भारतीय मानक

Indian Standard

IS 18326 : 2023
ISO 10794 : 2018

अंतरिक्ष प्रणाली — कार्यक्रम प्रबंधन — सामग्री, यांत्रिक भागों और प्रक्रियाओं

Space Systems — Programme Management — Material, Mechanical Parts and Processes

ICS 49.140

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July 2023 **Price Group 14**

Air and Space Vehicles Sectional Committee, TED 14

NATIONAL FOREWORD

This Indian Standard which is identical with ISO 10794 : 2018 ‘Space systems — Programme management — Material, mechanical parts and processes’ issued by International Organization for Standardization (ISO), was adopted by the Bureau of Indian Standards on the recommendations of the Air and Space Vehicles Sectional Committee and approval of the Transport Engineering Division Council.

The text of ISO standard has been approved as suitable for publication as an Indian Standard without deviations. Certain terminologies and conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words ‘International Standard’ appear referring to this standard, they should be read as ‘Indian Standard’; and
b) Comma (,) has been used as a decimal marker, while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their respective places, are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 9000 : 2005 Quality management systems — Fundamentals and vocabulary	IS/ISO 9000 : 2015 Quality management systems — Fundamentals and vocabulary (*fourth revision*)	Identical
ISO 14300-2 Space systems — Programme management — Part 2: Product assurance	IS 18327 (Part 2) : 2023/ISO 14300-2 : 2011 Space systems — Programme management: Part 2 Product assurance	Identical
ISO 27025 : 2010 Space systems — Programme management — Quality assurance requirements	IS 18336 : 2023/ISO 27025 : 2010 Space systems — Programme management — Quality assurance requirements	Identical
ISO 23461 : 2010 Space systems — Programme management — Non-conformance control system	IS 18335 : 2023/ISO 23461 : 2010 Space systems — Programme management — Non-conformance control system	Identical

Attention is drawn to the possibility that some of the elements of this standard may be the subject of patent rights. The Bureau of Indian Standards shall not be held responsible for identifying any or all such patent rights.

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Introduction

This document is intended for application by the management in space programmes and applications.

The formation of this document takes into account the existing International Standards prepared by ISO/TC 176, notably ISO 9000, ISO 9001 and ISO 9004, and the content of ISO 14300-1 and ISO 14300-2.

This document specifies the requirements and statements applicable to materials, mechanical parts and processes to satisfy the mission performance requirements.

This document also specifies the documentation requirements and the procedures relevant to obtaining approval for the use of materials, mechanical parts and processes in the fabrication of space systems and associated equipment.

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Indian Standard

SPACE SYSTEMS — PROGRAMME MANAGEMENT — MATERIAL, MECHANICAL PARTS AND PROCESSES

1 Scope

This document defines the programme management requirements for material, mechanical parts and processes for projects covering mission definition, design, development, production and operations of space systems, including disposal.

This document covers the following:

— management, including organization, reviews, acceptance status and documentation control;

— selection criteria and rules;

— evaluation, validation and qualification, or verification testing;

— procurement and receiving inspection; and

— utilization criteria and rules.

This document applies to all space deliverable products and all programme phases.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14300-2, *Space systems — Programme management — Part 2: Product assurance*

ISO 27025, *Space systems — Programme management — Quality assurance requirements*

ISO 23461, *Space systems — Programme management — Non-conformance control system*

ISO 9000, *Quality management systems — Fundamentals and vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9000 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
critical material
material that is new to an individual company or non-validated for the particular application and environment, or that has caused problems during previous use that remain unresolved

3.2
critical mechanical part
mechanical part that requires specific attention or control due to fracture mechanics aspects and limited-life aspects, or with which the contractor has no previous experience of using the mechanical part in the specific application and environment or are new or non-qualified, or that has caused problems during previous use that remain unsolved

3.3
critical process
process new to an individual company or non-verified for the application in question or has caused problems during previous use that remain unresolved

3.4
mechanical part
piece of hardware that is not electrical, electronic or electromechanical and that performs a simple elementary function or part of a function in such a way that it can be evaluated as a whole against expected requirements of performance and cannot be disassembled without destroying this capability

3.5
process
set of interrelated or interacting activities that transforms inputs into outputs

Note 1 to entry: See ISO 9000.

Note 2 to entry: In this document, "process" means the manufacturing process of product, i.e. set of interrelated resources and activities which transforms a material or semi-finished product into a semi-finished product or final product.

3.6
request for approval
document by which the supplier or user asks the competent body for permission to use a critical material, part or process

3.7
special process
process where quality cannot be completely ensured by inspection of the end article only

4 Abbreviated terms

The following abbreviated terms are defined and used within this document.

AA Aluminium Association

AOCS attitude and orbit control system

ATOX atomic oxygen

AISI American Iron and Steel Institute

CDA Copper Development Association

CDR critical design review

CFRP carbon fibre reinforced polymer

CI configuration item number (as per project definition)

DML declared materials list

DMPL declared mechanical parts list

DPL declared processes list

DRD document requirements definition

EEE electrical, electronic and electromechanical

ESA European Space Agency

GOX gaseous oxygen

GSE ground support equipment

LEO low earth orbit

LOX liquid oxygen

MIP mandatory inspection point

MMPP materials, mechanical parts and processes

MPCB Material, Mechanical Parts and Process Control Board

NASA National Aeronautics and Space Administration

NCR non-conformance report

NRB non-conformance review board

PA product assurance

PDR preliminary design review

PID process identification document

PMP parts, materials, processes

QR qualification review

QRR qualification review report

RFA request for approval

RFD request for deviation

SCC stress corrosion cracking

5 General requirements

5.1 Materials, Mechanical Parts and Processes Programme (MMPP) management requirement

5.1.1 Overview

The general MMPP activity within the framework of a project is summarized in Figures 1 and 2.

