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Space Administration

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

GUIDELINES FOR THE IMPLEMENTATION OF REQUIRED MATERIALS CONTROL PROCEDURES

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GUIDELINES FOR THE IMPLEMENTATION OF REQUIRED MATERIALS CONTROL PROCEDURES

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1.2 References

Document Number	Document Title
NHB 8060.1B (Under Revision)	Flammability, Odor, and Offgassing Requirements and Test Procedures for Materials in Environments that Support Combustion, with Errata
SP-R-0022A	Vacuum Stability Requirements of Polymeric Materials for Spacecraft Applications
SE-R-0006A	NASA-JSC Requirements for Materials and Processes
MSFC-SPEC-250A	Protective Finishes for Space Vehicles, Structures and Associated Flight Equipment
MSFC-SPEC-522A	Design Criteria for Controlling Stress Corrosion Cracking
JSC 11123	Space Transportation System Payload Safety Guidelines Handbook
NHB 1700.7A (Under Revision)	Safety Policy and Requirements for Payloads Using the Space Transportation System
MIL-H-83282A	Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base, Aircraft
MSFC-STD-506B	Materials and Processes Control
JSC 20149	Space Station Requirements for Materials and Processes
MSFC-HDBK-527/ JSC 09604	Materials Selection List for Space Hardware Systems
JSC 07700 Vol XIV Attachment I, ICD-2-19001	Shuttle Orbiter/Cargo Standard Interfaces

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GUIDELINES FOR THE IMPLEMENTATION OF REQUIRED MATERIALS CONTROL PROCEDURES

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1.0 Purpose

The purpose of this document is to provide a clear and concise description of the methods used to obtain compliance with materials control requirements. It is intended as an aid or guide to the payload developer/scientist/contractor in providing the methodology needed to assure that materials used meet the applicable requirements.

1.1 Introduction and Background

As more payloads, of increasing diversity and complexity, are added to the STS manifest, the task of assuring compliance with materials requirements becomes increasingly more complex. Therefore, a means to aid hardware developers was needed. This has been accomplished in the series of flow charts (attached) along with the accompanying explanatory material. A glossary of terms is also provided to aid in understanding the rationale in developing and complying with requirements.

Obviously, materials which by test meet the requirements for a particular use environment (i.e., are not flammable in 25% O_2, for example) are not normally a concern. The difficulty arises where a material has been selected for use because of certain desirable properties (for example, electrical or thermal properties) but does not meet one or more of the acceptance criteria required for use in space flight (for example, flammability or toxicity). If sufficient logical reasoning (or rationale) can be developed to show that this material, in its specific application and use environment does not present a hazard, either to the crew or to the vehicle, then the use may be permitted.

This process is documented by an MUA (Material Usage Agreement). This document discusses many of the factors involved in developing and providing the rationale for the use of a non-acceptable material, as well as flow charts to illustrate the various steps in the overall process.

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1.3 Definition of Terms

This glossary of terms is limited to those items peculiar to materials evaluation.

Ageing - Deterioration of material properties with age, whether in use or stored.

Barrier, Fire - An obstruction, such as a partition, that prohibits or tends to inhibit the propagation of burning. May be internal or external in configuration.

Break, Fire - A gap or opening between flammable materials which would prevent propagation of burning. Non-flammable materials would provide the same effect.

Beta Cloth - A non flammable Teflon coated fiberglass cloth used to cover or enclose flammable materials/components/ subassemblies.

Certification - The final step in the materials and processes evaluation in which the MSFC MAEB certifies to MSFC management the flight worthiness of the payload/experiment.

Container, Sealed - A container which permits atmosphere exchange rates no greater than 10^{-4} standard CC second with atmosphere pressure differential. Note: Such containers must be able to withstand pressure differential without failure (such as that imposed during ascent to orbit).

Container, Vented - An unsealed enclosure that permits atmosphere exchange.

Container, Vent Area Limits - Containers with surface area greater than 100 square inches should have vent areas not exceeding one (1) percent. Containers with surface areas less than 100 square inches should have vent area of at least 0.5 square inches.

The vents should be covered with metal mesh of 100 mesh or greater and the mesh material must itself meet flammability requirements.

Container Vent Location - Insofar as possible, the container vents should be located to prevent or minimize the "Chimney Effect" created by internal burning. Single vents, or in the case of multiple vents, locating these on the same face of the container will minimize this hazard.

Container Wall Thickness - This container should be constructed of metal or nonmetal nonflammable composites. Metal container walls should be at least .062 inches thick.

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Container Free Space - The free space (unoccupied volume in the container) should be limited as much as possible. In general, the free space should not exceed 25% of the total volume.

Corrosion - The attack of metal surfaces and dissimilar metals in contact on exposure to the environment.

Configuration Description - The development by the use of drawings, sketches, photographs and narrative of a description of the location and relative position of materials to permit an assessment of the total configuration.

Evaluation

1) Material - Identification of the material and a determination of the letter rating for that material from MSFC-HDBK-527/JSC 09604. Note: This must be specific. For flammability, thickness of the evaluated material must be equal to or greater than thickness/rating values in MSFC-HDBK-527/JSC 09604. Percentage O_2 values/ratings, likewise must be equal to or greater than use environment of the evaluated material.

2) MUA's, Generated Analysis, etc. - An assessment by EH02 personnel of the inputs submitted by the payload developer in support of the use of materials/components/subassemblies.

Environment - Refers, in general, to use environment of material. Specific examples are given as follows:

1) Orbiter Crew Compartment 10.5 psia, 30% O_2/14.5 psia 25.9% O_2, Remainder N_2

2) Spacelab Manned Compartment 14.7 psia, 24.5% O_2 .

3) Cargo Bay - 14.7 psia, 21% O_2 (Air) Vented to vacuum on ascent

4) Fluid Systems - Materials in actual contact with fluids or those which would come into contact in case of a single barrier failure.

Exposure Time - The actual time, including test, checkout and qualification times that a material is exposed to its use environment. Some experiments are stored in containers until deployed. Some materials are exposed to fluids only when experiment is in operation.

Fluid System Compatibility - The condition that the fluid in use does not react and it is not degraded by exposure to the

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materials in contact and conversely that the materials of construction do not react and are not adversely affected by exposure to the fluid in the system.

Flammable - A material which fails to meet the acceptance criteria when tested per the requirements of NHB 8060.1. i.e., will burn, if ignited.

Flammability Rating - As given in MSFC-HDBK-527D/JSC 09604, a letter (i.e., "A", "B", "C", etc.) designating the extent to which a material burns when tested as above.

Heat Sink - The condition where a structure or panel of good thermal conductivity and in intimate contact with a burning material, extracts a sufficient quantity of heat by conduction to lower the temperature below the ignition point and extinguish burning. Obviously an effective heat sink could limit ignition initially.

Ignition Source - A source of heat sufficiently intense and localized such as to induce combustion. In general, for flammability considerations, any electrical wire or elevated temperature component is considered an ignition source. Monopropellants, strong oxidizers, bases, etc. must also be considered.

Isolation - 1) The distance of separation of adjacent materials on any plane.

2) The distance of separation between flammable materials where adjacent materials are nonflammable.

LOS - (Line of Sight) The straight line distance between a material and a critical optical surface.

MAEB (Materials Application Evaluation Board) - The Board chartered by MSFC for the purpose of evaluating acceptability of Material Usage Agreements. Material Usage Agreements are submitted for (a) materials and processes not meeting a requirement (b) component MUA's (determination of acceptability of components, experiments, etc.). See next page.

Materials List - A complete listing of all materials for a project/payload. This list would contain material name, generic name, manufacturer, manufacturer's designation, cure cycle and post cure cycle, surface area, thickness, quantity NASA material code and selection criteria rating (as appropriate for use environment).

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Major Use Material

1) Flammability - Area greater than one square foot or amount greater than one half pound, exposed to oxygen containing environment.

2) Toxicity - All materials test data must be submitted and evaluated, regardless of amount of quantity used.

3) TVS - Surface area - LOS Distance as follows:

Surface Area	LOS Distance
> 1 in^2	< 24 in
> 4 in^2	> 24 < 48 in
> 10 in^2	> 48 < 96 in

Major Structural Material - A load carrying member to include struts, brackets, braces and all mounting hardware (fasteners).

MUA (Material Usage Agreement) - A request by the payload developer/experimenter with supporting rationale to permit the use of a non "A" rated material. The MUA is evaluated by MSFC Materials and Processes Laboratory, Materials Selection and Control Office, Code EH02 and approved/disapproved by the MAEB. If approved, it is valid for the specific material, in the specific usage for that hardware only.

MUA, Component - Same as MUA above, except that it is effective for an entire component, subassembly, "black box", etc. It is also specific for the covered application only.

MUA, Certification - A document that represents compilation of materials lists, MUA's and other items pertaining to a single specific component, container/experiment. Prepared by the Materials and Processes Lead Engineer and submitted to the Secretary of the MAEB, it represents a complete data package for the payload and covers all materials, components, subassemblies, etc. This document provides the basis for the MAEB certification for the payload and submission of certification to JSC.

Nonflammable - A material that meets the acceptance criteria when tested per the requirements of NHB 8060.1.

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Payload or Hardware Developer - The organization responsible for developing, assembling, integrating and delivering a specific end item. The developer and experimenter could be the same organization. For larger payloads, with multiple experiments, the developer could be the integration contractor or mission manager.

Process or Processing Parameters - The controlled variables involved in producing or applying a given material which determine the physical, chemical or metallurgical properties of the final material. In many instances variation in the desired processing parameters result in non acceptable properties.

Propagation Path - The path taken by a flame front external to or within an enclosure that represents the fire path between flammable materials. It is not necessarily a straight line, nor in the same plane.

Stress Corrosion Cracking (SCC) - The susceptibility of metallic materials under tensile stress to develop cracks along grain boundaries.

SCC Rating - As per MSFC-HDBK-527/JSC 09604, letter ratings are assigned as: "A" - highly resistant; "B" - moderately resistant; and "C" - not resistant to the development of stress corrosion cracking.

Subassembly - A complete unit, but part of a larger assembly - used interchangeably with component, "black box", etc.

