METRIC/INCH-POUND

KSC-NE-9187
Revision A

# SENSORS, TRANSDUCERS AND SIGNAL CONDITIONING SYSTEMS SELECTION PROCESS



**April 21, 2022**

**ENGINEERING DIRECTORATE**

National Aeronautics and
Space Administration

**John F. Kennedy Space Center**

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## RECORD OF REVISIONS/CHANGES

| REV LTR | CHG NO. | DESCRIPTION | DATE |
|---|---|---|---|
| | | Basic issue. | February 29, 2008 |
| A | | 1. Replaced Instrumentation Branch with Testing and Design Branch in 1.1.<br>2. Added Test requirements and conditions may be tailored according to program and project requirements in 1.2.<br>3. Revised list of Applicable Documents in 2.<br>4. Revised figure 1.<br>5. Revised the Measurement Level Criteria and Table 1 in 3.1.<br>6. Revised Qualification Levels in 3.2.<br>7. Deleted 3.3, 3.4, 3.5, and 3.6.<br>8. Revised and added Test requirements and conditions may be tailored according to program and project requirements.in 4.1.<br>9. Deleted MIL-STD-5015 and replaced with SAE A5015 in 4.1.13.<br>10. Revised and added Test requirements and conditions may be tailored according to program and project requirements.in 4.2.<br>11. Revised and added Test requirements and conditions may be tailored according to program and project requirements.in 4.3.<br>12. Deleted MIL-STD-461 and replaced with KSC-STD-E-0022 in 4.3.2.<br>13. Revised and added Test requirements and conditions may be tailored according to program and project requirements.in 4.4.<br>14. Revised and added Test requirements and conditions may be tailored according to program and project requirements.in 4.5.<br>15. Deleted National Electrical Code, in particular the National Fire Protection Agency document NFPA 70A Chapter 5 for special occupancies .and replaced with Per Kennedy NASA Procedural Requirements (KNPR) 8700.2, if a system has critical functions, the system is considered to be critical. For functions that are critical, a component Failure Modes and Effects Analysis (FMEA) is performed to further determine and analyze the criticality and effects of the failure in 4.5.<br>16. Added Per Kennedy NASA Procedural Requirements (KNPR) 8700.2, if a system has critical functions, the system is considered to be critical. For functions that are critical, a component Failure Modes and Effects Analysis (FMEA) is performed to further determine and analyze the criticality and effects of the failure and deleted Criticality level in 4.6.<br>17. Revised Transducer Request Form in Appendix A.<br>18. Deleted Appendix B. | April 21, 2022 |

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# 1. INTRODUCTION

## 1.1 Purpose

The purpose of this document is to establish the process for the selection of sensors, transducers, and signal conditioners (henceforth known as measurements) for use as ground support equipment (GSE) at Kennedy Space Center (KSC). This document will explain the process for measurement selection and define the four levels of minimum requirements for sensors and transducers.

## 1.2 Scope

This document's scope is limited to measurements being utilized at KSC in GSE. This set of guidelines has been developed by the NASA KSC Testing and Design Branch of the Engineering Directorate. It is intended to provide a consolidated and consistent approach for the selection of measurements. It is also intended to provide a listing of recommended equipment requirements and their definitions and usage to aide in the development of GSE for subsystems at KSC. Test requirements and conditions may be tailored according to program and project requirements.

# 2. APPLICABLE DOCUMENTS

The following documents form a part of this document. In the event of a conflict between this document and the documents referenced, the contents of this document shall supersede the reference document. The documents are as follows.

| | |
|---|---|
| NASA-STD-6001 | Flammability, Odor, Off-gassing, and Compatibility Requirements and Test Procedures for Materials in Environments That Support Combustion |
| KSC-STD-E-0002 | Hazard Proofing of Electrically Energized Equipment |
| KSC-STD-164 | Environmental Test Methods for Ground Support Equipment Installations at Cape Kennedy |
| SAE AS50151 | Connectors, Electrical, Circular Threaded, AN Type, General Specification For |
| MIL-STD-461 | Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference |
| KSC-YA-5936 | Reference Document for KSC 79K Transducer Terms and Specifications |
| ANSI/ISA S37.1 | Instrument Society of America Standards and Recommended Practices Electrical Transducer Nomenclature and Terminology |

# 3. TRANSDUCER SELECTION

## 3.1 Selection Process

The measurement selection process follows the flowchart shown in Figure 1.

