PD 686-036

SeaWinds Experiment

Materials and Processes Control Requirements

July 1994

Jet Propulsion Laboratory
California Institute of Technology

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JPL D-11151

PD 686-036

SeaWinds Experiment

Materials and Processes Control Requirements

Prepared by: _____
Willis, Materials and
Processes Engineer

Approved by: _____ P.
M.C. Trummel, Manager
Product Assurance

Approved by: _____
T. P. O'Donnell, Deputy Manager
Space Materials Science
and Engineering Section

Approved by: _____
J. E. Graf, Manager
SeaWinds Project

July 1994

Jet Propulsion Laboratory
California Institute of Technology

JPL D-11151

DOCUMENT LOG

Date	Revision No.	Notes
November 1993	Preliminary	All
January 1994	Original	3.4.1.17 "Electronic Cabling and Accessories"

JPL D-11151

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Section 1
Introduction

1.1 Purpose

The purpose of this document is to define a materials and processes (M&P) control requirements to ensure proper selection and utilization of materials and processes to meet the SeaWinds instrument functional, reliability, and safety requirements. Control of materials and processes used in the SeaWinds equipment is derived from: (1) the material requirements specified in JPL D-5266, (2) the need to prevent contamination of instruments adjacent to ADEOS II systems, (3) conformity with safety requirements, and (4) the requirement to meet Jet Propulsion Laboratory (JPL) engineering standards for flight quality hardware as identified in JPL document D-8966.

This document complies with the materials and processes requirements imposed by JPL D-5266 "Materials and Processes Requirements for Class B Instruments Using Expendable Launch Vehicles", PD686-037 "SeaWinds Systems Safety Requirements", and D-8966 "Flight Instrument Classifications and Product Assurance Requirements".

1.2 Scope

This document defines the control requirements for materials and processes to be used on the SeaWinds Instrument and approaches to document that these requirements have been satisfied. It is specifically directed at applications involving the flight equipment.

1.3 Applicability

All mechanical parts, materials and processes used in the fabrication of flight hardware, except electronic parts (eg. capacitors, transistors, diodes, CCD's, etc.), are covered by this document. Provisions of this plan apply to both organizations within JPL that are responsible for the development of flight hardware as well as all Contractors and their Subcontractors similarly providing flight hardware.

1.4 Applicable Documents

The following documents of issue at time of release are in effect and form a part of this Document. In case of conflict between a referenced document and this Document, the Materials & Processes Engineer should be contacted for resolution.

1.4.1 NASA Documents

TM-100351 Material Selection Guidelines to Limit Atomic Oxygen effects on Spacecraft Surfaces

1.4.2 JPL Documents

D-5945	JPL Standard for Waiver Requests
PD686-031	Reliability Assurance Requirements
PD686-032	Quality Assurance Requirements
PD686-033	Problem/Failure Reporting & Analysis Requirements
PD686-034	Electronic Packaging Requirements (JPL D-8208)
PD686-035	Contamination Control Requirements (JPL D-11312)
PD686-037	System Safety Requirements (D-11189)
PD686-430	Environmental Requirements
FS 511316	Detail Specifications for Qualification of Critical Fasteners
STD-00009	Flight Materials,Fasteners, Processes, and Packaging Hardware Selection Guide
D-1348	JPL Handbook for Electrostatic Discharge Control

1.4.3 Other Documents

Johnson Space Center

JSC SP-R-0022A	Vacuum Stability Requirements of Polymeric Materials For Spacecraft Applications
JSC 22267	Fatigue Crack Growth Computer Program "NASA/FLAGRO"

Marshall Space Center

MSFC-SPEC-522	Design Criteria For Controlling Stress Corrosion Cracking

Reference Documents

The following documents are mentioned in the text of this Document and are for reference purposes only:

JPL D-5266	Material and Processes Requirements for Class B Instruments Using Expendable Launch Vehicles
JPL D-8966	JPL Standard for Flight Instrument Classifications and Product Assurance Requirements
NASA RP-1124	Outgassing Data for the Selection of Spacecraft Materials

JSC-02681	Non-Metallic Materials Design Guidelines and Test Data Handbook
MSFC-HDBK-527/ JSC-09604	Materials Selection List for Space Hardware Systems
MIL-HDBK-5	Metallic Materials and Elements for Aerospace Vehicle Structures
MIL-HDBK-17	Plastics for Flight Vehicles
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-889	Dissimilar Metals
MIL-I-6870	Requirements for Non-Destructive Inspection Program

Section 2
Organization and Responsibilities

2.1 SeaWinds Organization

The SeaWinds Materials & Processes Engineer reports directly to the appropriate Cognizant Subsystem Technical Manager. The System Safety and Quality Assurance functions report to the Product Assurance Manager who reports directly to the SeaWinds Project Management.