Thermal Vacuum Stability (TVS - Outgassing) - The condition where nonmetallic materials at operating temperature in vacuum evolve molecules through various mechanisms that may deposit on nearby surfaces.

TVS Rating - As per MSFC-HDBK-527/JSC 09604.

Toxicity (Toxic Outgassing) - The condition in a closed habitable environment where nonmetallic and certain metallic materials evolve molecules or fragments of molecules that may be hazardous to crew members.

Toxicity Rating - As per MSFC-HDBK-527/JSC 09604.

Use Environment - See Environment.

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1.4 Use Environment

As indicated by Table 1, a material is to be evaluated only in its use environment, and is not required to meet all selection criteria imposed. For example, materials in the Crew Bay do not have to meet thermal vacuum stability requirements. Similarly, materials in the Cargo Bay do not have to meet Crew Bay toxicity requirements. Only materials actually exposed to LOX/GOX or to other hazardous fluids have to meet those criteria. Evaluate materials for the selection criteria applicable to their usage/function.

1.5 Effectivity

Since the materials and processes controls imposed on a particular end item are often a function of the controlling, managing or contracting agency, it is recommended that the payload/hardware developer determine from the CEI (Contract End Item) or other applicable NASA specification the actual (M&P) requirements. All payloads in the STS have to meet the requirements of NHB 1700.7A "Safety Policy and Requirements for Payloads Using the Space Transportation System" and ICD 2-19001 (Shuttle Orbiter/Cargo Standard Interfaces).

The procedures in this document have been developed to conform to the requirements of MSFC-STD-506B, JSC 0006 and JSC 20149. Materials must meet the safety requirements of NHB 1700.7A. Ultimately, all organizations involved in the development of a payload, and its certification for flight have the same objective - that of providing safe, reliable, functioning hardware - and to this end utilization of the criteria and procedures specified herein is believed to provide the best method.

1.6 Information and/or Assistance

The MSFC Materials Selection and Control Office (EH02) maintains numerous computerized data bases containing information on materials usage in flight hardware. In addition, extensive catalogs of vendor and manufacturer's literature are maintained to assist in material identification and property determination. It is recommended that where uncertainty exists concerning identification, properties, or usage of a material, personnel of EH02 be consulted.

For the case where the material is not listed in MSFC-HDBK-527/ JSC 09604 (or is listed as untested) several options exist. If test data from another source exists, then this information should be forwarded to EH02 for evaluation. If no data exists then a sample should be submitted for test. This effort will be coordinated by Materials Selection and Control Office, Code EH02.

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1.7 Re-Use of Certified Hardware

Experiments, "black boxes", components or other items that have been previously flown (and therefore have an approved Certification MUA) do not require re-certification if the following conditions are met:

a) Original Certification is valid

b) Intended use environment is the same for which the original certification was issued (i.e., previously qualified for Crew Bay, for example, and will be re-flown in Crew Bay)

Certification for the new use will be accomplished by the hardware developer by:

a) Citing the original MIUL (Material Usage List), complete with MIUL number and date of issue.

b) Providing a materials list for all changes to the original list.

c) Specifying the new STS flight effectivity.

This information will be supplied to EH02, who will evaluate the submission, determine if additional information is required, and when all issues have been resolved, issue a "Revision A" to the original Certification MUA to cover the re-use of the hardware

2.0 Methods of Implementation

This document lists the factors normally employed in determining the suitability of a specific usage of a non acceptable (or not listed) material. The rationale for use is developed by logically applying the appropriate factors to the specific case to show that the material application is acceptable and does not present a hazard in its specific use condition. Factors other than those listed may be used where applicable. Reasoning based on previous use on other hardware/spacecraft is not acceptable since the premise for acceptability in either case is application specific.

Accomplishing an assessment of the payload, as to compliance with the imposed materials requirements, involves a number of specific actions by the payload developer, followed by an evaluation of the results of these actions by EH02. Both the actions by the payload developer and the evaluation by EH02 involve a number of options which may be chosen as appropriate. The general flow of the assessment process is shown

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schematically in Figure 2. The first step in the process is the preparation by the payload developer of a complete materials list for each subassembly. The first choice presented is that of determining whether to evaluate as a subassembly or by individual materials in the subassembly. Evaluation is accomplished by determining for each material, the rating given in MSFC-HDBK-527/JSC 09604.

a) Option I - Evaluate as Subassembly

Result A - All materials are "A" rated, subassembly is acceptable. Information is submitted to EH02, who prepares a Certification MUA for submission to the MAEB.

Result B - All materials not "A" rated or all materials not identified - Generate analysis and detailed rationale for all non "A" rated materials and submit to EH02 for evaluation. Rationale should be developed at subassembly level as for materials in "closed container", etc. Subsequent actions result from the evaluation by EH02.

b) Option II - Evaluation by Individual Materials

Result A - All materials "A" rated. Materials list is acceptable. Information is submitted to EH02 who prepares a Certification MUA for submission to the MAEB.

Result B - All materials not "A" rated. Payload developer prepares and submits rationale for each material not "A" rated. The rationale should be annotated on the materials list. Items used in structures, bracket and mounting hardware that are not highly resistant to stress corrosion cracking must have MUA's with a stress corrosion evaluation. This information will be submitted to EH02 for evaluation. Subsequent actions result from the evaluation by EH02, primarily, acceptance or requests for additional information. In all cases, the final action is a review by the MSFC Materials Application Evaluation Board (MAEB).

Comparison of Component MUA vs. Individual Material MUA

If the situation exists where there are many different materials located within a container, housing, main body, compartment, or other enclosure then it may be advantageous to handle all of the materials with a single MUA. Depending on the particular selection criteria applicable, if the enclosure meets the requirements, for example, for a closed container for flammability, then the entire assembly may be covered with a single component MUA. The rationale must be developed for the specific selection criteria applicable and the specific configuration and submitted on a component MUA form. The development of rationale and submission of MUA's on each individual materials is thus avoided.

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2.1 General Instructions

2.1.1 Compile Materials List

Develop sufficient information on each material to uniquely identify the specific material used. Designation (or name) of material, generic type or class, manufacturer, manufacturers' designation and/or "trade name", NASA material code, thickness, surface area, weight, surface finish (if needed), cure or processes information , part number and use environment would normally be adequate. (See attached form for standard format).

2.1.2 Rate Each Material

Reference MSFC-HDBK-527/JSC 09604 and look up the letter rating for each material for the application and use environment and thickness as appropriate. Any material rated unacceptable will require substitution of an acceptable material, or development of sufficient rationale for acceptance. Materials not listed in MSFC-HDBK-527/JSC 09604 are handled by (1) providing data in remarks section of material list from another source which clearly indicates the material meets the appropriate selection criteria; or (2) providing material sample for test, to develop data, or (3) providing rationale justifying the use of the material in the particular application with no further action. The compiled list would thus contain identification of each material application used by drawing number, part number, use environment, rating for each appropriate criteria, and an entry in the remarks column for each rating less than "A" (or no rating) to explain what action is being taken to prove acceptability for use. EH02 will evaluate the above information to determine if additional rationale/ or MUA's are required.

2.1.3 Use of Flow Charts

Referring to Fig. 2, for Path 1,

a) Evaluation by Subassembly

1) If all materials listed are "A" rated, submit copy of materials list to EH02, who will prepare the Certification MUA for the subassembly

2) If all materials are not "A" rated, generate an analysis using the factors given (appropriate to selection criteria) and submit to EH02 for evaluation. Subsequent activities depend on action taken by EH02 Lead Engineer and MAEB, as shown in Fig. 2.

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Referring to Fig. 2, for evaluation by material.

b) 1) If all materials are "A" rated, submit copy of materials list to EH02, who will prepare a Certification MUA for the subassembly.

2) If all materials are not "A" rated, submit rationale for each non "A" rated material. Subsequent activities, MUA's, depend on action taken by EH02 Lead Engineer and MAEB, as shown in Fig. 2.

2.2.1 Corrosion Protection

Corrosion is not considered a safety critical parameter, but is a requirement on all MSFC built or managed flight hardware. Therefore, it is strongly recommended that corrosion protection be implemented on all flight hardware.

The assessment procedure is shown in Fig. 3.

2.2.2 Stress Corrosion Susceptibility

For payloads and experiments the assessment of materials for stress corrosion cracking susceptibility is normally limited to those items considered to be structure members; these elements that support the payload, to include brackets, braces, and mounting hardware, and whose failure could result in loss of function.

Non "A" rated metallic materials defined above will be evaluated by the procedures given in MSFC-SPEC-522A. A stress corrosion evaluation analysis is submitted with an MUA for evaluation by EH02.

2.3 Non-metals

2.3.1 Analysis Procedure - Nonmetals Flammability by Material

Flammability - Weight and surface areas must be provided for all materials on the following items for:

1) Quantity or Amount - Exposed surface area greater than one (1) square foot or weight greater than one half (1/2) pound must be evaluated as major use materials.

2) Propagation Path - (Separation distance from other flammable materials) Separation greater than or equal to 12" from "C" rated material is considered a non propagating path.

3) Ignition Sources - Materials less than or equal to two (2) inches distance from an ignition source are considered

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ignitible. Ignition sources are any electrical wire or elevated temperature component or element or other heat source.

4) Heat Sink - Materials sprayed on or bonded to a metallic surface are considered to be on a heat sink. Metallic materials of thickness equal to or or greater than .062 inches are considered heat sinks sufficient to preclude continued burning. Less than 10 mils nonmetallic material bonded to such metal substrates are considered acceptable.

5) Stowage Item - Items are normally stowed in a standard storage drawer or other nonflammable (metal or nonflammable metallic) enclosure until use, and then re-stored (unpowered). Items stowed in a powered condition, either by battery or off the "orbiter" bus must be considered on an individual basis as to flammability. The use of nonflammable storage inserts and materials is strongly recommended.

The analysis consists of evaluating each of the listed factors (as appropriate) and providing information (photos, drawings and sketches) on configuration, identification of adjacent materials, heat sinks, etc. as required to substantiate conclusions.

2.3.2 Procedure Non-metals, Flammability by Subassembly

1) Evaluate by the five (5) items listed in Part 2.3.1.