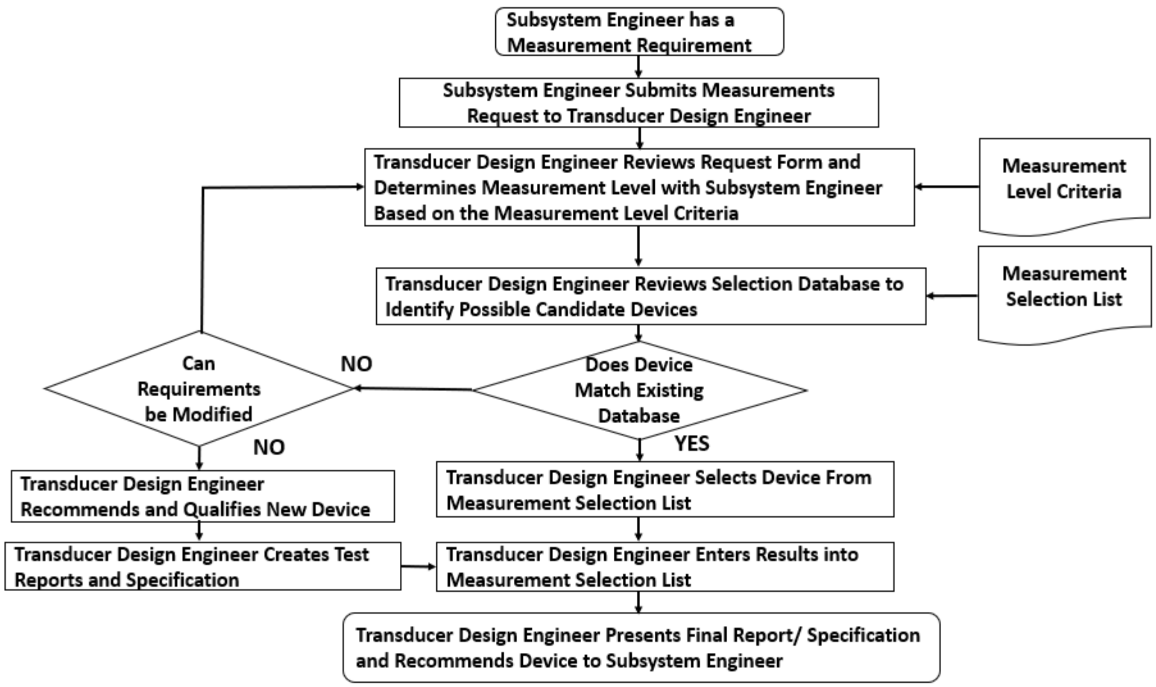


**Figure 1: Measurement Selection Process**

The process begins when the subsystem design engineer (hereinafter subsystem engineer) determines the need for a particular measurement. The subsystem engineer then submits a Transducer Selection Request Form (KSC Form 21-618) to a transducer design engineer in the Testing and Design Branch of the NASA KSC Engineering Directorate. (See Appendix A for a copy of this form). The transducer design engineer will assist the subsystem engineer in completing this form. From this form, the transducer design engineer can determine the selection criteria for this measurement or can select a previously qualified measurement that would be applicable. Once the selection criteria are established, the transducer design engineer will:

a. Compare the selection criteria and desired measurement against the Measurement Selection List to determine if there are devices that are available to meet the requirements in the Transducer Selection Request Form. If no items are available, the transducer design engineer will discuss with the subsystem engineer the possibility of changing the requirements.