2.2 Responsibilities

2.2.1 SeaWinds Cognizant Technical Managers

The SeaWinds Cognizant Subsystem Technical Managers are responsible for implementing the requirements of this document, either through actions within JPL or by assignment to subcontractors or suppliers. The SeaWinds Subsystems Technical Managers are also responsible for ensuring the timely submittal of design information to the SeaWinds Materials & Processes Engineer.

2.2.2 Contractor Requirements

The SeaWinds contractors shall meet the requirements contained in this document. The contractor Technical Managers shall submit MIUL forms for approval by the JPL Materials & Processes Engineer prior to fabrication of hardware. In the event that changes are made, a final update shall be submitted for approval.

2.3 Approach

The process for materials control on the SeaWinds Instrument is shown in Figure 1. Each Cognizant Engineer will submit material selections and concerns to the SeaWinds Materials & Processes Engineer as early as practical in the design. The SeaWinds Materials & Processes Engineer will review material applications based on instrument safety, functional, and reliability requirements as well as the requirements contained herein, and sign all JPL drawings for the SeaWinds Instrument. Material Identification and Usage Lists (MIUL's), shown in Appendix A, shall be prepared by the subcontractor Technical Managers for all flight hardware fabricated to non-JPL drawings. MIUL's will be prepared prior to each major project review milestone (ie. PDR, CDR. Materials Usage Agreements (MUA's), shown in Appendix B, will be prepared by the Cognizant Engineer for materials which do not meet either flammability, stress corrosion cracking, or outgassing requirements. All MUA's shall be reviewed and approved or disapproved by the SeaWinds Materials & Processes Engineer. In cases where approval is not granted and use is still desired, a waiver request shall

be submitted per JPL D-5945. All approved Material Usage Agreements and Stress Corrosion Evaluation Forms will be provided to the Product Assurance Manager. The SeaWinds Materials Engineer will be the custodian for the SeaWinds MIULs and MUAs.

Section 3
Requirements

.c1.3.1 Introduction;

The section establishes the requirements for the selection and application of materials and processes for the SeaWinds flight hardware. All the requirements contained in this Document shall apply to instrument and sub-system contractors as well as JPL, and shall be identified in appropriate contractual documentation. Unique requirements are described in the subsequent sections.

3.2 Selection of Materials and Processes

All materials and processes shall be qualified for the application in which they are used. Issues of flight qualification are very application specific and shall be reviewed by the Materials & Processes Engineer on a case-by-case basis. In the event the design agency does not have appropriate data to indicate the suitability of a material or process, a qualification/evaluation test plan shall be generated and submitted to the SeaWinds Materials & Processes Engineer for approval.

3.2.1 Standard Materials and Processes Selection Sources

JPL-STD-00009, "Preferred Materials, Fasteners, Processes and Packaging and Cabling Hardware"

PD686-034, "Electronic Packaging Requirements"

JSC-02681, "Non-Metallic Materials Design Guidelines and Test Data Handbook"

NASA RP-1124, "Outgassing Data for Selection of Spacecraft Materials"

MSFC-HDBK-527/ "Material Selection Lists for Space

JSC-09604, Hardware Systems"

MSFC-SPEC-522, "Design Criteria for Controlling Stress Corrosion Cracking"

The preceding documents are recommended as sources for general material selection and design. For Contractor produced hardware, the contractors existing preferred materials lists can be used, subject to review and approval by the SeaWinds Materials & Processes Engineer. In selecting materials from JPL-STD-00009, contractor

documents, and the other documents listed, the following caveats should be noted:

(1) Materials listed are not given blanket approval for all spacecraft uses. The particular application involves numerous considerations which must be approved by the contractor Technical Manager and reviewed by the SeaWinds Materials & Processes Engineer.

(2) Process and control documentation constitute an integral part of the "preferred" listing. For example, polymers applied in the uncured state shall be mixed and cured as specified in JPL STD-00009 and supporting process specifications. A mix ratio of ingredients or a cure temperature different from those listed constitutes a new material and must be uniquely qualified for its intended use.