2) Fire Barrier - The existence of a metal or non flammable partition within the enclosure constitutes a fire barrier. The degree to which the partition isolates one compartment from another must be considered.

3) Fire Break - A substantial area within the enclosed volume which contains no flammable materials, constitutes a fire break. See item 2, under part (a).

4) Enclosed Free Space - The amount of unfilled volume within an enclosure should be minimized.

5) Chimney Effect - Normally enclosures should be vented in one end only. If vents exist on opposite ends creating a flow path for oxygen, this must be evaluated.

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2.3.3 Thermal Vacuum, General Evaluation Factors

1) Critical Optical Surface

Any reflecting or refracting surface, sensitive to deposition of a molecular layer of outgassed material is considered a critical optical surface. In addition, thermal control surface and surfaces of solar cells are considered critical since the degradation of reflectivity (or transmissivity) is a function of operating wavelength, in general tending to greater degradation at short wavelengths. The wavelengths must be specified. As general design practice only materials with very low VCM values should be used in proximity to critical optical surfaces. For guideline purposes to determine materials that must be evaluated the following is provided.

Exposed Surface Area	LOS Distance
> 1 in^2	< 24 in
> 4 in^2	> 24 in < 48"
> 10 in^2	> 48 in < 96"

2) Overcoating - Overcoating an unacceptable material with an acceptable material is permissible provided the combination has been tested and found acceptable.

3) Thermal/Vaccum Bake - Outgassing of materials by means of a thermal/vacuum bake-out is acceptable provided the following conditions are met:

a) Bake at 125°C for 48 hours at a pressure of 10^{-6} torr, or less, or

b) Bake at a maximum hot case temperature at 10^{-6} torr or less until outgassing has sensibly ceased, as determined by TQCM, RGA, or other suitable instrumentation. Materials, or complete subassemblies, baked out utilizing the above described procedures are considered acceptable for flight. Evidence to indicate compliance with the requirements must be provided. (Ex: test plans, test reports, etc.)

2.3.4 Analysis Procedure Nonmetals, Toxicity by Subassembly

a) If all materials are "A" rated submit materials list to EH02.

b) If all materials are not "A" rated, develop rationale for use and submit materials list to EH02, showing

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rationale for use for all non "A" rated materials. A "B" rated material need only have the proper cure, then the material is "A" rated and is acceptable.

c) If appropriate, based on the EH02 evaluation of submitted information, the entire subassembly may be subjected to a toxicity test, as a unit.

2.3.5 Analysis Procedure Nonmetals Toxicity by Individual Materials

Unidentified trace gases will have all constituents treated as one gas. MAC for unidentified trace gas totalled mus t not exceed 0.1 milligrams/M^3.

a) If all materials are "A" rated submit materials list to EH02.

b) If all materials not "A" rated, develop rationale for use and submit materials list to EH02 showing with for all non "A" rate d materials. "B" rated materials are acceptable provided they are cured to the minimum parameters required to meet the "A" rating criteria.

Evaluation Factors

a) Materials Quantity - State total quantity of material used in all locations.

b) Sealed Container - Material is totally enclosed in a sealed container, as defined in 1.3, Definition of Terms.

c) Odor Only - Is odor removed by baking?

d) Exposed Area - What is exposed area of material?

2.3.6 System Evaluation for Toxicity

The entire system shall be evaluated for toxicity and an offgassing and summation report submitted to JSC.

2.4 Fluids Compatibility - Metals and Nonmetals

Ratings are specific for a given material exposed to a given fluid. Materials that are part of a fluid system, but not exposed or in contact with the actual fluid, need not be evaluated. Exception: Materials classed as above, but which would be exposed to the fluid in the case of a single barrier failure should be evaluated.

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a) Fluid Parameters - Identify fluid used as to composition (if required), pressure flow rate, temperature and quantity.

b) Material Parameters - Quantity used, area exposed (or in contact with fluid).

c) Time of Exposure(Operational or Life of Hardware) - Continuous contact or intermittently.

2.5 LOX/GOX Service

Testing and rating of materials (both metallic and nonmetallic) for LOX/GOX service is a complex process involving many parameters. For this reason, it is required that materials intended for use in contact with LOX/GOX be submitted to EH02 for review/approval prior to final selection and use.

2.6 AGEING

Since ageing primarily affects the proper functioning of the payload, particularly if the unit is intended for multiple flights, it is not normally an imposed criteria. However , the use of such data as is available is encouraged in order to insure the reliability of payloads.

2.7 Standard/Commercial Parts

Standard/commercial parts are listed in MSFC-HDBK-527/JSC 09604 with ratings for the selection criteria, based on the entire assembly. For parts not listed in the selection list, use the rating for each individual material of the part, and list all the materials which comprise the part (including EEE parts also).

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TABLE I

GENERAL APPLICABILITY OF SELECTION CRITERIA

	CORR	SCC	FLUID COMP	FLAM	TOX	TVS
ORBITER CREW BAY	X	X	*	X - 1	X	
SPACELAB HABITATION ENVIRONMENT	X	X	*	X - 2	X	
CARGO BAY	X	X	*	X - 3		X

1. 10.2 PSIA, 30% O_2

2. 14.5 PSIA, 24.5% O_2

3. 14.7 PSIA, 21% O_2 (AIR)

* APPLICABLE ONLY IF CONTAINS/USES/EXPOSURE TO LOX/GOX, N_2 O_4, HYDRAZINE, H_2, ETC.

FIGURE 1

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PAYLOAD ASSESSMENT GENERAL

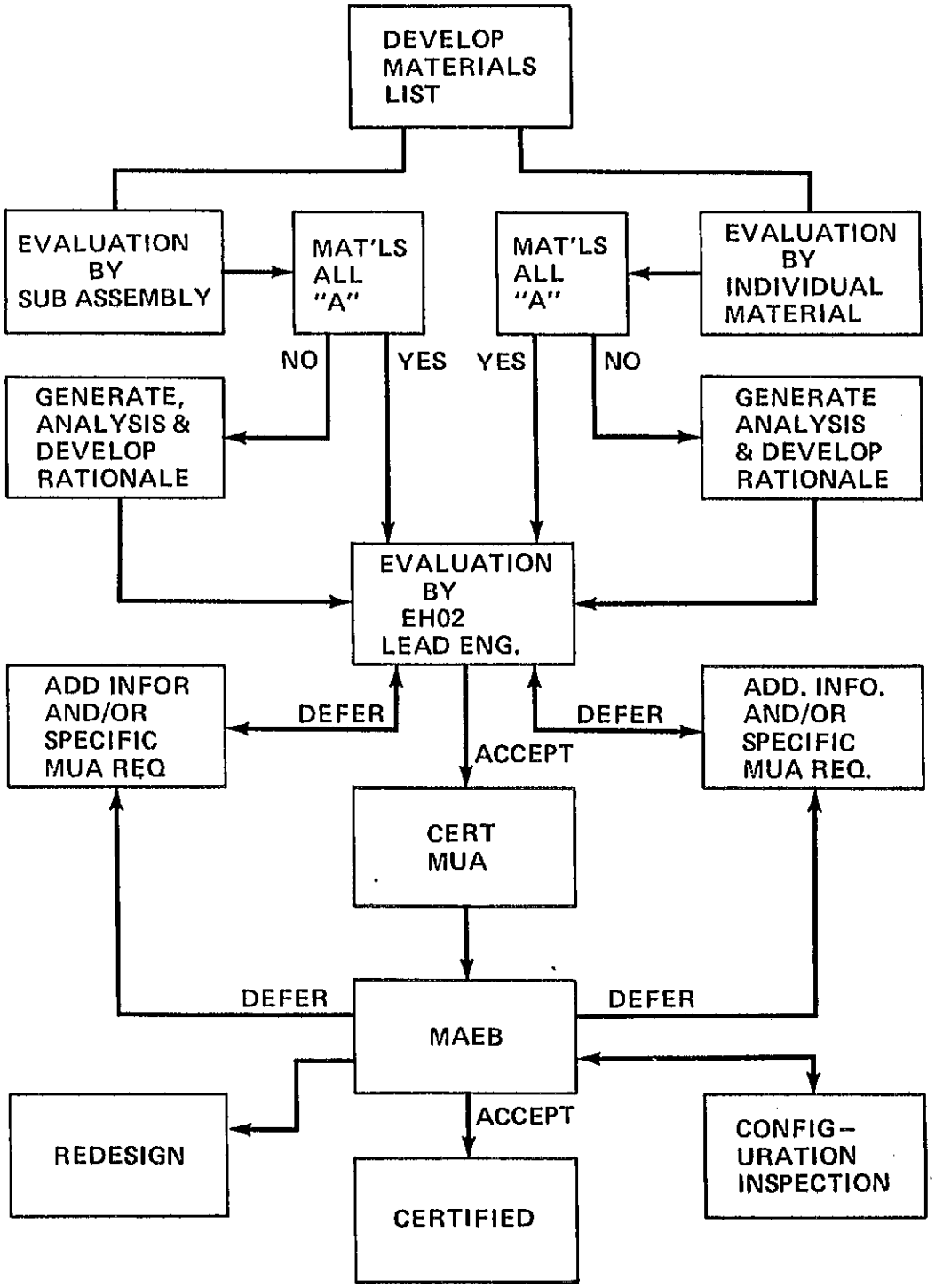

FIGURE 2

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ASSESSMENT FOR CORROSION PROTECTION