b. If the requirements cannot be changed, then the transducer design engineer will perform a market survey to find a new device that will meet the requirements. If the requirements can be changed, the subsystem engineer and transducer design engineer will alter the requirements to meet system requirements against device availability.

c. If the requirements could not be changed then the subsystem engineer will procure several samples (from the market survey) for qualification testing and the transducer design engineer will proceed with testing using approved and documented test procedures.

d. Following the successful performance of a qualification test, the transducer design engineer will file a test report. If the testing was not successful, then additional qualification test devices will need to be procured based on the market survey. The transducer design engineer will create and release a specification into the Engineering Document Control Center. This specification will denote the requirements and will list the devices that passed the qualification testing (section 6 Approved Sources). The transducer design engineer will also enter the device into the Measurement Selection List.

e. Finally, the transducer design engineer will present the final test report, a specification, and the approved device recommendation to the subsystem engineer

The Measurement Level Criteria has been established by the NASA KSC Engineering Directorate for sensors, transducers, and signal conditioning systems based on a specific classification method. This classification method is composed of levels. Levels will be defined based on the intended location of use and will be determined based on the vibration level, acoustic, thermal, electromagnetic environment, and exposure to hazardous fluids. Along with functional and performance requirements, this will be used to determine the qualification testing that will be required as well as aid in component selection for use in each subsystem.

The classification levels presented in this document will be a major driver in the selection of sensors, transducers, and signal conditioning systems to be utilized by the different ground support systems at KSC. Although there will be applications where level classification will not be 100% applicable, the selection will be made based on the most critical parameters required by the subsystem. An overview of the selection levels is found in Table 1.

**Table 1. Overview of Qualification Levels**

| | | | Level Description | LEVEL A | LEVEL B | LEVEL C | LEVEL D |
|---|---|---|---|---|---|---|---|
| HL | | | Hazardous Location | Class 1 Div 1 | Class 1 Div 2 | None | N/A |
| | VL | | Vibration -root-mean-square acceleration (grms) and overall sound pressure level OASPL (dB) | Mobile Launcher, around exhaust well, no shock mount | Mobile Launcher, Launcher Umbilical Tower | Mobile Launcher, Shock Mounted or minimal grms | Launch Pad |
| | | EL | Environmental Control (KSC-STD-164) | Outdoor/Ext temp | Outdoor | Indoor (no climate control) | Indoor (climate controlled) |
| A | A | A | <--Three Letter Qualification Level | | | | |
| Hazard Level | Vibration/Acoustic Level | Environmental Control Level | (Example 1) | Level Examples:<br><br>Example 1, AAA qualified part will be qualified to:<br>A - Class 1 Div 1<br>A - Vibration > 20 Grms and Acoustic level > 160 dB OASPL<br>A - Outdoor (Extended temp -25C to +85C, Humidity, Rain, Icing, Fungus, Salt fog, Sand and Dust)<br><br>Example 2, BAA qualified part will be qualified to:<br>B - Class 1 Div 2<br>A - Vibration > 20 Grms and Acoustic level > 160 dB OASPL<br>A - Outdoor (Extended temp -25C to +85C, Humidity, Rain, Icing, Fungus, Salt fog, Sand and Dust) | | | |

### 3.2 Qualification Levels

The qualification level is described by three digits. The first digit denotes its Hazardous Location level. The second digit denotes it Vibration/Acoustic level, and the third digit denotes its Environmental Control level. Each will be described by a letter as listed below:

(1) Hazardous Location

A – Class 1 Div 1

B – Class 1 Div 2

C – Nonhazardous

(2) Vibration/Acoustic Level

A – Mobile Launcher, around exhaust well, no shock mount

B – Mobile Launcher, Launch Umbilical Tower

C – Mobile Launcher, Shock Mounted or minimal grms

D – Launch Pad

N – N/A

T – TBD

(3) Environmental Control as defined by KSC-STD-164, except electromagnetic interference (EMI), acoustic, vibration, explosion and lift-off blast

A – Outdoor, extended temperature, humidity, rain, icing, fungus, salt fog, sand, and dust)

B – Indoor Climate Control

C – Indoor (No Climate Control)

Note: All EGSE subassemblies and components will be required to meet EMI specification KSC-STD-E-0022.

