

STATEMENT OF WORK
ISS SAFER
HIGH PRESSURE TRANSDUCER

INTRODUCTION:

This specification is for a pressure transducer for use on the International Space Station Simplified Aid for EVA Rescue (ISS SAFER) fleet replacement project. The ISS SAFER is a jetpack unit that provides an astronaut with self-rescue capability in the event of unexpected detachment from structure during a spacewalk. The existing SAFER units are being retired over the next two years. The current project emphasizes the maximum use of the existing design, tooling, engineering and qualification testing already accomplished during the previous SAFER fleet delivery. Selective upgrades have been included where necessary due to obsolescence, but no changes are anticipated to any of the requirements used for previously delivered pressure transducers. The replacement pressure transducers must be interchangeable with the existing design.

These pressure transducers will be used in self-rescue devices worn by astronauts during spacewalks. They must be manufactured, tested, and qualified to the highest standards consistent with aerospace hardware. The transducers shall be manufactured per the following specifications and perform at the specified levels and conditions. For continuity and interchangeability, they shall also fit within the envelope and comply with the mounting requirements, as used in the existing SAFER units.

The operational use of the transducer is as follows: the units monitor the pressure in the gaseous nitrogen tank which provides cold gas propellant to the jetpack. As such, it will spend its operational life at approximately 8000 psig and room temperature. The key functional use of the transducer is to verify adequate propellant prior to EVA operations. The system is periodically turned on and a checkout is performed (not less than every 24 months). As readings are taken, they are used to both verify adequate propellant, and to identify any leakage from the sealed nitrogen tank. Long term high pressure stability of the transducer is therefore a key performance parameter. The transducer should be capable of long term (many years) exposure to constant pressure, with negligible change in the measured output.

1.0 Standards and Specifications (or equivalents)

SAE AS9100C	Quality Management Systems for Aviation, Space and Defense Organizations
ANSI NCSL Z540-1	Requirements for Calibration Laboratories, Measuring and Test Equipment
IEST-STD-CC1246D	Product Cleanliness Levels and Contamination Control Program
J-STD-001ES	Space Applications Electronic Hardware Addendum to Requirements for Soldered Electrical and Electronic Assemblies

JSC-49879

**SAE-AS22759/8
SAE-AMS 2681
AS930E
MIL-STD-453**

**Johnson Space Center (JSC) Wire and Cable Integrity
Compliance Program
Wire, Electric, Fluoropolymer Insulated, High Strength Alloy
Welding, Electron beam
Fitting End, Straight Thread, Port Connection
Inspection, Radiographic**

2.0 Quality Requirements: The contractor shall have a Quality Management System (QMS) that complies with International Supplier for Standardization document SAE, AS9100C - Quality Management Systems - Requirements for Aviation, Space and Defense Organizations. The QMS shall be able to provide adequate assurance that the requirements of the technical system specifications can be consistently met and compliance demonstrated. The QMS procedures, planning, and all other documentation and data that comprise the QMS shall be made available to NASA for review. NASA may perform any necessary inspections, verifications, and evaluations, to ascertain conformance to requirements and the adequacy of the implementing procedures. The contractor shall require of sub-tier suppliers a QMS capable of achieving control of the quality of the services and supplies provided. The contractor shall submit a Quality Plan with their proposal. The contractor's quality plan shall make provisions for the following supplements to the SAE AS9100 elements.

2.1 Customer Verification of Subcontracted Product: The contractor shall submit procurement documents to the designated NASA quality representative for determination of the need for Government Source Inspection (GSI) prior to release of the procurement. All work on this order is subject to inspection and test by the Government at any time and place. The Government quality representative who has been delegated quality assurance functions on this procurement shall be notified immediately upon receipt of this order. The Government representative shall also be notified 48 hours in advance of the time articles or materials are ready for inspection or test.

2.2 Review and Disposition of Nonconforming Product

2.2.1 The contractor shall commence formal failure reporting at the start of acceptance testing of production hardware, including certification hardware.

2.2.2 The cognizant Government quality representative shall be a member of the board that approves all dispositions of nonconforming products other than those dispositions being reworked to specification requirement or scrap. Scrap value greater than \$25,000 shall be approved through the MRB process.

2.2.3 A system shall be in place to ensure identification of all materials/products, whether separately produced discrete items, or material produced in batches, to ensure traceability to the original source/manufacturer and to determine verification status. This system shall be maintained throughout the life of this contract, including material/product receipt; all stages of production, delivery and installation, etc.

2.3 Raw Material Controls: Raw materials shall be inspected and tested (e.g., chemical and/or physical testing conducted) to determined conformance to applicable drawing and specifications. Reports of actual test reports shall be identified with particular materials. Raw materials shall be segregated and controlled to prevent use of materials which do not conform to specifications or which are awaiting completion and receipt of satisfactory test results.