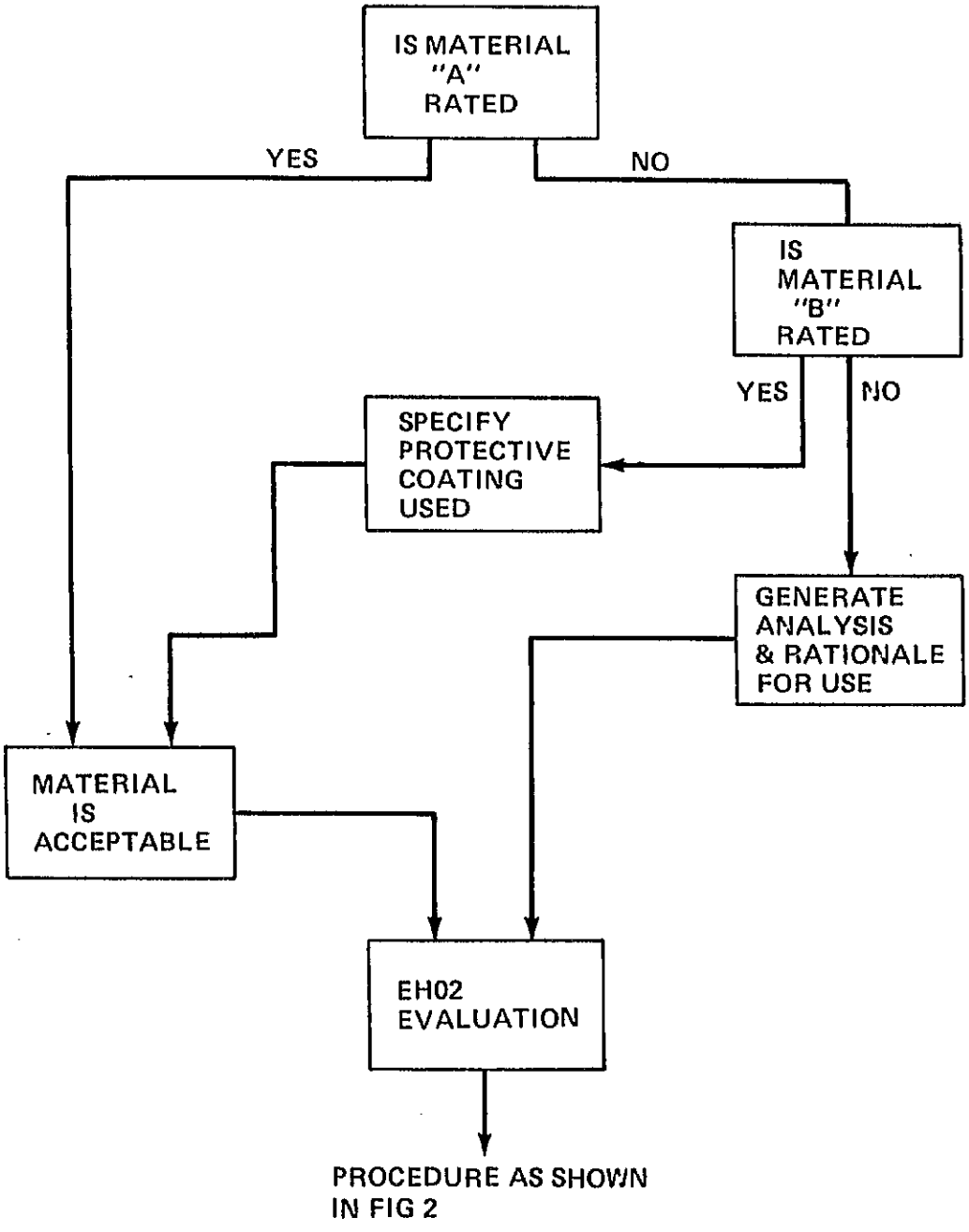

FIGURE 3

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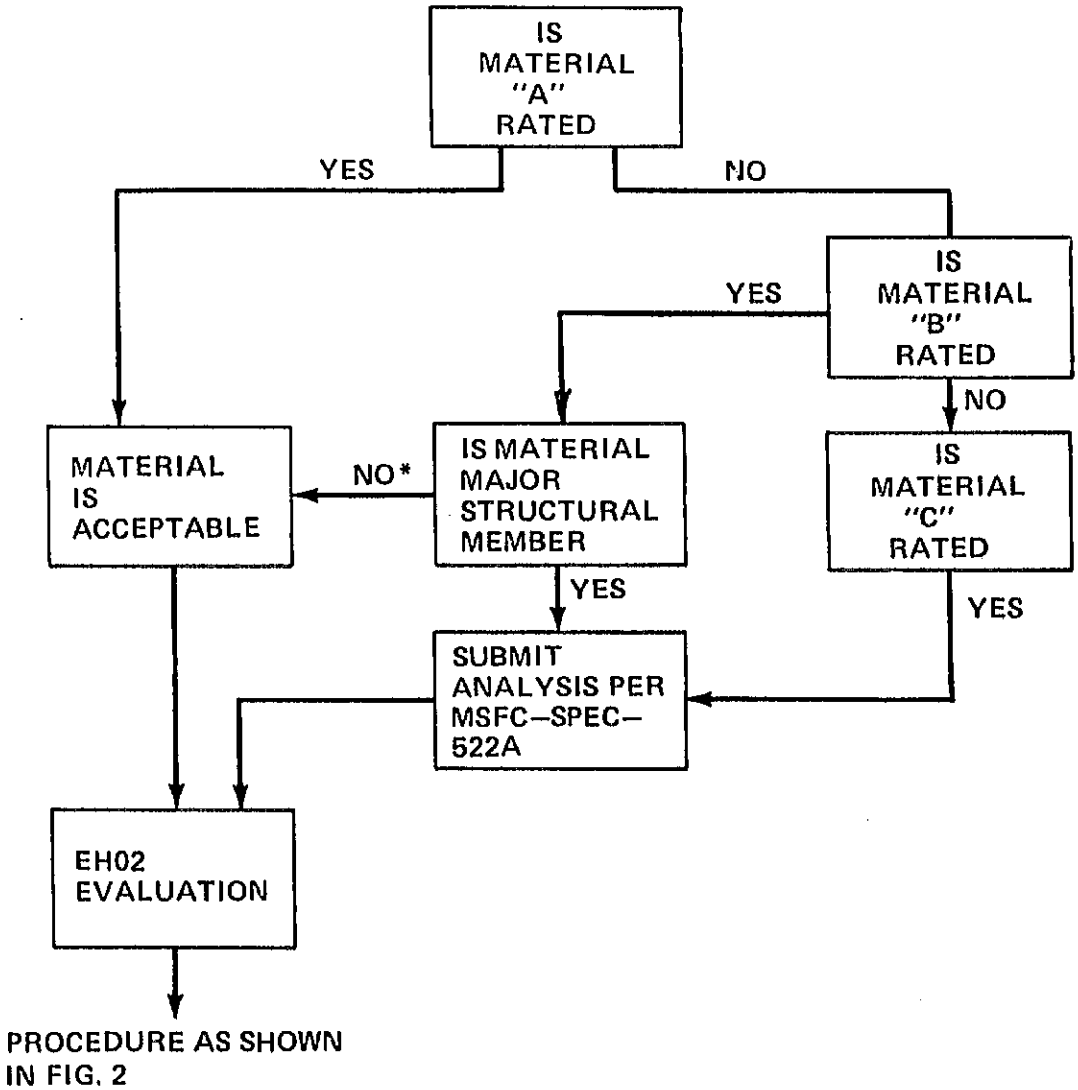
ASSESSMENT FOR STRESS CORROSION



*FOR MSFC DEVELOPED/FUNDED/ MANAGED PROGRAM, MUA IS REQUIRED

FIGURE 4

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FLAMMABILITY BY MATERIAL

- ONLY RATINGS FOR SPECIFIC O_2 LEVEL & PRESSURE MAY BE USED
- ONLY THICKNESS VALUES EQUAL TO OR GREATER THAN STATED VALUES MAY BE USED

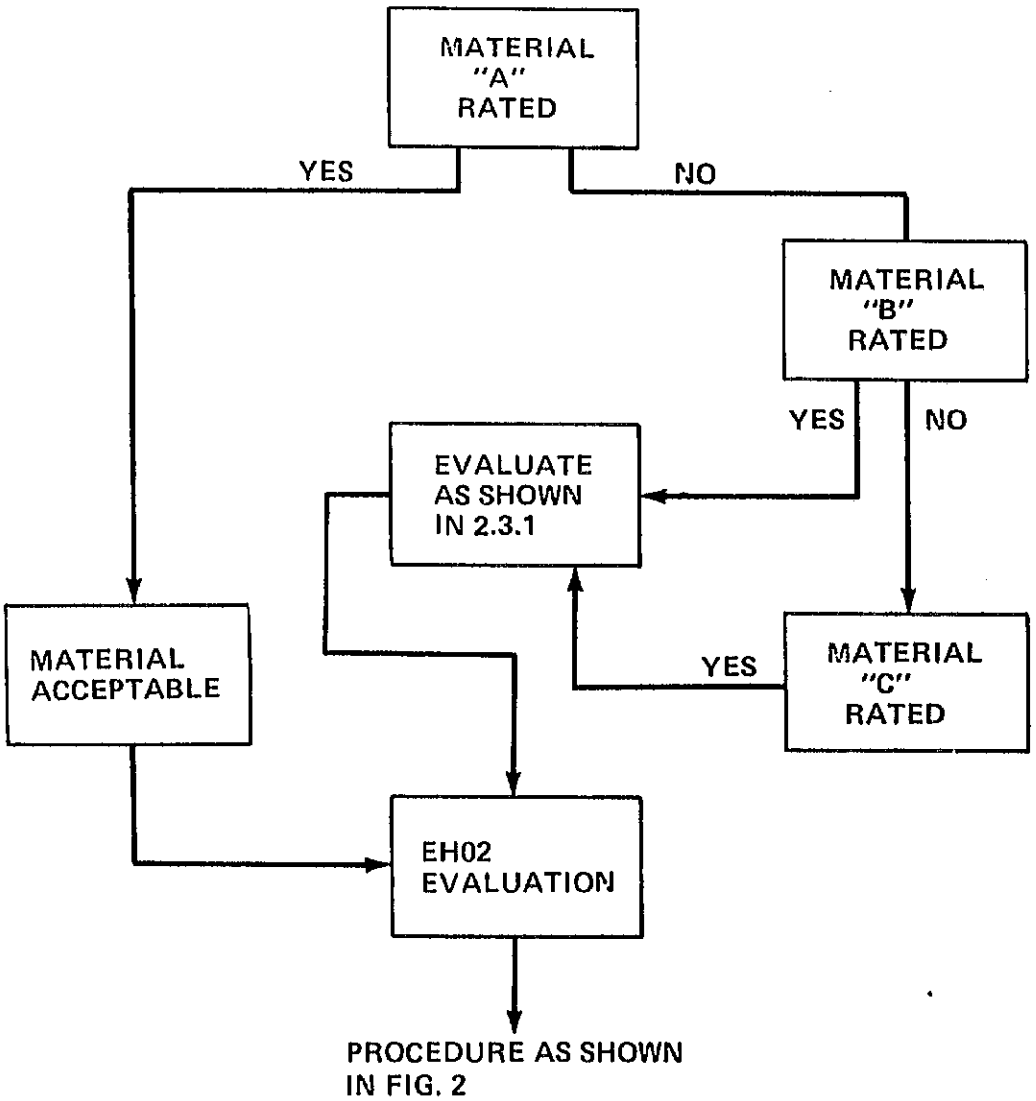

FIGURE 5

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FLAMMABILITY
ASSESSMENT BY SUB–ASSEMBLY