(3) Materials applications listed in JPL STD-00009 are indicative of how each material is commonly used. The listings are not intended to exclude other potential applications, provided these are identified early in the design effort and approved by the contractor Technical Manager and reviewed by the SeaWinds Materials & Processes Engineer.

(4) Applications of listed materials and processes may be additionally restricted due to unique requirements. For example, restrictions may apply due to molecular or particulate contamination, magnetics, radiation susceptibility, electrostatic discharge, electromagnetic interference, atomic oxygen erosion, and other environmental or operations driven requirements.

Assistance in dealing with materials and processes functional, safety or multi-instrument issues such as contamination can be obtained from the SeaWinds Materials & Processes Engineer. All safety issues shall be coordinated with, and resolved through the SeaWinds Safety Engineer.

3.2.2 Non-Standard Materials and Processes Selection Sources

Design agencies intending to use selection sources not included in 3.3.1, shall submit a written request to the SeaWinds Materials & Processes Engineer for use (identifying subject materials, processes, and parts) along with a justification for use. Appropriate JPL technical specialists designated by the SeaWinds Materials & Processes Engineer shall review and approve or disapprove such requests within a period of time not exceeding two working weeks. The justification shall identify the heritage, investigation, studies, and analyses performed that substantiate the need for and acceptability of using a non-

standard design item. If disapproved, and the implementing organization still requests its use, this use may be granted after a user submittal and Project Manager approval of a waiver per JPL document D-5945.

The designing agency shall include a qualification/ evaluation test plan as part of the initial justification package, in the event the design agency does not have appropriate data which indicates the suitability of the non-standard design item. The design agency shall also include the implications of weight, power, volume and cost, if the use of the non-standard design item is not approved. The proposed non-standard design item shall not be considered acceptable for use in flight hardware application until the JPL Materials & Processes Engineer provides written approval, based on the results of the qualification process, that includes a risk assessment for the use of the non-standard design item.

The Materials & Processes Engineer, assisted by the appropriate JPL technical specialists, shall assure that, as an alternative, no standard design item can be used to accomplish the required function, and that the risks for use of the non-standard item are acceptable to the SeaWinds instrument.

3.3 Submittal of Material Identification and Usage Lists

Material Identification and Usage Lists (MIUL) for packaging and cabling, fasteners, materials, processes, mechanical parts, and special parts shall be developed by all design agencies (JPL, subsystem contractors and suppliers). Each MIUL shall contain the information described in 3.4.2. These lists shall be provided to the Project for approval. MIUL's shall be submitted to the Project one month prior to the Preliminary Design Review (PDR) for review and approval by the SeaWind Materials and Processes Engineer. MIUL will be provided by the SeaWinds Materials Engineer one month prior to the Critical Design Review (CDR). Any open or unresolved issues are to be discussed at the CDR.

3.3.1 Classification of MIUL Submittals

The Project will classify all submittals according to the following criteria. The classification given to the design item combinations proposed for the use in flight instrument hardware designs shall be determined by evaluation based on the acceptability of the: (1) design item, (2) application, and (3) controlling documentation.

(1) Class 1 - Acceptable
The identified design item combination (including specified manufacturer) is acceptable when used in the

indicated application and under the control of the listed documentation, and the evaluation/qualification data and applicable documents are available and are all acceptable.

(2) Class 2 - Qualified Acceptable
The identified design item combination (including specified manufacturer) is considered qualified acceptable when used in the indicated application and under the control of listed documentation, even though only limited evaluation qualification data are available. No further effort is considered warranted to improve the classification.

(3) Class 3 - Provisional
This is a temporary classification for a design item combination where the qualification/evaluation data or applicable documentation is available, but where a decision as to its acceptability has not yet been made. Eventual Class 1 or Class 2 assignment is anticipated and design may proceed subject to final reclassification (although the Class 4 possibility is not excluded). All Class 3 combinations shall be reviewed for reclassification 1, 2, or 4) prior to the Preliminary Design Review (PDR) of each subsystem. All remaining Class 3 combinations shall be reclassified prior to each subsystem's Critical Design Review (CDR).