## 4. DEFINITIONS OF EQUIPMENT REQUIREMENTS

The equipment requirements that are listed below are not a complete listing but are a listing of requirements commonly found in the existing KSC specifications and commercially available measurement specifications. Use of these requirements by the sensors and transducers lab will follow interpretation as found in KSC-YA-5936 where applicable. These requirements will be the basis of the test procedures used to qualify a new measurement.

### 4.1 Electrical Requirements

The following are those requirements associated with the electrical properties of a measurement. Test requirements and conditions may be tailored according to program and project requirements.

#### 4.1.1 External Power

External power is the electrical energy supplied to the transducer for its normal operation. At KSC, external power is from the Ground Special Power subsystem and is set at 28VDC ± 4VDC. Any other power limits will be evaluated against KSC and the request form inputs.

#### 4.1.2 External Power Overvoltage

External power overvoltage is the maximum allowable external power voltage that can be applied to the transducer without sustaining damage. At KSC this has been specified as 35VDC, however it will be evaluated against the request form input.

#### 4.1.3 Fault (External Power) Current Limiting

Current limiting is the capability of a device to prevent propagation of its overcurrent condition to its external power source. This is a KSC specification requirement that is rarely found in commercial specifications. If this is requested by the subsystem engineer, then testing is performed by electrical circuit analysis of the selected device.

#### 4.1.4 Reversed Polarity Protection

Reversed polarity protection is the protection of the device from the application of reversed poles on the external power leads. This is a KSC specification requirement that is rarely found in commercial specifications. If this is requested by the subsystem engineer, then testing is performed by reversing power leads for 15 minutes then restoring the leads and performing a performance check.

#### 4.1.5 Transient Voltage Protection

Transient voltage protection is the protection of the device from the application of a transient voltage spike applied to the external power leads, the input and signal output leads of a device. At KSC this is defined as a 100-volt amplitude spike of 10 millisecond duration. This is a KSC specification requirement that is rarely found in commercial specifications. If this is requested by the subsystem engineer, then testing is performed by injecting a transient voltage to the device leads (power or signal) then performing a performance check.

#### 4.1.6 Signal Output Short Circuit

The signal output short circuit requirement defines how long a device can withstand a signal output short circuit without suffering damage. This is a KSC specification requirement that is rarely found in commercial specifications. If this is requested by the subsystem engineer, then testing is performed by shorting the output leads for 15 minutes then restoring the leads and performing a performance check.

#### 4.1.7 Isolation Resistance

The isolation resistance is the electrical isolation internal to the device between the external power and the output signal of the device. This is a KSC specification requirement that is rarely found in commercial specifications. If this is requested by the subsystem engineer, then testing is performed by measuring the resistance between output and power leads using a 50VDC megohmmeter.

#### 4.1.8 Insulation Resistance

The insulation resistance is the electrical isolation between the external case of a device and the internal electronics of the device. This is a KSC specification requirement that is rarely found in commercial specifications. If this is requested by the subsystem engineer, then testing is performed by measuring the resistance between device leads and the device case using a 50VDC megohmmeter.

#### 4.1.9 Output Impedance

The output impedance is the internal impedance of a device measured across the output leads. This is a KSC specification requirement that is rarely found in commercial specifications. If this is requested by the subsystem engineer, then testing is performed by loading the output signal with a 1000-ohm load and measuring the signal output over this load, then comparing with a high impedance load to calculate the internal impedance.

#### 4.1.10 Output Drive

The output drive is the device's ability to output a signal into a specified input load without degradation of the output signal. This is a KSC specification requirement that is rarely found in commercial specifications. If this is requested by the subsystem engineer, then testing is performed by loading the output signal with a 100,000-ohm load that is shunted by 0.25 microfarads of capacitance and measuring the signal output then comparing to the output measured with a digit multimeter. (1 mega ohm input impedance or better.)