- ONLY RATINGS FOR SPECIFIC O_2 LEVEL & PRESSURE MAY BE USED
- ONLY THICKNESS VALUES EQUAL TO OR GREATER THAN HANDBOOK VALUES MAY BE USED

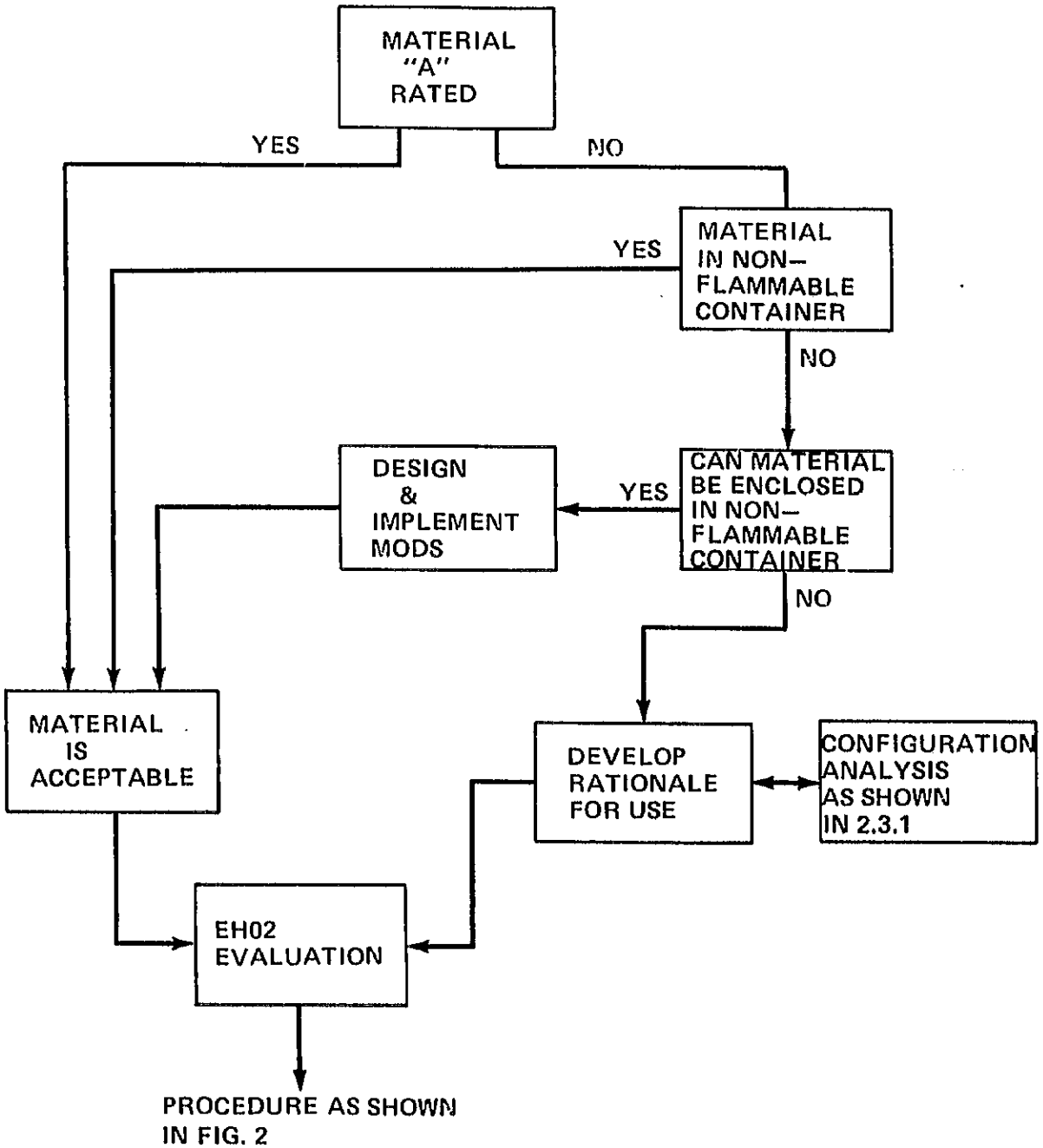

FIGURE 6

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THERMAL VACUUM STABILITY BY MATERIAL

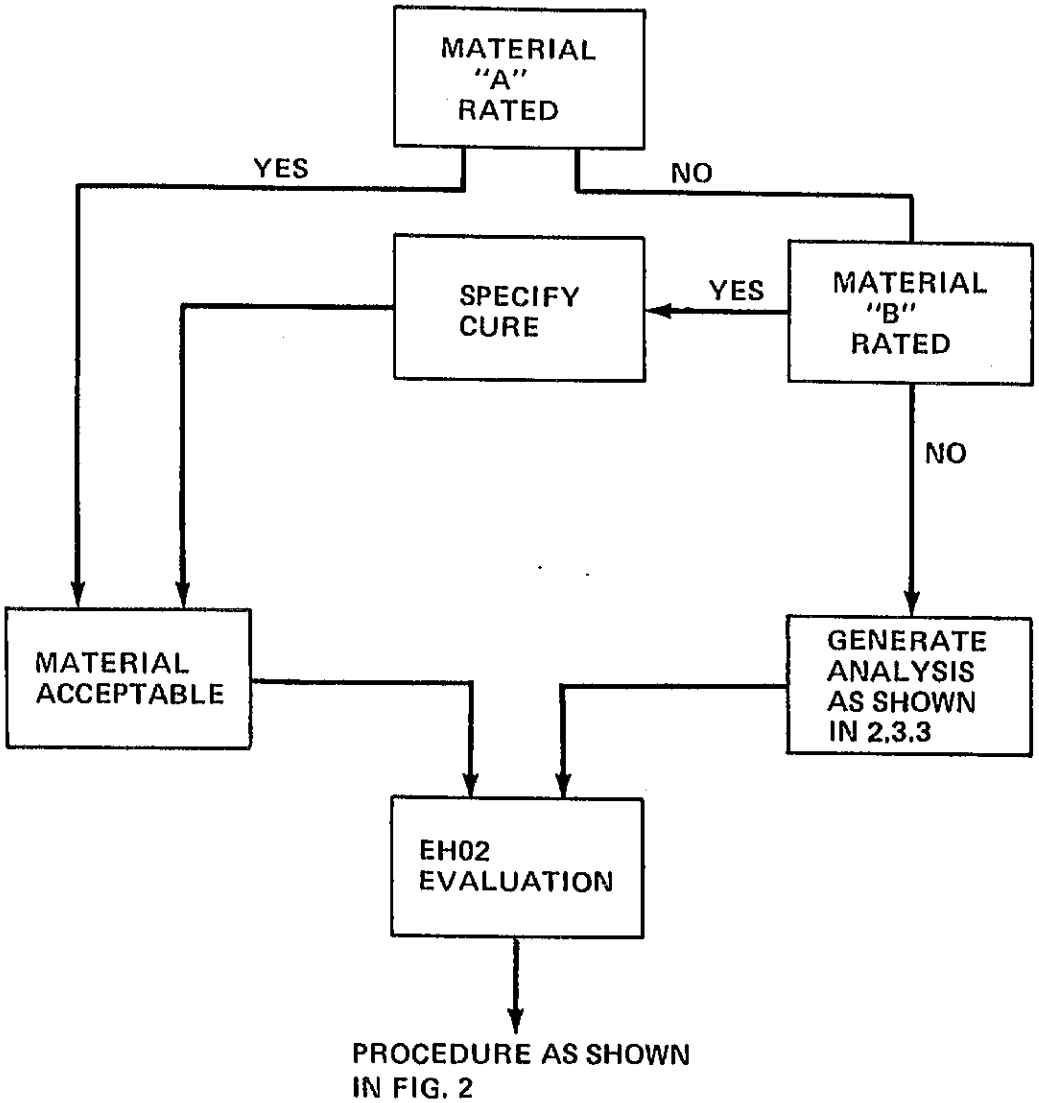

FIGURE 7

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THERMAL VACUUM STABILITY
BY SUB ASSEMBLY