(4) Class 4 - Unacceptable
One or more elements of the design item combination is considered unacceptable for the indicated application. All Class 4 design item combinations shall be reviewed by the Project Manager or his designee prior to or at the CDR. The use of a Class 4 design item combination beyond the CDR requires an approved Class B waiver (Reference Document D-5945) that will include a risk assessment by the SeaWinds Materials & Processes Engineer, which identifies all risks and assesses their significance.

3.3.2 Development of Materials and Processes Information

The following information shall be documented in the MIUL format shown in Attachment 1, in support of the selection of materials and processes.

a. Polymeric materials used, with the following information:
   1. Identification of material and manufacturer, e.g., Epoxy, Epon/828, Shell Chemical Company.
   2. Mix formula, including proportions and name of resin, catalyst, filler, etc., e.g., Epon

828/V 140 Silflake 135 as 5/5/38 parts by weight.

3. Application (e.g., encapsulation, conformal coating, potting for high-voltage components).
4. Cure (time, temperature, environment)
5. Expected environment (testing, storage, handling, transportation, launch, orbit and re-entry).

b. Inorganic materials used, with the following information:

1. Identification (name and number of material, manufacturer, e.g., aluminum 6061-T6; electroless nickel plate, Enplate; NI-410, Enthone, Inc.; fused silica, Corning 7940, Corning Glass Works; Weld Filler Metal 4043).

2. Condition, including details of the finished condition of the material, heat treat designation (hardness or strength) surface finish and coating, cold worked state, welding, brazing, etc., e.g., heat-treated to R_C 60 hardness, gold electroplated brazed, surface coated with .002 inch thick vapor-deposited aluminum, cold worked to full hard condition and welded by tungsten inert-gas process, electroless nickel plate.

3. Applications (e.g., electronics box structure in electronics control sub-system, not hermetically sealed).

4. Expected environment.

c. Lubricants used, with the following information:

1. Component identification, type, material(s) (e.g., Antenna scan actuator, ball bearing, CRES 440C).

2. Component manufacturer and manufacturer identification.

3. Proposed lubricant and approximate amount used.

4. Type and number of wear cycles (e.g., intermittent rotation, Cycles $>10^6$).

5. Speed, temperature, atmosphere during

operation (e.g., variable speed, -15/+50˚C, air, vacuum).

6. Type of loads and amount (e.g., axial, 200 lbf).

7. Any other pertinent details.

d. Processes used, with the following information:

1. Type of process (e.g., chemical conversion coat).

2. Contractor specification number.

3. MIL, ASTM, Federal or other specification number (e.g., MIL-STD-810, etc.).

4. Description of material processed (e.g., aluminum 6061-T6). In the case of polymeric processing such as encapsulation or conformal coating, give the trade name, formulation, and cure conditions. The polymeric materials shall be cross-referenced with those specified in the polymeric materials list.

5. Application for which the materials are proposed.

3.4 Review of Materials and Process Applications

The SeaWinds Materials & Processes Engineer shall review the applications of the proposed materials and processes on the basis of engineering drawings or completed MIUL lists prior to approval. The Materials & Processes Engineer sign off on JPL drawings shall also be required. The Materials & Processes Engineer shall also participate in audits and consult with all subtier contractors and vendors to assure that their materials and processes are acceptable for the intended application.

Material Usage Agreement (MUA) forms (shown in Appendix B) shall be prepared by the design agency for all applications of materials and processes that do not meet the requirements of Section 3.5.1.1 Flammability, Section 3.5.1.2, Vacuum Stability & Outgassing, and Section 3.5.1.3 Corrosion and Stress Corrosion Cracking. For JPL designed hardware, MUA's shall be submitted to the SeaWinds Materials and Process Engineer for approval. For non-JPL designed hardware, MUA's shall be prepared for review and approval of the contractor Materials & Processes Engineer. All contractor approved MUA's shall be submitted to the JPL Materials & Processes Engineer for final approval. If approval is not granted and use is still desired, a waiver request shall be submitted to

JPL (per D-5945) by the contractor. The SeaWinds Materials & Processes Engineer shall provide a risk assessment identifying all risks and assessing their significance.

3.4.1 Evaluation

Materials and processes shall be assessed by the combined consideration of three factors: 1) materials or process type (including manufacturer), 2) specific design application or requirement, and 3) documented control provisions.