#### 4.1.11 Common Mode Rejection Ratio

The common mode rejection ratio is the common mode amplification by a device in ratio to the differential mode amplification. This is a KSC specification requirement that is sometimes found in commercial specifications. If this is requested by the subsystem engineer, then testing is performed by driving a variable frequency signal input over the standard input for a device and measuring the offset on the output signal.

#### 4.1.12 Excitation

Excitation is the energy that a device provides in making a measurement. An example is the excitation current that a resistance temperature detector (RTD) signal conditioner uses to measure the resistance of the RTD and hence its temperature. This is a KSC specification requirement that is commonly found in commercial specifications. If this is requested by the subsystem engineer, then testing is performed by measuring the excitation energy (voltage or current) and comparing to the requirements.

#### 4.1.13 Electrical Connection

Electrical connection is how power and signals are conveyed to and from the device. This is a KSC specification requirement that is commonly found in commercial specifications. If this is requested by the subsystem engineer, then selection of the device will be made based on the specific connection required by the subsystem engineer. The subsystem engineer shall make use of connections listed in SAE AS5015 when the ambient environment of the device may support explosive fluids either during normal or accidental conditions.

### 4.2 Performance Requirements

The following are those requirements associated with the performance properties of a measurement. Test requirements and conditions may be tailored according to program and project requirements.

#### 4.2.1 Error Band

The error band for a device is the band of maximum deviations of output values from a specified reference line or curve. The error band encompasses all sources of error that the device can have. This is a KSC specification requirement that is often found in commercial specifications as the accuracy (this is an incorrect application.). If this is requested by the subsystem engineer, then testing is performed by performing a three-cycle temperature test (lab temperature, highest then lowest temperatures) using varying inputs and measuring outputs against the reference output for the device. The error band is usually stated in percentage of total or full scale or of reading.

#### 4.2.2 Linearity

The linearity for a device is the amount of closeness that a device's output comes to a straight line fit through the output endpoints. This is a KSC specification requirement that is rarely found in commercial specifications. If this is requested by the subsystem engineer, then the data taken in the error band testing would be used to determine the closeness of the device's performance to a straight line through the endpoints. The linearity of a device is usually stated in percentage of total or full scale.

### 4.2.3 Repeatability

The repeatability for a device is the ability of a device to reproduce output readings when the same measurement value is applied to it consecutively under identical conditions. This is a KSC specification requirement that is commonly found in commercial specifications. If this is requested by the subsystem engineer, then the data taken in the error band testing would be used to determine the repeatability of the device's performance under identical conditions. The repeatability of a device is usually stated in percentage of total or full scale.

### 4.2.4 Warm-up Period

The warm-up period for a device is the time stated by the manufacturer between initial power up and the time that the device can be effectively used. This is a KSC specification requirement that is commonly found in commercial specifications. If this is requested by the subsystem engineer, then the device will be tested after a warm-up period to determine that the device is functioning properly.

### 4.2.5 Drift

The drift of a device is the amount of output shift with a fixed input over a stated time period. This is a KSC specification requirement that is commonly found in commercial specifications. If this is requested by the subsystem engineer, then the device will be tested over a stated time (usually 8 hours) for output variation with the input fixed.

### 4.2.6 Stability

The stability of a device is the amount of output shift with a fixed input over an extended time period. This is a KSC specification requirement that is rarely found in commercial specifications. If this is requested by the subsystem engineer, then the device will be tested over a stated time (usually 90 days) for output variation with the input fixed.

### 4.2.7 Response Time

The response time of a device is the length of time required for the output of a device to rise to a specified percentage of its final value as a result of a step change in input stimulus. This is a KSC specification requirement that is rarely found in commercial specifications. If this is requested by the subsystem engineer, then the device will be tested with a step change from zero to span input stimulus monitored as the same time as the output of the device.

### 4.2.8 End Points

The end points of a device are the outputs of the device at a specified upper and lower input stimulus limits. This is a KSC specification requirement that is commonly found in commercial specifications. If this is requested by the subsystem engineer, then the device will be tested at the stimulus upper and lower setpoints.