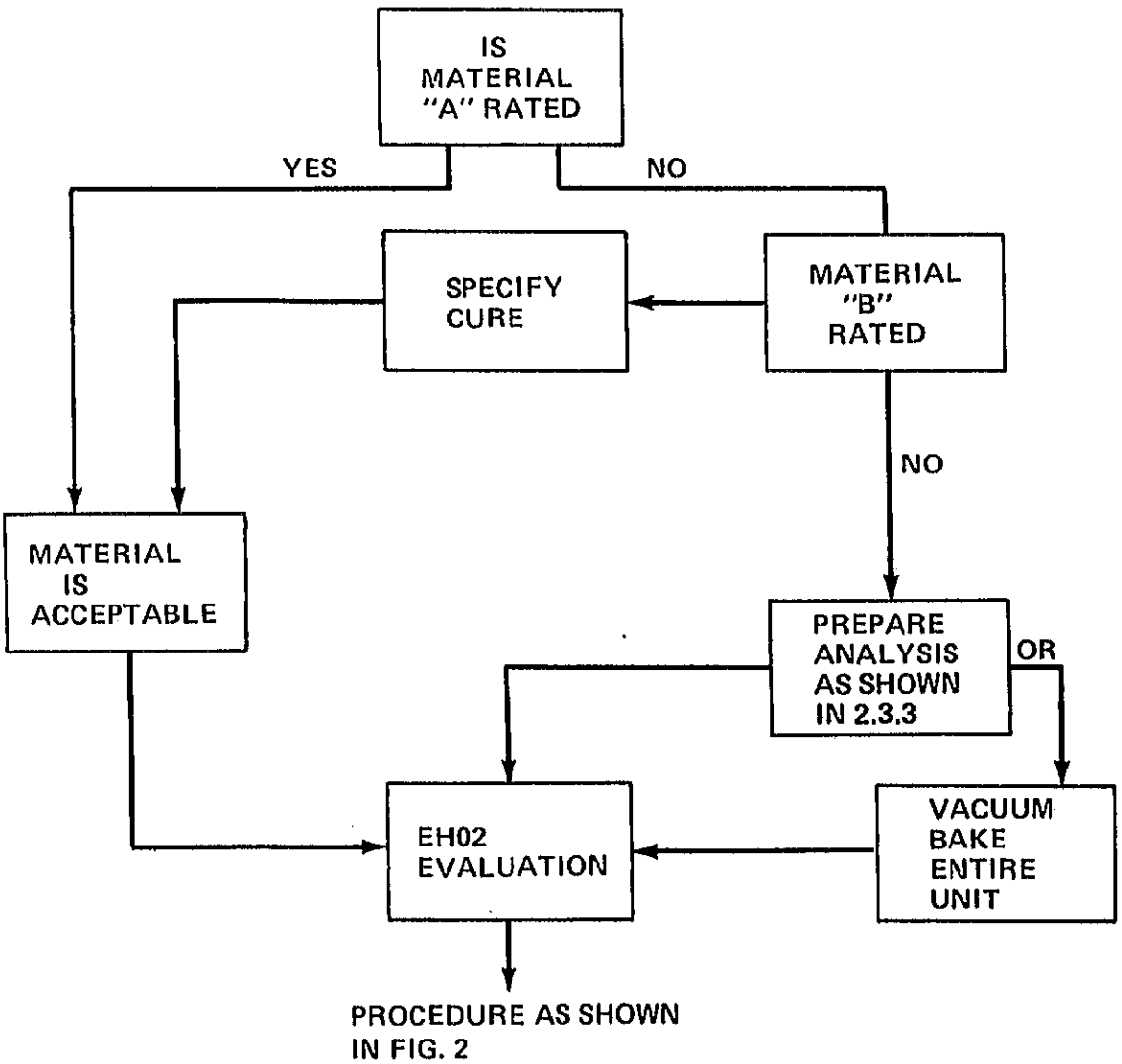

FIGURE 8

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TOXICITY
BY SUB ASSEMBLY

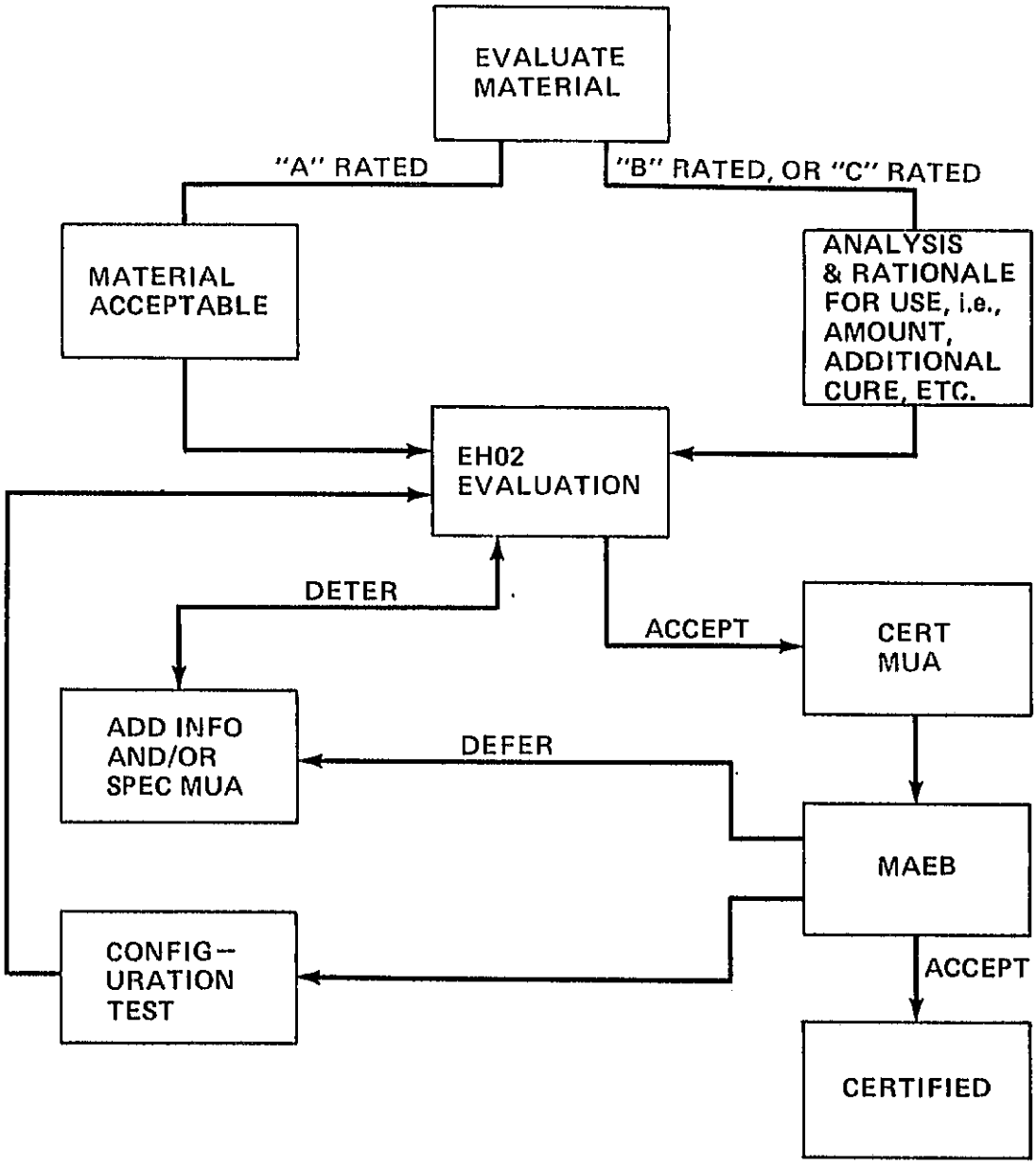

FIGURE 9

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TOXICITY, BY MATERIAL

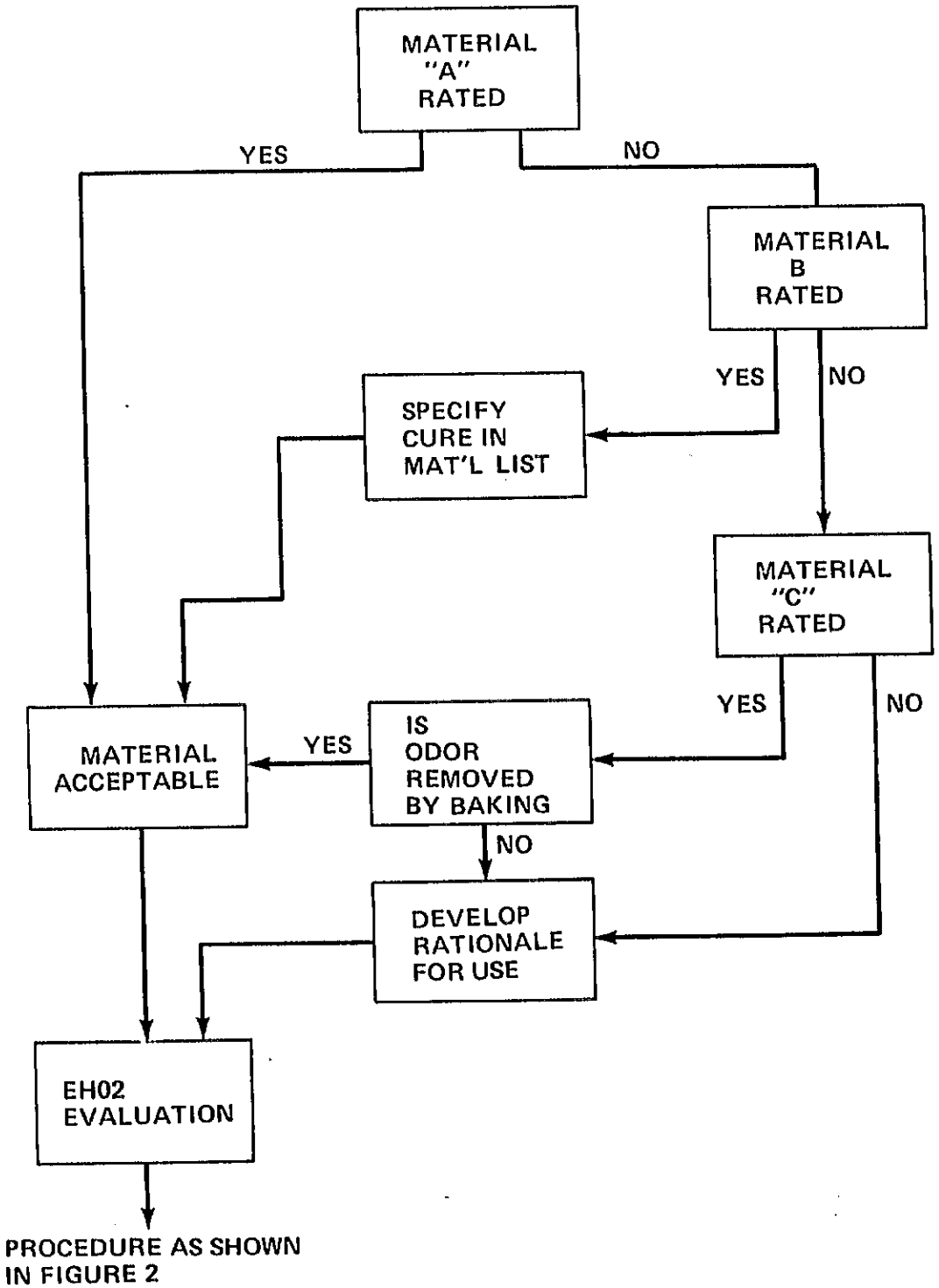

FIGURE 10

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FLUIDS COMPATIBILITY

- PROCEDURE USED FOR ALL HAZARDOUS FLUIDS
- RATING MUST BE FOR SPECIFIC FLUID AND MATERIAL

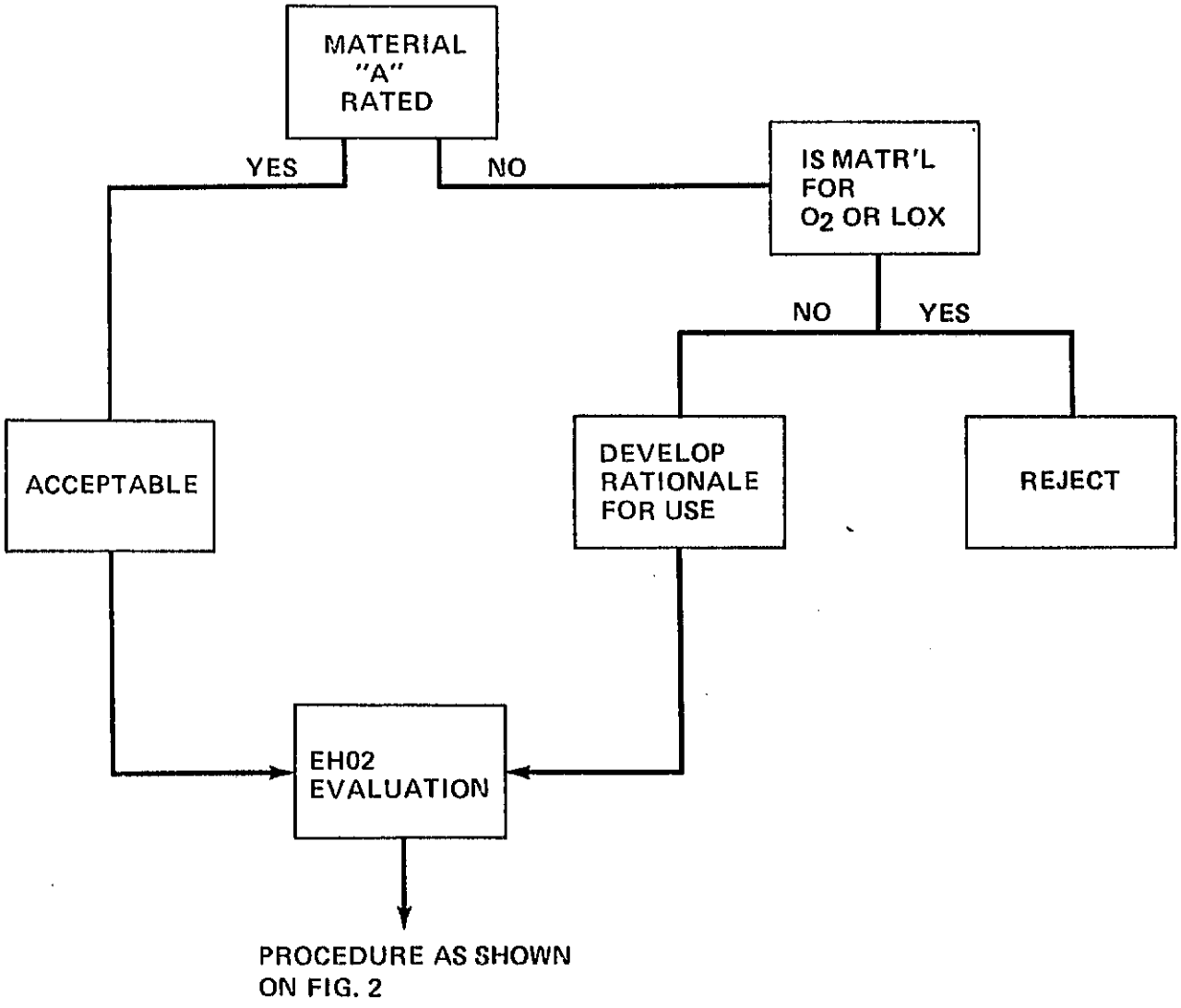

FIGURE 11

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MATERIAL IDENTIFICATION AND USAGE LIST

DOCUMENT NO. _____
DOCUMENT REV. LTR. _____
ORIGINAL ISSUE DATE _____
REVISION DATE _____

BUYER'S PART NO. _____
SELLER'S PART NO. _____ NOMENCLATURE _____
NEXT ASSEMBLY _____ PRESSURE _____ MEDIA _____ TEMP RANGE _____

			MATERIAL IDENTIFICATION				NONMETALLIC MATERIAL		USAGE EVALUATION							MATERIAL USAGE AGREEMENTS STATUS	REMARKS
PART/DWG NUMBER	REV LTR	NOMENCLATURE	MAT'L CODE	MATERIAL SPEC	MATERIAL Desig/Mfgr	Process SPEC	WT	THK	Flam	TOX	TVS	ACE	FSC	SCC	Corr		

Attachment 1

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CERTIFICATION MUA

C (1)	USAGE AGREEMENT NO.: (13)	REV (1)	PAGE____OF____

PROJECT: (5)	SUBSYSTEM: (10)	ORIGINATOR:	ORGANIZATION: (4)

PART NUMBER (S)	SERIAL NUMBER (S)	ITEM DESCRIPTION (16)

NOMENCLATURE	FLIGHT EFFECTIVITY	SPECIFICATION	DEVELOPER/MANUFACTURER

DIMENSIONS/CLOSED/SEALED	LOCATION (4)	ENVIRONMENT		
		PRESSURE	TEMPERATURE	MEDIA
	HABITABLE ☐			
	NON HABITABLE ☐			

APPLICATION: THIS MUA PROVIDES CERTIFICATION OF THE FOLLOWING HARDWARE PER THE PROVISIONS AND RESTRICTIONS OF:

☐ NHB 1700.7A ☐ JSC–SER–0006B

☐ MSFC STD 506B ☐ OTHER

ITEM	LOCATION			FLAMMABILITY			OUTGASSING			STRESS CORROSION		
	SL	ORB	CB	HAB		NO HAB	TOX		TVS	NONE		RPTD
					ACCEPTABLE PER CRITERIA OF NHB–8060.1 B			TOX ACCEPTABLE PER CRITERIA 1 & 2 OF NHB 8060.1 B TVS MEETS INTENT OF SP–R–0022A			REPORTED SCC ITEMS ARE ACCEPTABLE	

RATIONALE: THE CERTIFICATION BASED ON EVALUATION OF ☐ FINAL MATERIALS LIST ☐ DRAWINGS

SUBMITTED BY: _____

ATTACHMENT 1 BRIEF DESCRIPTION OF ITEM & GENERAL CORRESPONDENCE
ATTACHMENT 2 MATERIAL USAGE AGREEMENTS & VERIFICATION SUMMARY
ATTACHMENT 3 TOXIC OUTGASSING DATA & VERIFICATION SUMMARY