Material selections shall be reviewed for radiation effects (ultraviolet and charged particle), atomic oxygen effects, resistance to debris and micrometeroid impact, potential for surface charging, stress-corrosion cracking, galvanic corrosion, hydrogen embrittlement, lubrication, potential for particulate contamination and weld heat-affected areas, as applicable. Mission or instrument critical high-strength fasteners and pressurized systems shall be reviewed from a structural integrity viewpoint before they are accepted for use.

Recommendations regarding materials and processes (as provided by the technical support disciplines, specialists, and Reliability Engineering) shall be considered by the Project/Task Manager or his designee in conjunction with other relevant factors. Such factors include the functional design requirement, reliability, fabrication and assembly techniques, design aspects of electronic packaging, temperature control and environmental compatibility, cost and hardware delivery schedule.

3.4.1.1 Material Outgassing

Only those organic materials with a total mass loss (TML) of less than 1.00 percent and a collected volatile condensable mass (CVCM) of less than 0.10 percent, when tested in accordance with ASTM Method E-595, JSC SP-R-0022A "Vacuum Stability Requirements of Polymeric Materials For Spacecraft Applications", or contractor equivalent, are acceptable for general spaceflight use.

3.4.1.2 Cleanliness/Contamination Control

Cleanliness and contamination control considerations to ensure that the integrity of the hardware, or its performance, is not compromised during fabrication, assembly, test, or transportation shall be defined by the Contamination Control Plan. Reliability assurance considerations for prevention and control of contamination are given in PD686-035 "Seawinds Contamination Control Requirements". Unique requirements for the use of materials

and processes will also be governed by this document.

3.4.1.3 Flammable Materials

Materials shall be noncombustible or self-extinguishing to the greatest extent possible and conform with the flammability requirements of Western Space and Missile Center Regulation (WSMCR) 127-1, par 3.10, or contractor equivalent. Where flammable materials must be used, the standard hazard elimination and control requirements apply, as follows: (a) two failure tolerance on ignition sources, (b) physical separation of the flammable material from ignition sources, and (c) elimination of flame propagation paths.

3.4.1.4 Stress Corrosion Cracking

The use of A or B rated materials per MSFC-HDBK-527/JSC-09604, or Table I and II materials per MSFC-SPEC-522, is required. The alloys listed in Table III should be considered for use only in applications where it can be demonstrated conclusively that the probability of stress corrosion is remote. If Table III materials (or materials not listed in MSFC-SPEC-522) are planned to be used, a Materials Usage Agreement (MUA) (Appendix B) along with a Stress Corrosion Evaluation Form (Appendix B) shall be prepared and submitted for approval.

3.4.1.5 General Surface and Galvanic Corrosion

Corrosion can be aggravated through the coupling of dissimilar metals. MIL-STD-889, or contractor equivalent, shall be used as a guideline document for controlling dissimilar metal contacts.

3.4.1.6 Lubricants

Selection of bearings, gears, lubricants, surface finishes, etc., will be dictated by application requirements which may include relative part speed, load, temperature, operating lifetime, and contamination. JPL standards, or contractor equivalent, shall be used as a guide in the selection of lubricants, and of those listed, the least volatile should be considered. The requirements of the "SeaWinds Contamination Control Requirements", document PD686-035, should be used as a guide to the selection of bearing lubricants.

3.4.1.7 Ceramic and Composite Materials

All applications of ceramic and composite materials will be reviewed by the SeaWinds Materials & Processes Engineer. This review will include all qualification data, specifications and acceptance requirements. Acceptability

for the desired application shall be verified on the basis of similarity, analysis, test, inspection, existing data or a combination of these techniques. Where necessary data or documentation does not exist, the SeaWinds Materials & Processes Engineer will assist in the development of new specifications or qualification test plans.

3.4.1.8 Moisture and Fungus Resistance

Flight hardware shall be designed so that materials are not nutrients for fungi except when used in permanent hermetically sealed assemblies and other accepted and qualified parts. Other necessary fungi nutrient material applications shall require treatment by a method which will render the resulting exposed surface fungi resistant. The criteria for the determination of fungi and moisture resistance shall be that contained in MIL-STD-810.

3.4.1.9 Magnetic Materials

The use of magnetic materials shall be limited, as necessary, to meet the magnetic requirements contained in PD686-430 "SeaWinds Environmental Requirements".

3.4.1.10 Hazardous Materials

The design of systems which contain toxic materials shall be carefully assessed to eliminate releases of these materials to atmosphere and the necessity to establish toxic hazard corridors.

