

**Document No. SU P0145**

# **Standard Materials and Processes Control Plan**

**May 1995**

**Stanford University**

**Contract No: NAS8 – 39225 and follows**

**Gravity Probe B Relativity Mission**

---

**BenTaller**  
**Quality Engineer**

---

**Jeremy Kasdin**  
**Chief System Engineer**

---

**Prof. J. Turneaure**  
**Hardware Manager**

---

**Prof. B. Parkinson**  
**Program Manager**

Note: August 04, 1999 Newly produced for d/b input

**TABLE OF CONTENTS**

**1 Introduction.....3**

**2. Applicable Documents.....3**

**3. General Requirements .....3**

**3.1 Policy .....3**

**3.2 Materials Selection .....4**

**3.3 Controlling Documents.....4**

**3.4 Special Materials and Processes.....4**

**3.5 Verification and Responsibility .....4**

**3.6 Sub-Contractors .....4**

**3.7 Off-the-Shelf Items .....4**

**4. Process Specification .....4**

**Attachment A .....5-7**

## 1. Introduction

This document defines the requirements for standard materials and processes use in Relativity Mission program during design, fabrication and test, at Stanford and its sub-contractors. This document was written to meet the intent of MSFC-STD-506C “Standard Materials and Processes Control”.

- Since equipment made at SU does not include structural members, SU’s activities described in this document do not include all the requirements of MSFC-STD-506C.

*The Relativity Mission Quality Plan, P0108*, is part of this plan and covers general issues like Organization, Identification, Procurement Control, Design and Development Control including Drawing Release and Change Control and more.

## 2. Applicable Documents

|                |   |
|----------------|---|
| MSFC-STD-506C  | Standard Materials and Processes Control.                                 |
| SU-P0108       | SU, Science Mission Quality Plan  |
| LMSC/GPB100275 | Science Mission, LMSC Payload, Approved Material and Process List LSE-03. |
| LMSC SSD       | F440459, Approved Materials and Processes List                            |

## 3. General Requirements

### 3.1 Policy

Materials and processes used in Relativity Mission will be selected by considering all operational and engineering properties including magnetic, strength, cryogenic, fatigue, outgassing and so on.

The major sub-contractors, like LMSC, whose SOW includes design and material selection, will prepare Material and Processes Control Plan that will meet all the requirements described in this plan. These plans will be reviewed and approved by SU.

### 3.2 Materials Selection

Materials for items designed at SU will be selected from SU’s Materials and Processes Selection List, Appendix A.

Materials for items designed at LMSC RDD will be selected from LMSC Approved Material and Process List, LMSC/GPB 100275.

Materials for items designed at LMSC SSD will be selected from LMSC SSD F440459, Approved Materials and Processes List.

### **3.2 Materials Selection (continued)**

Materials for items designed at LMSC SSD will be selected from LMSC SSD F440459, Approved Materials and Processes List.

### **3.3 Controlling Documents**

Materials and processes are defined by standard or specification like MIL, AMS, ASTM, AWS etc.

### **3.4 Special Materials and Processes**

Materials or processes which might contribute to deterioration of structural members (due to hydrogen embrittlement, creep, fatigue, radiation exposure etc.), will be identified and reported to MSFC. The deterioration mechanism will be evaluated, reviewed and resolved prior to fabrication.

### **3.5 Verification and Responsibility**

As described in the Quality Plan, each drawing / design, is reviewed prior to its release by Design Review Board. This Board includes the Senior Design Engineer for the system, the Quality Engineer and all other disciplines that are relevant for the specific part. During this review it's the responsibility of each member of the board to verify and approve the material selection from their point of view. The approval will be signing the Drawing Approval Form.

### **3.6 Sub-Contractors**

- Major sub-contractors – see paragraph 3.1
- Other subcontractors: All materials used by subcontractors will be either supplied or approved by SU.

### **3.7 Off the Shelf Items-**

List of all 'Off the Shelf' and/or Custom Modified items for each assembly will be part of the assembly drawing and will be reviewed and approved by the Design Review Board as described in paragraph 3.5.

## **4. Process Specification**

Standard Processes used at SU are described in SU's Materials and Process Selection List, Appendix A.

**ATTACHMENT A**

**Stanford University Materials and Processes Selection List**

**I. Materials**

**1. Aluminum**

- 1.1 QQ-A-225/8E Federal Specification, Aluminum alloy 6061, Bar, Rod, Wire and special shapes; rolled, drawn or cold finished.

**2. Beryllium Copper**

- 2.1 ASTM B 194-92A  
Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip and Rolled Bar
- 2.2 ASTM B 196-90  
Standard Specification for Copper-Beryllium Alloy Rod and Bar.

**3. Copper**

- 3.1 ASTM B 133-92 Standard Specification for Copper Rod, Bar, and Shapes.

**4. Delrin**

- 4.1 ASTM D 4181-92a  
Standard Specification for Acetal (POM) Molding and Extrusion Materials.

**5. Niobium**

- 5.1 ASTM B392-89  
Standard Specification for Niobium and Niobium Alloy Bar, Rod, and Wire.
- 5.2 ASTM B393-89  
Standard Specification for Niobium and Niobium Alloy Strip, Sheet, and plate.
- 5.3 ASTM B 394-89  
Standard Specification for Niobium and Niobium Alloy Strip, Seamless and Welded Tubes.

**6. Phosphor Bronze**

- 6.1 ASTM B 103-89

**6. Phosphor Bronze (continued)**

6.2 ASTM B 139-90

6.3 ASTM B 159-86

Standard Specification for Phosphor Bronze Wire.

**7. Quartz**

MIL-G-174B, Military Specification, Glass Optical.

**8. Sapphire**

**9. Teflon**

9.1 ASTM D1710, TFE-Fluorocarbon Rod

(replacing MIL-P-19468A, Military Specification, Plastic Rods,  
Polytetrafluoroethylene Molded and Extruded.

9.2 MIL-P-22241B (Notice 1 February 1987)

Military Specification, Plastic Sheet (and Film), Polytetrafluorethylene (TFEE-  
Fluorocarbon Resin).

9.3 MIL-P-22296B (Notice 1 February 1987)

Military Specification, Plastic Tubes and Tubing, Polytetrafluoroethylene (TFE-  
Fluorocarbon Resin), Heavy Walled.

**10. Titanium**

10.1 ASTM B 265-90

Standard Specification for Titanium and Titanium alloy Strip, Sheet, and Plate.

10.2 ASTM B 348-93

Standard Specification for Titanium and Titanium alloy Bars and Billets.

10.3 AMS 4902F

Aerospace Material Specification, Titanium Sheet, Strip, and Plate, Commercially  
Pure, Annealed, 40.0 ksi Yield Strength.

10.4 AMS 4921F

Aerospace Material Specification, Titanium Bars, Forging, and Rings Annealed,  
70,000 psi Yield Strength.

## **10. Titanium (continued)**

### 10.5 AMS 4928L

Aerospace Material Specification, Titanium Alloy Bars, Forging, and Rings, 6A1-4V, Annealed.

## **11. Vespel**

### 11.1 MIL-R-45198, Type 1M, Rod

## **II. Processes**

### 1. AMS 2525B

Aerospace Material Specification, Graphite Coating, Thin Lubricating Film, Impingement Applied

### 2. AMS 2526B

Aerospace Material Specification, Molybdenum Disulfide Coating, Thin Lubricating Film, Impingement Applied.

### 3. AMS 248B

Aerospace Material Specification, Anodic Treatment of Titanium and Titanium Alloys.