ATTACHMENT 4 FINAL MATERIALS LIST AND/OR FLAMMABILITY VERIFICATION SUMMARY
ATTACHMENT 5 SCC VERIFICATION SUMMARY
ATTACHMENT 6 THERMAL VACUUM STABILITY VERIFICATION SUMMARY
ATTACHMENT 7 OPEN ITEMS

ORIGINATOR:	PROGRAM MANAGER:	DATE:

MATERIALS APPLICATIONS EVALUATION BOARD DISPOSITION

	DATE	ACCEPT	REJECT	DEFER	MAEB MINUTES
CHAIRMAN:					
EF, EH02:					
SECRETARY:					

REMARKS:

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MATERIAL USAGE AGREEMENT

C	USAGE AGREEMENT NO.:	REV	PAGE OF

PROJECT:	SUBSYSTEM:	ORIGINATOR:	ORGANIZATION:

DETAIL DRAWING (S)	USING ASSEMBLY (S)	ITEM DESCRIPTION	ISSUE

MATERIAL	TRADE NAME	SPECIFICATION	MANUFACTURER

THICKNESS	WEIGHT	EXPOSED AREA	LOCATION	ENVIRONMENT		
				PRESSURE	TEMPERATURE	MEDIA
			HABITABLE ☐			
			NONHABITABLE ☐			

APPLICATION

RATIONALE:

ORIGINATOR:	PROGRAM MANAGER:	DATE:

MATERIALS APPLICATIONS EVALUATION BOARD DISPOSITION

	DATE	APPROVE	REJECT	DEFER	MAEB MINUTES
CHAIRMAN:					
CHIEF, EH02:					
SECRETARY:					

REMARKS:

MSFC - Form 501 (Rev. February 1983)

Attachment 3

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MSFC - SPEC - 522A

APPENDIX C

STRESS CORROSION EVALUATION FORM

1. Part Number _____
2. Part Name _____
3. Next Assembly Number _____
4. Manufacturer _____
5. Material _____
6. Heat Treatment _____
7. Size and Form _____
8. Sustained Tensile Stresses-Magnitude and Direction
   a. Process Residual _____
   b. Assembly _____
   c. Design, Static _____
9. Special Processing _____
10. Weldments
    a. Alloy Form, Temper of Parent Metal _____
    b. Filler Alloy if none, indicate _____
    c. Welding Process _____
    d. Weld Bead Removed - Yes ( ), No ( ) _____
    e. Post-Weld Thermal Treatment _____
    f. Post-Weld Stress Relief _____
11. Environment _____

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APPENDIX C (CONTINUED)

12. Protective Finish _____

13. Function of Part _____

_____

14. Effect of Failure _____

_____

15. Evaluation of Stress Corrosion Susceptibility _____

_____

16. Remarks: _____

_____

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MC C-PROC-1301

	C (1)	USAGE AGREEMENT NO.: (13)	REV (1)	PAGE ___ OF ___
[redacted] COMPOSITE MUA				

T: (5)	SUBSYSTEM: (10)	ORIGINATOR:	ORGANIZATION: (4)