#### 4.2.9 Signal Output Range Limits

The signal output range limits of a device are the outputs of the device when the input stimulus exceeds the specified upper and lower input stimulus limits. This is a KSC specification requirement that is rarely found in commercial specifications. If this is requested by the subsystem engineer, then the device will be tested outside the stimulus upper and lower setpoints. When listed in commercial specifications, it is known as the rail state of the device.

#### 4.2.10 Cable Length

The cable length requirement of a device is the ability of the device to send the output signal over 600 feet of instrumentation grade cable used at KSC. This is a KSC specification requirement that is never found in commercial specifications. If this is requested by the subsystem engineer, then the device will be tested with a cable simulator placed on the system and sensor side of the device.

### 4.3 Environmental Requirements

The following are those requirements associated with the environmental properties of operation at KSC. Test requirements and conditions may be tailored according to program and project requirements.

#### 4.3.1 Ambient Temperature

The ambient temperature requirement of a device is the temperature within which the device is intended to operate. This is a KSC specification requirement that is commonly found in commercial specifications. If this is requested by the subsystem engineer, then the device will be tested at the upper and lower ambient temperatures for performance. This testing is done as part of the error band testing. (See section 4.2.1.)

#### 4.3.2 Electromagnetic Interference

The electromagnetic interference requirement of a device is the testing to determine whether a device is going to have problems with electronic noise or will be a source of electronic noise. This testing is based on limits and test procedures established by MIL-STD-461 and is a NASA testing requirement that is not commonly found in commercial specifications. If this is requested by the subsystem engineer, then the device will be tested for compliance with KSC STD-E-0022 latest or specified revision.

#### 4.3.3 Launch Environment

The launch environment requirement of a device is the accumulation of all effects found in the launch environment of KSC. This includes the effects of humidity, salt fog, sand and dust, fungus and sunshine. The test can be performed per KSC-STD-164 or by testing the device outside in the KSC area. This is a KSC specification requirement that is not commonly found in commercial specifications except for humidity. If this is requested by the subsystem engineer, then the device will be tested outside in the KSC area.

#### 4.3.4 Vibration

The vibration requirement of a device is the vibrational power spectral energy that the device will experience during operation or space launch. The vibration requirement at KSC is based on the vibrational energy measured at the location that the device will operate and the number of cycles the device could see during operation. This is a KSC specification requirement that is not commonly found in commercial specifications. If this is requested by the subsystem engineer, then the device will be tested at the power spectral density of the intended location. Additionally, the device will either be operating during vibration testing or will be performance tested before and after each axis of vibration.

#### 4.3.5 Shock

The shock requirement of a device is the ability of the device to operate after a transportation shock associated with dropping the device from a height of four feet. This is a KSC and military specification requirement that is not commonly found in commercial specifications. If this is requested by the subsystem engineer, then the device will be dropped onto a hard surface and the device performance tested.

#### 4.3.6 Acoustic

The acoustic requirement of a device is the ability of the device to operate after an acoustic shock associated with launch. This is a KSC and military specification requirement that is not commonly found in commercial specifications. If this is requested by the subsystem engineer, then the device will be evaluated for resistance to acoustic shock, based on the vibration testing in section 4.3.4.

### 4.4 Mechanical Requirements

The following are those requirements associated with the mechanical properties of a device. Test requirements and conditions may be tailored according to program and project requirements.

#### 4.4.1 Size

The size requirement of a device is the maximum dimensional device envelope for the area that the device will be used. This requirement is usually taken from the manufacturer's drawings and from any specific size that the subsystem engineer requires. If this is requested by the subsystem engineer, then the device will be evaluated for maximum size envelope.