3.4.1.11 Static Charge Sensitivity

The degree to which differential charging of exposed-to-space materials must be limited depends on the degree of sensitivity to electrostatic discharge (ESD). For those cases in which ESD must be limited to some maximum permissible amount, guidelines identified in the documentation shall be followed. The requirements of JPL D-1348 Rev.A, "JPL Handbook for Electrostatic Discharge Control", or contractor equivalent, shall apply for all other situations. Special handling procedures, for devices which are susceptible to damage from static electrical discharge, as identified in D-1348 and document PD686-034.

3.4.1.12 Atomic Oxygen Resistance

All materials considered for use on the external surface of spacecraft intended for low-earth-orbit operations shall be evaluated for their resistance to atomic oxygen erosion. NASA-TM-100351, "Material Selection Guidelines to Limit Atomic Oxygen Effects on Spacecraft Surfaces" shall be used as a guideline in determining the amount of oxygen incident on materials. Proposed tests to simulate these effects shall

be subject to the SeaWinds Materials & Processes Engineer approval.

3.4.1.13 Non-Destructive Inspection

Non-Destructive Evaluation (NDE) shall be conducted on highly stressed and mission or safety critical items. Non-destructive inspection techniques shall meet the requirements of MIL-I-6870 (or contractor equivalent) for dye penetrant, magnetic particle, radiographic, eddy current, and ultrasonic inspection.

3.4.1.14 Space Environmental Effects

All materials will be evaluated for their performance in the anticipated SeaWinds space environment, as described in document PD686-430 "SeaWinds Environmental Requirements". Particular attention will be given to the thermal, vacuum, atomic oxygen, UV and electron/proton radiation environment on materials. The Materials Engineer will review existing data on materials and recommend environmental test programs where deemed necessary. The SeaWinds Materials & Processes Engineer will review all plans for environmental testing of materials.

3.4.1.15 Design Allowables for Structural Parts

Only the statistically based material property allowables contained in MIL-HDBK-5, the properties contained in MIL-HDBK-17, and the fracture properties contained in JSC 22267 "NASA FLAGRO" shall be used for structural and fracture analysis. Any other source of material strength or fracture mechanics data (eg. data sheets, handbooks, etc.) used for structural analysis shall be approved by the SeaWinds Materials & Processes Engineer.

3.4.1.16 Fasteners

Fasteners shall be selected from the JPL Preferred Fastener List (PFL) contained in JPL STD-00009, or contractor equivalent. Exceptions shall be submitted to the JPL Fastener Specialist in the Mechanical Systems Development Section, for approval. Where fasteners are used in critical applications, document FS 511316 "Detail Specifications for Qualification of Critical Fasteners" shall be followed.

All externally threaded fasteners used for flight applications must be certified. Fasteners used in structural applications must have critical certification. Critical certification requires documentation of chemical and physical test results traceable to both heat and lot numbers. Fasteners used in non-structural applications must have, as a minimum, a certificate of conformance.

3.4.1.17 Electronic Cabling and Accessories

Materials selected for electrical packaging and cabling applications shall be in accordance with document PD686-034 "SeaWinds Electronic Packaging Requirements", or contractor equivalent. Electrical wire insulation, wire accessories, and materials in contact with electric circuitry shall not be capable of arc-tracking due to electrical discharges. Polyimide materials such as Kapton shall not be used in such applications. Polyimide coated wire is susceptible to arc-tracking and once initiated, the arc can be sustained between two or more conductors at currents far below the values necessary to activate circuit protection breakers or fuses.

The following are the general traceability requirements for packaging parts and materials:

Item	Traceability Level
Adhesives & Coatings	Critical
Cabling Accessories	Basic
Connectors	Critical
IC Modules	Critical
IC and Wirecon Accessories	Lot
Printed Circuits/Assemblies	Critical
Semiconductor Accessories	Basic
Subchassis/Subassemblies	Critical
Terminals	Lot
Transformer/lnductor Materials	Lot
Wire	Lot
Wirecon Modules	Critical
Hybrid Microcircuits Materials/ Components	Lot

3.4.1.18 Traceability

The three levels of traceability for materials and processes used on SeaWinds flight hardware are defined as follows:

a) Critical Traceability - required for 1) applications where materials are used near their limits (eg. highly loaded structures), 2) materials which require special or verified properties (eg. magnetic materials, low expansion alloys), or

3) materials where experience has shown potentially serious batch variations.

b) Lot Traceability - required for metallic alloys produced in low volume or requiring special processing and for most adhesives, coatings, etc.

c) Basic Traceability - suitable for most large production, well controlled materials.