RT NUMBER (S)	SERIAL NUMBER (S)	ITEM DESCRIPTION (16)

OMENCLATURE	FLIGHT EFFECTIVITY	SPECIFICATION	DEVELOPER/MANUFACTURER

IMENSIONS/CLOSED/SEALED	LOCATION (4)	ENVIRONMENT		
		PRESSURE	TEMPERATURE	MEDIA
	HABITABLE ☐			
	NON HABITABLE ☐			

APPLICATION: THIS MUA PROVIDES CERTIFICATION OF THE FOLLOWING HARDWARE PER THE PROVISIONS AND RESTRICTIONS OF:

☐ NHB 1700.7A ☐ JSC-SER-0006B

☐ MSFC STD 506B ☐ OTHER

ITEM	LOCATION			FLAMMABILITY			OUTGASSING			STRESS CORROSION		
	SL	ORB	CB	HAB		NO HAB	TOX		TVS	NONE		RPTD
[redacted]					ACCEPTABLE PER CRITERIA OF NHB-8060.1 B			TOX ACCEPTABLE PER CRITERIA 1 & 2 OF NHB 8060.1 B TVS MEETS INTENT OF SP-R-0022A			REPORTED SCC ITEMS ARE ACCEPTABLE	

RATIONALE: THE CERTIFICATION BASED ON EVALUATION OF ☐ FINAL MATERIALS LIST ☐ DRAWINGS

SUBMITTED BY: _____

ATTACHMENT 1 BRIEF DESCRIPTION OF ITEM & GENERAL CORRESPONDENCE
ATTACHMENT 2 MATERIAL USAGE AGREEMENTS & VERIFICATION SUMMARY
ATTACHMENT 3 TOXIC OUTGASSING DATA & VERIFICATION SUMMARY
ATTACHMENT 4 FINAL MATERIALS LIST AND/OR FLAMMABILITY VERIFICATION SUMMARY
ATTACHMENT 5 SCC VERIFICATION SUMMARY
ATTACHMENT 6 THERMAL VACUUM STABILITY VERIFICATION SUMMARY
ATTACHMENT 7 OPEN ITEMS

ORIGINATOR:	PROGRAM MANAGER:	DATE:

MATERIALS APPLICATIONS EVALUATION BOARD DISPOSITION

	DATE	ACCEPT	REJECT	DEFER	MAEB MINUTES
CHAIRMAN:					
[redacted], EH02:					
SECRETARY:					

REMARKS:

Attachment 4

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PACKAGE NO. 10443R

DOCUMENTATION RELEASE LIST
GEORGE C. MARSHALL SPACE FLIGHT CENTER

MSFC CODE IDENT 14981/339B2
ISSUE DATE FEB 22 2007

C H	DOCUMENT NUMBER	DRL DSH	DRL REV	TITLE	CCBD NO.	PCN	PC	EFFECTIVITY
*	MSFC-PROC-1301	202	-	GUIDELINE FOR IMPL OF MATERIALS CONTROL	000-00-0000	0000000	ZA	NONE

CHG NO.	CHG REV	CHG NOTICE	RESPONSIBLE ENGINEER	RESPONSIBLE ORGANIZATION	ACTION DATE	DESCRIPTION
			FRANK KEY	EH02	02/23/94	BASELINE RELEASE
*	1	DCN000	EUGENA GOGGANS	EO03	02/22/07	DOCUMENT RELEASED THRU PDS. NO LONGER TRACKED IN ICMS.

CHECKER

N/A
02/15/07

(FINAL)

Downloaded from http://www.everyspec.com

PACKAGE NO: 10443R

PROGRAM/PROJECT: MULTI LAST UPDATED: 02/22/07

NOMENCLATURE: MSFC-STD- GOING TO NONE EFFECTIVITY

ECR NO:	PCN:	CCBD NO:	DATE PREPARED:
E003-0000	0000000	000-00-0000	02/22/07
		SB3-00-0000	

DWG SIZE	DRAWING NUMBER	DWG REV	EPL/DRL/DDS NUMBER	DWG REV	EPL DSH	EPL REV	EO DASH NUMBER	EO REV	PART NUMBER
			MSFC-HDBK-1453		202	-			
			MSFC-HDBK-1674		202	-			
			MSFC-HDBK-2221		203	-			
			MSFC-HDBK-505		202	-			
			MSFC-HDBK-670		202	-			
			MSFC-MNL-1951		209	-			
			MSFC-PROC-1301		202	-			
			MSFC-PROC-1721		202	-			
			MSFC-PROC-1831		202	-			
			MSFC-PROC-1832		202	-			
			MSFC-PROC-404		202	-			
			MSFC-PROC-547		202	-			
			MSFC-QPL-1918		204	-			
			MSFC-RQMT-1282		202	-			
			MSFC-SPEC-1198		202	-			
			MSFC-SPEC-1238		202	-			
			MSFC-SPEC-1443		202	-			
			MSFC-SPEC-164		202	-			
			MSFC-SPEC-1870		202	-			
			MSFC-SPEC-1918		203	-			
			MSFC-SPEC-1919		206	-			
			MSFC-SPEC-2083		202	-			
			MSFC-SPEC-2223		202	-			
			MSFC-SPEC-2489		206	-			
			MSFC-SPEC-2490		205	-			
			MSFC-SPEC-2491		203	-			
			MSFC-SPEC-2492		203	-			
			MSFC-SPEC-2497		211	-			
			MSFC-SPEC-250		202	-			
			MSFC-SPEC-445		202	-			
			MSFC-SPEC-504		202	-			
			MSFC-SPEC-521		202	-			
			MSFC-SPEC-548		202	-			
			MSFC-SPEC-560		202	-			
			MSFC-SPEC-626		202	-			
			MSFC-SPEC-684		202	-			
			MSFC-SPEC-708		202	-			
			MSFC-SPEC-766		202	-			
			MSFC-STD-1249		202	-			
			MSFC-STD-1800		202	-			
			MSFC-STD-246		202	-			
			MSFC-STD-2594		203	-			

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PACKAGE NO: 10443R

DWG SIZE	DRAWING NUMBER	DWG REV	EPL/DRL/DDS NUMBER	DWG REV	EPL DSH	EPL REV	EO DASH NUMBER	EO REV	PART NUMBER
			MSFC-STD-2903		202	-			
			MSFC-STD-2904		202	-			
			MSFC-STD-2905		202	-			
			MSFC-STD-2906		202	-			
			MSFC-STD-2907		202	-			
			MSFC-STD-366		202	-			
			MSFC-STD-383		202	-			
			MSFC-STD-486		202	-			
			MSFC-STD-506		203	-			
			MSFC-STD-531		202	-			
			MSFC-STD-557		202	-			
			MSFC-STD-561		203	-			
			MSFC-STD-781		202	-			

SUBMITTED BY ENGINEERING AREA:	BASIC CHANGE	PARTIAL	COMPLETE	CLOSES ACTION
EO03	X		X	EO03

PREPARED BY:
EUGENA GOGGANS
12/19/06

SUBMITTED BY:

CONCURRENCE:

TRANSMITTAL DATES
TO RELEASE DESK 02/22/07 10:00
TO MSFC DOC REP 02/22/07 00:00

REMARKS:

2007 FEB 22 AM 11:22

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I. GENERAL INFORMATION

1. APPROVED PROJECT:	2. DOCUMENT/ DRAWING NUMBER:	3. CONTROL NUMBER:	4. RELEASE DATE:	5. SUBMITTAL DATE:
Multi Program/Project Document	MSFC-PROC-1301		06/01/1986	08/11/2003

6. DOCUMENT/DRAWING TITLE:
Guidelines for the Implementation of Required Materials Control Procedures

7. REPORT TYPE:
Procedure

8. CONTRACT NUMBER / PERFORMING ACTIVITY:	9. DRD NUMBER:	10. DPD / DRL / IDRD NUMBER:
N/A	N/A	N/A

11. DISPOSITION AUTHORITY (Check One):	12. SUBMITTAL AUTHORITY:	13. RELEASING AUTHORITY:
☒ Official Record - NRRS 8/13/A ☒ Reference Copy - NRRS 8/5/A/3 (destroy when no longer needed)	Richard Wegrich	8/11/03 Gail H. Gordon

MJ

14. SPECIAL INSTRUCTIONS:
This procedure is a multiprogram/project support document used to define how to complete a Materials Usage Agreement.

15. CONTRACTOR/SUBMITTING ORGANIZATION, ADDRESS AND PHONE NUMBER:	16. ORIGINATING NASA CENTER:
Richard Wegrich ED35/Materials Processes & Manufacturing Dept. Building 4612 544-2626	MSFC
	17. OFFICE OF PRIMARY RESPONSIBILITY: ED35

18. PROGRAMMATIC CODE (5 DIGITS): 336-33-60	19. NUMBER OF PAGES: 36

II. ENGINEERING DRAWINGS

20. REVISION:	21. ENGINEERING ORDER:	22. PARTS LIST:	23. CCBD:
N/A			

III. REPORTS, SPECIFICATIONS, ETC.

24. REVISION:	25. CHANGE:	26. VOLUME:	27. BOOK:	28. PART:	29. SECTION:
N/A					

30. ISSUE:	31. ANNEX:	32. SCN:	33. DCN:	34. AMENDMENT:

35. APPENDIX:	36. ADDENDUM:	37. CCBD:	38. CODE ID:	39. IRN:

IV. EXPORT AND DISTRIBUTION RESTRICTIONS

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- ☐ Proprietary (see MPD 2210.1)
- ☐ Patent (see MPG 2220.1)
- ☐ ITAR (see MPG 2220.1)
- ☐ EAR (see MPG 2220.1)
- ☐ Other ACI (see NPG 1620.1 and MPG 1600.1) _____
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V. ORIGINATING ORGANIZATION APPROVAL

40. ORG. CODE:	41. PHONE NUMBER:	42. NAME:	43. SIGNATURE/DATE:
ED35	(256) 544-2626	Richard Wegrich	Richard T. Wegrich 8/11/03

VI. TO BE COMPLETED BY MSFC DOCUMENTATION REPOSITORY

44. RECEIVED BY:	45. DATE RECEIVED:	46. WORK ORDER:
Tammy Wise	10-15-03	