900grams.

3.1.3 Electrical Connections:

3.1.3.1 The electrical connector should be a hermetically sealed spaceflight qualified male Mil-C-38999.

3.1.3.2 The electrical interface/connector should be configured for power, ground, analog signal and analog return, and RTD accommodations.

3.1.4 Pressure Connections:

The pressure connection should be a ¼” flared tube fitting (7/16-20 UNJF) per AS4395-4 or equivalent.

3.1.5 Interchangeability:

Electrical connector pin designations should allow for interchangeability of mating connectors for all pressure transducers. Variability between units should be restricted to the point that qualification data obtained with one unit defines the performance/accuracy characteristics and flight-worthiness of the others.

3.1.6 Parts, Materials, and Processes:

Wetted materials should be in accordance with MSFC-HDBK-527 rev. F, MIL-HDBK-5 and should comply with the stress corrosion requirements of MSFC-SPEC-522 rev B, Table I. Materials and processes should be compatible with the environmental conditions specified herein and the following gases or any mixture:

Air (unfiltered)

Helium per Mil-P-27407 rev C

Nitrogen Mil-P-27401 rev D

Carbon Dioxide

Parts, materials, and processes used in the construction of the unit should be controlled by specification or procedure per AS9100 or equivalent.

3.1.6.1 Soldering

All soldering should meet NASA-STD-8739.3.

3.1.6.2 Welding

All fusion welding for Aerospace applications should follow MIL-STD-2219.

3.1.7 <u>Electronic Parts:</u>

Grade 1 parts should be used for all of the electronics.

Note: GSFC INST-EEE-002 should be used for criteria on parts selection, screening, qualification, and derating of Grade 1 parts.

3.1.7.1 Environmental Considerations:

Materials and processes should be selected so that transducer performances are unaffected by humidity, rain, fungus, salt spray, sand, and dust. MIL-STD-810G should be followed.

3.1.7.2 EMI Standards:

All transducers should meet MIL-STD-461 for EMI compliance.

4 Design Goals

4.1 <u>Design Life:</u>

Transducers should be designed for a minimum ten (10) year mission life.

4.2 <u>Temperature:</u>

4.2.1 Survival Temperature:

The pressure measurement head and all electronic circuitry should be capable of surviving a thermal environment as low as -130°C to +70°C t 10-5 torr in a non-operation mode for a period of 10 months and still be capable of meeting performance requirements for the remaining mission life.

4.2.2 Dry Heat Microbial Reduction Temperature

Each pressure sensor will have to survive (non-operational) a dry heat microbial reduction process at temperatures of 104°C for 200 hours, or at 110°C for up to100 hours. The specification noted is for Planetary Protection requirements.

4.2.3 Operational Temperature:

The pressure transducers will be powered and operational over a temperature range of -90ºC to -50ºC.

4.3 Random Vibe and Shock Environment

The transducers should survive and perform within specification after being subjected to random vibration levels that are likely to be within the range of 15 – 20 grms and shock levels that may be as high as 3000g.

4.4 Functional Characteristics Needs:

4.4.1 Accuracy:

The vendor is requested to provide a description of their approach used to demonstrate accuracy of the sensor. This includes any testing required to achieve the characterization and examples of how this was performed on past projects.

4.4.2 Static Error Band:

The static error band should be no greater than ±0.5 percent of full scale based on an un-weighted least squares straight line fit. The static error band includes errors due to nonlinearity, hysteresis, and non-repeatability.

It is desired that these errors be reduced, this reduction can be performed post processing. If the vendor has performed such reduction on previous missions, explain how the reduction was performed and what needs additional integration, additional pressure testing, etc.

4.4.3 Temperature Error Effects:

The transducer output voltages should not vary from a best fit straight line more than ± 80 mV or ±2.0 % due to temperature variations within the operating temperature range -90 to -60°C (TBR) of the transducer. Overall temperature error, within this temperature range, should not exceed ±1% FS/50°C including both thermal zero and thermal sensitivity effects combined.

It is desired that these thermal effects be reduced. This reduction can be performed post processing. If the vendor has performed such reduction on previous missions, explain how the reduction was performed and what needs additional integration (i.e. internal RTD, other), and testing (additional thermal calibrations, other).

4.4.4 **Full-Scale Pressure Ranges:** ***Note: Ranges are for _two_ different transducers***

4.4.4.1 Supersonic Sensors Pressure Range:

The pressure measurement range covered by this specification should have full-scale absolute pressure ranges of 0-1.0 psia. Zero psia is considered to be less than 10^{-5} torr.

4.4.4.2 Backshell Sensor Pressure Range:

The pressure measurement range covered by this specification should have full-scale absolute pressure ranges of 0-0.1 psia. Zero psia is considered to be less than 10-5 torr.

4.4.5 Response Time:

The transducers should have a maximum response time of 20 milliseconds, defined as the time between the 10 and 90 percent output points from an applied pressure step input.

4.4.6 Resolution:

Each transducer output should have infinite pressure resolution.

4.4.7 External Leakage:

External leakage should not exceed 1 x 10^{-6} cubic centimeters per second of helium from 0 to full scale pressure.

4.4.8 Input Voltage:

The transducers should meet the static error band requirement (Paragraph 4.5.2) when operated with steady-state voltages from 24 Vdc to 32 Vdc.

4.4.9 Input Current:

The transducer input currents should not exceed 50 milliamps during normal operation or for any non-measuring condition such as overpressure or electrical short.

4.4.10 Load Impedance:

The pressure transducer should be calibrated with a nominal load impedance of 10 megohms. The change in output when subjected to a 50K ohm load should be 200 millivolts or less.

4.4.11 Output Impedance:

The transducer output impedance should not exceed 1000 ohms.

4.4.12 Output Voltage:

The transducers should provide a 0 – 5VDC output based on full scale pressure range.

4.4.13 Zero Pressure Output Voltage:

The Pressure System output voltage at zero pressure (10-5 torr) should be 0.5 Vdc ± 0.2 Vdc, nonadjustable, referenced to ground. Accuracy requirements during flight will rely on zero offset correction referenced to deep space vacuum.

4.4.14 Output Voltage Span:

The Pressure System should have an output voltage span of 5.0 Vdc ± 0.2 Vdc for the specified pressure ranges.

4.4.15 Insulation Resistance:

The pressure sensor head should have an insulation resistance of 10 megohms minimum at 50 Vdc between the case and any input or output pin for the pressure sensor head.

4.4.16 Proof Pressure:

The transducers should withstand an overpressure condition of 25 psia without degradation of performance.

4.4.17 Protection:

4.4.17.1 Short Circuit:

Shorting of the output terminals for 15 minutes should cause no performance degradation after the condition is removed.

4.4.18 Vibration:

Transducers (pressure head and electronic circuitry) should have output variations not exceeding ±0.l%/G. The output variation, due to vibration, should be provided (in % change in output per G) for each pressure transducer.

5 Acronyms

CFD	Computational Fluid Dynamics
EEE	Electrical, Electronic, and Electromechanical Parts
EIDP	End Item Data Pack
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
EU	Engineering Unit
LaRC	Langley Research Center
MEADS	Mars Entry Atmospheric Data System
MEDLI	Mars Entry Descent & Landing Instrument
MPE	Maximum Predicted Environments
NPPL	NASA Preferred Parts List
Pa	Pascal
PSIA	Pressure per Square Inch (Absolute)
SOW	Statement of Work
RFI	Request for Information
RTD	Resistive Temperature Device
TBD	To be Determined
TBR	To be Refined
TC	Thermocouple
TPS	Thermal Protection System
TRL	Technology Readiness Level