Each type of traceability includes the following requirements: Critical Traceability:

1) Drawing note indicating level of traceability and the serial number.
2) Unique serial number (S/N) applied either directly to the item or to the data package accompanying the item. All manufacturing instructions and data shall be identifiable from the serial number. Manufacturing records shall either accompany the items or be retained and readily available for review throughout the life of the SeaWinds Project.

Lot Traceability:

1) Items shall be certified through inspection and test to meet all the requirements of the applicable specifications.
2) Items shall be segregated in bonded stores by lot prior to use.

3) Certification documentation of the lot to the specification shall be kept on file for the duration of the project.

Basic Traceability:
1) Items shall be certified though inspection/test to meet all requirements of the applicable specification.

3.4.1.19 Alerts

Materials used in SeaWinds Flight Hardware that are identified in a Government/Industry Data Exchange Program (GIDEP), NASA Safety, or JPL Quality Alerts shall be evaluated for relevance to the SeaWinds instrument.

3.4.1.20 Quality Assurance Interaction

The quality of materials and processes in the SeaWinds program will be assured by the contractors' submittal of MIULs as specified in the Contract Data Requirement List to the SeaWinds Materials & Processes Engineer. Overall product assurance will be under the cognizance of the Product Assurance Manager. Documents relevant to the quality assurance interactions include the following:

PD686-031 Reliability Assurance Requirements
PD686-032 Quality Assurance Requirements
PD686-033 Problem/Failure Reporting & Analysis Requirements

APPENDIX A

MATERIALS IDENTIFICATION AND USAGE LIST (MIUL) FORMS

APPENDIX B

MATERIALS USAGE AGREEMENT (MUA) FORM

AND

STRESS CORROSION EVALUATION FORM

APPENDIX C

CONTRACTOR REQUIREMENTS

APPENDIX D

GLOSSARY

Application	The required functional performance of the design item; its operational limits including environmental factors.
CCD	Charge-Coupled Device
CDR	Critical Design Review
CVCM	Collected Volatile Condensable Mass
Design Item	A term connoting part, material, or process that is specifically identified and is subject to the provisions of this Document.
Design Item Combination	A term which is used to identify the combination of design item, the specific design application, and the applicable documentation.
Flammability	A measure of the degree to which a material will support combustion.
GIDEP	Government/Industry Data Exchange Program
JSC	Johnson Spaceflight Center
M&P	Materials and Processes
MIL-HDBK	Military Handbook
MIUL	Materials Identification and Usage List. There are four categories of MIUL: Inorganic, polymeric, lubrication systems and processes.
MSFC	Marshall Space Flight Center
MUA	Materials Usage Agreement, a document in which rationale is enumerated justifying the use of a material for a particular application.
NDE	Non-Destructive Evaluation
PDR	Preliminary Design Review
PFL	Preferred Fastener List
SCC	Stress Corrosion Cracking, the initiation and/or propagation of cracks due to the combined action

	of tensile stresses (applied or residual) and a corrosive environment.
SCC Threshold Stress	The applied tensile stress level below which,for a given environment, SCC will not occur.
SCC Threshold Stress Intensity	The applied tensile stress intensity level below which, for a given environment, SCC will not occur.
Subsystem Technical Manager	The JPL Project individual with primary responsibility for a specific subsystem, or major hardware assembly. This individual is responsible for directing design and fabrication activity either at JPL or at contractor/ supplier facility. This may be interpreted as cognizant engineer.
TML	Total Mass Loss
Technical Specialist	The JPL engineer who is responsible for a specific technical function such as materials and processes, packaging, temperature control, etc.
Technical Support Representative	The individual who provides the liaison and interfacing relationship between the subsystem Technical Manager and a number of Technical Specialists.
Vacuum outgassing	The evolution of volatile constituents from a material when exposed to a vacuum environment Three parameters are usually measured: (1) the Total Mass Loss (TML), (2) the Volatile Condensable Material (VCM) and (3) the Water Vapor Regained (WVR).
WSMCR	Western Space and Missile Center Regulation