2.4 Control of Inspection, Measuring, and Test Equipment: The Contractor shall have a documented calibration system that meets the requirements of American National Standard Institute (ANSI)/National Conference of Standards Laboratories (NCSL) Z540-1, General Requirements for Calibration Laboratories and Measuring and Test Equipment.

3.0 Transducer End Item Requirements

The transducers shall be manufactured per the following specifications and perform at the specified levels and conditions.

3.1 Transducer Range: 0 - 10,000 psia with minimum 7 point calibration curve.

3.2 Combined Accuracy: less than 1% full scale output (combined non-linearity, hysteresis, repeatability, temperature compensation, and zero and full scale set points)

3.3 Non-linearity: Less than +/- 0.15% full scale output.

3.4 Hysteresis: Less than +/- 0.1 % full scale output.

3.5 Long Term Stability: After installation, the pressure transducer will be held at a nominal pressure of 8000 psia for several years. The transducer shall have less than 0.1 % Full Scale drift per year in this application. Verification may be by test or similarity.

3.6 Compensated Temperature Range: -50^oF to +150^oF.

3.7 Operational Temperature Range: -100°F to 200°F.

3.8 Maximum Dimensions: 1.0" diameter by 1.50" case length.

3.9 Minimum Frequency Response: 10 Hz.

3.10 Maximum Transducer Weight: 3 oz.

3.11 Excitation Voltage: 10 +/- 0.1 VDC.

3.12 Full Scale Output: 3.00 +/- 0.03 mV/V

3.13 Input Impedance: Not less than 3000 ohms (nominal 3500 ohms)

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3.15 Materials: Must be compatible for use with gaseous nitrogen and helium.

3.16 Proof Pressure: The minimum proof pressure shall be 15,000 psia. A qualification test shall be performed on a qualification transducer.

3.17 Burst Pressure: The minimum burst pressure shall be 25,000 psia. A qualification test shall be performed on a qualification transducer, shown by similarity, or analysis.

3.18 Fluid Connection: The end fitting shall be per AS930-2 and the surface finish between the threads and transducer case shall have a surface finish of 16 rms. Wrench flats shall be provided.

3.19 Lockwire holes: minimum 2 lockwire holes of 0.043" diameter, preferably on the corners of the wrench flats.

3.20 Vibration: The transducer shall perform nominally after exposure to the following vibration environment, which will be used for acceptance test of the completed SAFER system:

GRMS 8.38

20 - 45 HZ decreasing from 0.2 to 0.04 g²/Hz

45-80 HZ increasing from 0.04 to 0.067 g²/Hz

80 - 350 Hz at 0.067 g²/hz constant

350 - 500 HZ decreasing from 0.067 to 0.056 g²/Hz

500 to 2000 HZ decreasing from 0.056 to 0.014 g²/Hz

The duration will be 5 minutes in each of 3 axes. Qualification can be by test, analysis or assessment. Vibration acceptance test of the transducer is not required.

3.21 Welding: All welds shall be inspected per MIL-STD-453.

3.22 Soldering: All soldering shall be performed per J-STD-001ES

3.23 Humidity Requirements: The transducers shall not be affected by external humidity environments of up to 100% relative humidity.

3.24 Part Identification: The transducers shall be marked with the part number identification, and bagging shall be marked "Class 1, Flight Item."

3.25 Electrical Wiring: "Pig-tail" configuration 2 feet in length, with shrink-wrap tubing, and using 24 gauge wire size per SAE-AS22759/8. Alternate 22759/xx wires may be acceptable, pending NASA review and approval. Test documentation that the procured length of wire met specification shall be provided (i.e. the wire shall be directly from the tested/certified spool, not from a smaller spool that was wound from a larger certified spool); or, the wire shall be tested in accordance with JSC-49879 Johnson Space Center (JSC) Wire and Cable Integrity Compliance Program. Wire shall be less than 10 years from its manufacture date when the transducers are delivered.

3.26 Cleanliness: The transducer shall be cleaned to a level consistent with use in an oxygen system (e.g. CGA 4.1 or equivalent; or level 100A per IEST-STD-CC1246D.) Note the transducer will NOT be used in an oxygen system, but system cleanliness must be maintained.

4.0 Deliverables

4.1 Acceptance Data: Acceptance data shall be provided with quality inspection to verify the specifications 3.1, 3.2, 3.3, 3.4, 3.11, 3.12, 3.13, 3.14, 3.16, 3.21, 3.22, and 3.26. Data sheet/report format is acceptable.

4.2 Qualification Data, Analysis or similarity: Evidence of compliance with the balance of specifications shall be provided per the manufacturer's discretion, subject to NASA review and approval of methodology. Data sheet/report format is acceptable.

4.3 Drawings: Installation drawings showing materials and processes shall be provided prior to acceptance testing of the first unit. These drawings shall show conformance to specifications 3.8, 3.10, 3.15, 3.18, 3.19, 3.24 and 3.25.

4.4 Transducers: 10 transducers shall be provided to NASA within 24 weeks after the order is placed.