#### 4.4.2 Media Compatibility

The media compatibility is the compatibility of a device to the media it will encounter during operation. This requirement is important for devices intended for use with hypergolic, petroleum and cryogenic fluids. The subsystem engineer shall inform the transducer design engineer of what fluids the device is intended for including any possible cross contamination issues or multiple usages of the device. Media compatibility is conducted using evaluation of materials used in the device either by direct testing or by analysis using the approved lists of materials found in NASA-STD-6001, which is maintained by the KSC Materials Officer. If this is requested by the subsystem engineer, then the device will be evaluated for compatibility to the intended operational media. Any additional testing of materials for the device will be forwarded through the KSC Material Officer for incorporation into NASA-STD-6001.

#### 4.4.3 Materials

The materials requirements are used to establish a list of materials for production of the device that have proven reliable in the KSC environment. At KSC, most of the sensors and transducers are made of corrosion resistant materials like 304 and 316 stainless steel or aluminum with epoxy coatings. If this is requested by the subsystem engineer, then the device will have a list of materials generated.

#### 4.4.4 Sealing

The sealing requirements are based on the need either to weatherproof the device for outdoor usage or to seal the device hermitically for safety. At KSC, most of the sensors and transducers use military weatherproof or hermitically sealed connectors and the devices have O-ring or gasket seals to prevent water and gas intrusion. If this is requested by the subsystem engineer, then the device will have to be tested or evaluated for sealing against water or gas intrusion.

#### 4.4.5 Interchangeability

The interchangeability requirement is based on the need to eliminate the need to make unique installations for same measurement and to limit the number of units in logistics for a particular measurement. Optimum operations dictate that the removal of a measurement should not require the changing of the system to accommodate the next device. If this is requested by the subsystem engineer, then the device will have to be tested in groups of 3-10 units to determine interchangeability.

#### 4.4.6 Mean Time Between Failures

The mean time between failures (MTBF) requirement is used to guarantee that a device will have an operational life sufficiently long enough to support the program. Mean time between failures is a KSC and military requirement based on operational usage, analysis of design elements, and testing of several test units over an extended time. At KSC, the typical MTBF is 100,000 hours between failures at 25 °C. If this is requested by the subsystem engineer, then the device will have to be tested for MTBF.

### 4.5 Safety Requirements

The following are those requirements associated with the safety requirements of operations at KSC. Test requirements and conditions may be tailored according to program and project requirements.

#### 4.5.1 Hazard-proofing

Hazard-proofing at KSC is defined in KSC-STD-E-0002. This document references the National Fire Protection Association (NFPA) 70 National Electrical Code (NEC) Article 500. Hazard-proofing analysis and testing will be required on all Level A and B devices due to the materials involved.

#### 4.5.2 National Electrical Code Rating

As part of the National Electrical Code (NEC), areas that are deemed hazardous are rated by the amount of hazard involved. For the Level A devices this rating is Class I, Division I Groups A-D. This means that the device will or may be in physical contact with the gas acetylene (Group A), flammable gases like hydrogen (Group 8), flammable gases like ethylene (Group C), and flammable gases like propane (Group D). For the Level B devices this rating is Class I, Division II Groups A-D. This means that the device may be in physical contact due to an accident or fault in the system. The group rankings are the same as Division I. The Level C and D devices will not be used in either Class I Division I or Division II areas. The NEC rating will be evaluated by the sensors and transducers lab using the manufacturer's ratings, independent testing such as the Factory Mutual testing or in-house analysis and testing.

### 4.6 Mission Criticality

Per Kennedy NASA Procedural Requirements (KNPR) 8700.2, if a system has critical functions, the system is considered to be critical. For functions that are critical, a component Failure Modes and Effects Analysis (FMEA) is performed to further determine and analyze the criticality and effects of the failure.

The criticality is usually assigned by the program safety, quality, and reliability engineer as part of the design review process. The mission criticality will be listed by the subsystem engineer in the transducer request form.

# APPENDIX A. TRANSDUCER REQUEST FORM

## Transducer Selection Request

Name ____________________________ TSR # ________________ Phone __________________ Date Submitted _________________

Subsystem ________________________ Project _________________________ Date Required __________________

What is the Measurement? _________________________________________________________________ (Pressure, Temperature, Flow, etc.)

