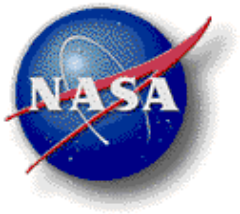
Statement of Work
Orion Crew Exploration Vehicle
TPS Thermocouple Procurement

Orion Thermal Protection System I/O Project

November 6, 2009



National Aeronautics and Space Administration
Ames Research Center
Moffett Field, California

1.0 Definitions:

Reference: ASTM Manual Series MNL12 Manual on The Use Of Thermocouples in Temperature Measurement 4th edition p. 246 Terminology.

1.1 Thermoelement: An electrical conducting circuit component of a single nominal material type that functions as a source of Seebeck emf.

1.2 Thermocouple: Two dissimilar thermoelements electrically isolated from each other except where electrically coupled at a common connection.

1.3 Sensing Junction: The junction where temperature is sensed by the thermocouple.

1.4 Butt-Weld: Thermocouple production method where thermoelements are aligned coaxially and butted together for welding of the sensing junction.

2.0 Thermocouple Construction

The sensing junction of the thermocouple shall be formed by joining the thermoelements in a linear fashion (see Fig. 1a). Joining of the thermoelements to form the thermocouple is to be performed (in the presence of a shielding gas such as argon in order to eliminate or minimize oxidation during the joining process.

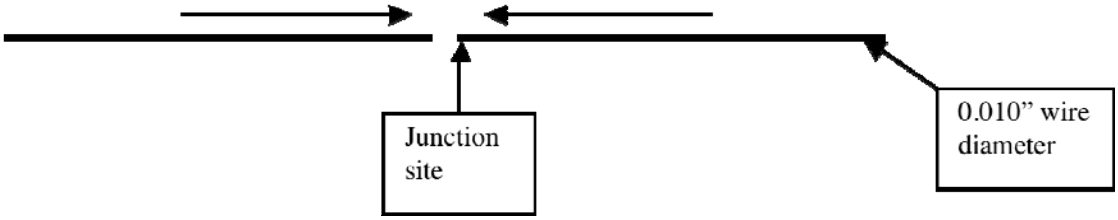


Figure 1 – Thermoelement alignment.

Bead: The sensing junction for the thermocouples is to be placed at the middle of the thermocouple, forming a spherical bead not to exceed 30% of the wire diameter or .013-inches in diameter (see figure 2).

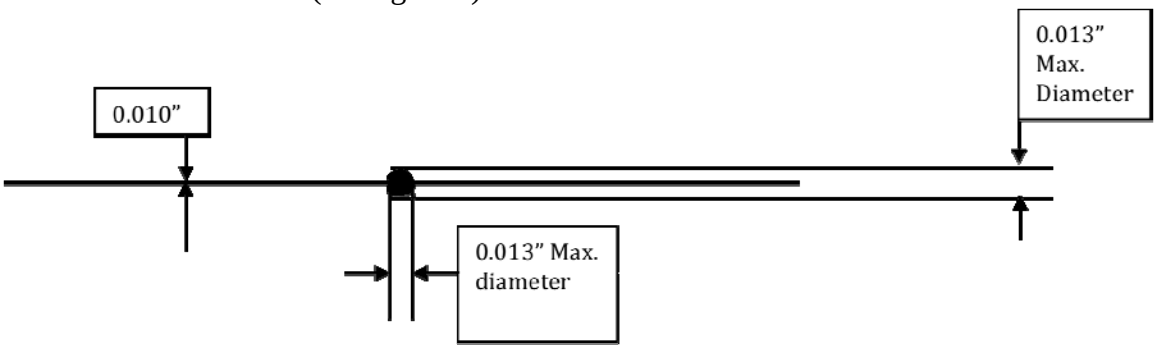


Figure 2 – Thermocouple bead dimensions.

Wire alignment: Thermoelements must be aligned coaxially. Maximum offset not to exceed 15% of the wire diameter.

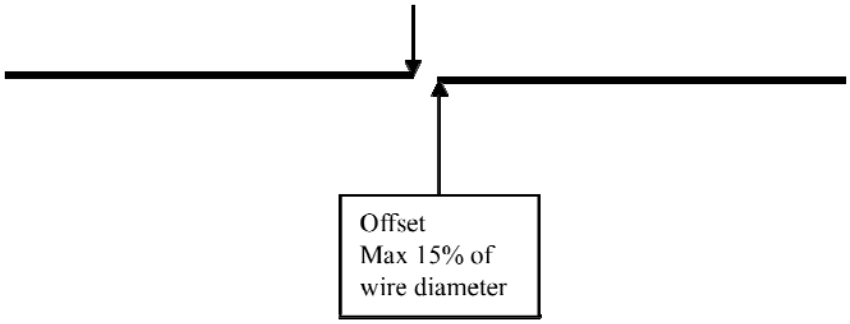


Figure 3 - Coaxial alignment of thermoelements.

Tolerences: All thermocouples shall be "special tolerance" per ITS-90: +/- 1.1°C or +/- 0.4%, which ever is greatest.

Handling: Nitrile or latex gloves shall be worn at all times when handling bare thermoelements to prevent contamination from fingerprints. Thermoelements must remain straight and free of kinks or bends.

3.0 Thermocouple Type:

3.1 K-Type

3.1.1 Quantity: 500 each, butt-welded, Type K thermocouples comprised of nickel with10% chromium for the positive thermoelement versus nickel with 2% aluminum and 2% manganese for the negative thermoelement.

3.1.2 Dimensions: The overall length for each Type K thermocouple shall be 34 +/- 1/2 of an inch. Each thermoelement's length shall be 17 +/- 1/4-inches and a wire diameter of 0.010-inches.

3.2 R-Type:

3.2.1 Quantity: 310 each, butt-welded, Type R thermocouples comprised of platinum with 13% rhodium for the positive thermoelement versus platinum as the negative thermoelement.

3.2.2 Dimensions: The overall length for the Type R thermocouple shall be 24 +/- 1/2 of an inch with each thermoelement's length at 12 +/- 1/4-inches and a wire diameter of 0.010-inches.

4.0 Certification/Quality Assurance:

4.1 Each individual thermocouple shall have its resistance checked and recorded to a resolution of 0.0001 Ohms. The resistance check is to be performed and recorded at ambient temperature. The ambient temperature shall also be recorded

4.2 Thermocouples shall be packaged in groups of 5, with each individual TC tagged with its serial number, resistance measurement, and each negative thermoelement identified.

5.0 Delivery:

A minimum of 20% of each type of thermocouples shall be delivered by December 30, 2009 and the remaining 80% shall be delivered by February 28, 2010. All thermocouples shall be delivered no later than February 28, 2010 to the following address:

NASA Ames Research Center
Building N240A
TPS/MCS, Room 135
Moffett Field, CA. 94035

Attn: Mike Otto 650-604-2547