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Standard Materials and Processes Control Plan

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Stanford University

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Gravity Probe B Relativity Mission

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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 used 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**

- 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

4. Delrin
   4.1 ASTM D 4181-92a

5. Niobium
   5.1 ASTM B392-89
       Standard Specification for Niobium and Niobium Alloy Bar, Rod, and Wire.
   5.2 ASTM B393-89
   5.3 ASTM B 394-89

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

7. Quartz


8. Sapphire

9. Teflon

9.1 ASTM D1710, TFE-Fluorocarbon Rod
   (replacing MIL-P-19468A, Military Specification, Plastic Rods,
   Ploytetrafluoroethlyene Molded and Extruded.

9.2 MIL-P-22241B (Notice 1 February 1987)
   Military Specification, Plastic Sheet (and Film), Polytetrafluorethylene (TFE-
   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

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