What is the Range of this Measurement? ___________________________________________________________ (0-10 psig, -40ºF to 100ºF, etc.)

**Hazardous Location** Choose an item.

**Vibration Level** Choose an item.

**Environmental Level** Choose an item.

Desired Output Signal ___________________________________________________________________________ (0-5 VDC, 4-20mADC, etc.)

Desired Accuracy ____________________________________________________________________________ (1% of FS, 0.5% of reading, etc.)

Voltage/Current Limits __________________________________________________________________________ (26 VDC to 32 VDC, 500mA, etc.)

What Material or Media is Being Measured? ________________________________________________________ (GH2, GOX, LH2, MMH, etc.)

What are the Material Compatibility Issues? _______________________________________________________ (Oxidizer or fuel compatible, etc.)

Desired Electrical Connection _________________________________________________________________________ (Mil-STD, ½"EMT, etc.)

Desired Mechanical Connection _________________________________________________________________________ (ANSI, DN, NPT, etc.)

Maximum Size and Weight __________________________________________________________________________ (40 lbs., 5' X 5' X 3', etc.)

Location of Measurement ______________________________________________________________ (Pad and room, MPPF, ML-level outdoors, etc.)

**Other requirements, comments (please specify):** ______________________________________________________________________

**Contact the transducer group for sensor selection: (or enter legacy part number)** ______________________________________________

***Note: All terminology used in this form can be referenced in Section 4 of KSC-NE-9187.***

## Transducer Selection Request Status (To be filled out by transducer group)

Assigned Engineer ______________________________________________ Phone _______________________________

Projected Qualification Start Date __________________________________ Projected Completion Date __________________________

**Items/Information needed from Requestor: (include date of request)** ________________________________________________

**Qualification Information: (including specification number, etc.)** ________________________________________________

QTP # _______________________________ QTR # ____________________________________

EML Document # _________________________________________ Vibration/Acoustic Date: ______________________

Date TSR Closed: _________________________ Reason for Closure (tests complete, cancelled, etc.) ____________________________

# Transducer Selection Request Form 21-618 Instructions

***<u>First Sheet to be filled out by the requestor.</u>***

**Name, Phone, Dates (submitted and required), Subsystem and Project** – All fields are required before work can begin. **TSR#** will be assigned by the Transducer Lab.

**What is the Measurement?** – Name of value to be measured. Example: *Pressure, Temperature, Flow*

**Range of this Measurement** – Low and high values to be measured. Example: *-40F to 100F. 0-10 psig*

**Hazardous Location** – Select from drop-down

**Vibration Level** – Select from drop-down

**Environmental Level** – Select from drop-down

**Desired Output Signal** – Example: *4-20ma, 0-5V, Profibus*

**Desired Accuracy** – Accuracy needed to take this measurement. Not manufacturer spec. Example: *1% FS*

**Voltage/Current limits** – *Operating and limits for voltage/current.*

**Material or Media being measured** – Needed to insure property of measurement. Example: *GH2, LH2, MMH*

**Compatibility issues** – Example: *Oxidizer or Fuel compatible*

**Desired Electrical Connection** – Need Pins, Style, and materials. Example: *Mil-STD 6 pin, Stainless Steel*

**Desired Mechanical Connection** – Fitting needed for connection to system. Example: *ANSI, NPT, DN*

**Maximum Size and Weight** - Any restrictions for size and weight. Example: *20 lb. and 5" X 5"*

**Enclosure Rating** – Environmental parameters required. Example: *Weatherproof, Class 1 Div 1*

**Location of Measurement** – Example: *ML 180 level location EE-012 cabinet, PAD flame trench*

**Other Requirements** – Example: *Desired operating voltage, Viewable display, Specific size and wiring length,*

*Burst pressure*

**Sensors under Consideration** – Any manufacturer and part numbers of items identified. (if available)

**CHECK BOXES** – What testing do you need completed by the Transducer Lab?

***<u>Second Sheet to be filled out by Transducer Lab personnel.</u>***