5.1.2 MMPP plan

The suppliers shall prepare, maintain and implement a MMPP plan, as part of the overall PA plan in accordance with ISO 14300-2 and this document, or exist as a separate document.

The MMPP plan shall be submitted to the customer for approval.

5.1.3 Management

The supplier shall appoint a MMPP manager. The MMPP Manager shall ensure that the Materials, Mechanical Parts and Processes used to manufacture a spacecraft or a launcher satisfy both the ground and flight functional requirements and constraints of the project. To obtain the validation status for materials and qualification status for parts and verification status for processes, the MMPP manager shall present to the customer activities which were performed in conformance with this document together with results obtained.

5.1.4 Material, Mechanical Parts, Processes Control Board (MPCB)

The MMPP manager shall organize Material, Mechanical Parts and Processes Control Board (MPCB) with his or her suppliers at all levels, as appropriate. The MPCB activity shall start not later than at PDR. The MMPP Manager shall agree with the customer on the MPCB's activities at PDR. Minimum tasks of the MPCB shall be as follows:

— coordination of the initiation and approval of RFA's in conformance with DRD from the Annex E by involving the relevant technical discipline;

— review and approval of test programme and related results;

— review of preliminary Declared Materials, Mechanical Parts and Processes Lists and of any available evidence to support the approval, by the PDR;

— review and approval of Declared Materials, Mechanical Parts and Processes Lists and of the evidence for the approval by the CDR; and

— review and approval of any change to the approved Declared Materials, Mechanical Parts and Processes Lists.

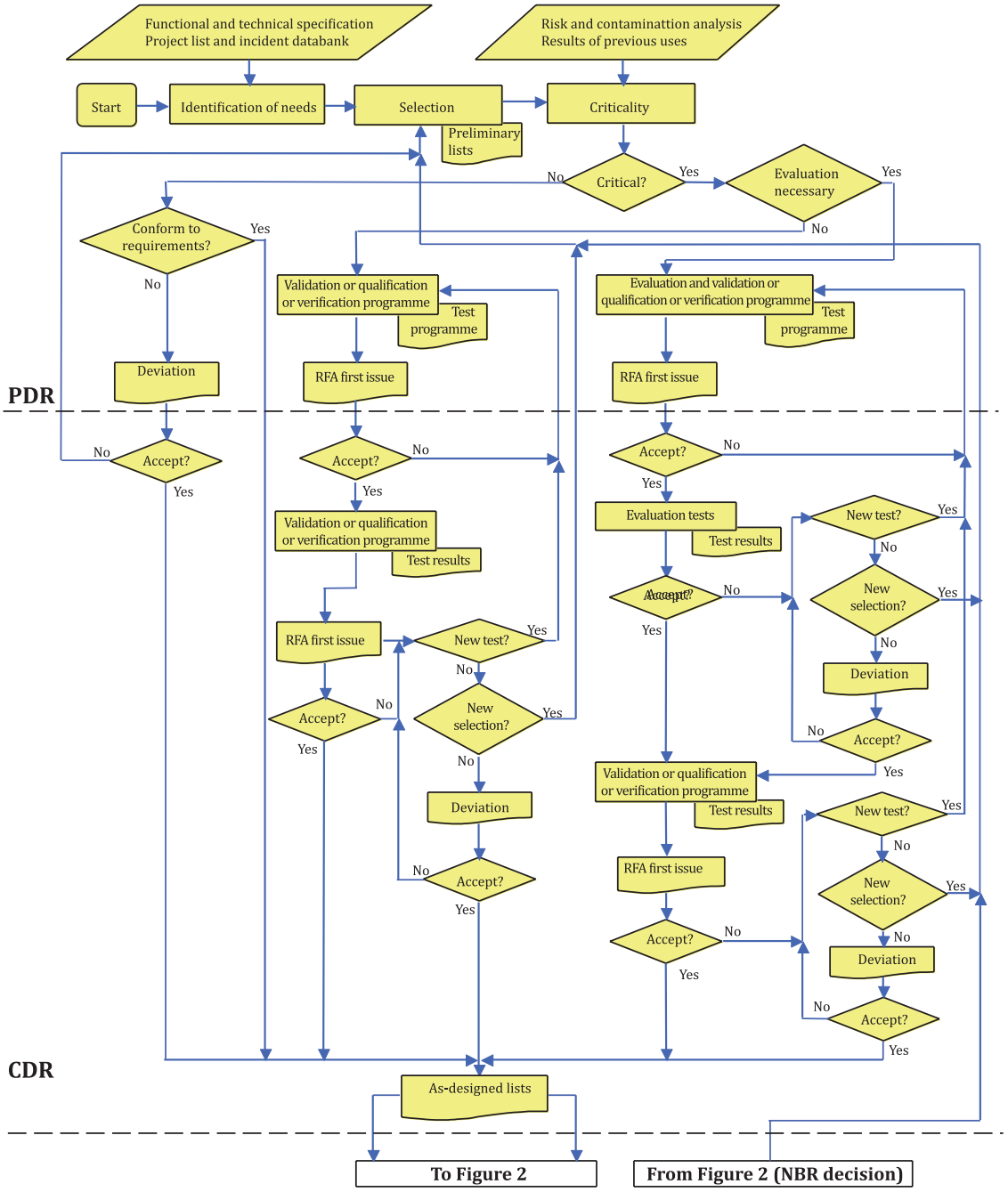

Figure 1 — Materials, mechanical parts and processes flow chart (continued in Figure 2)

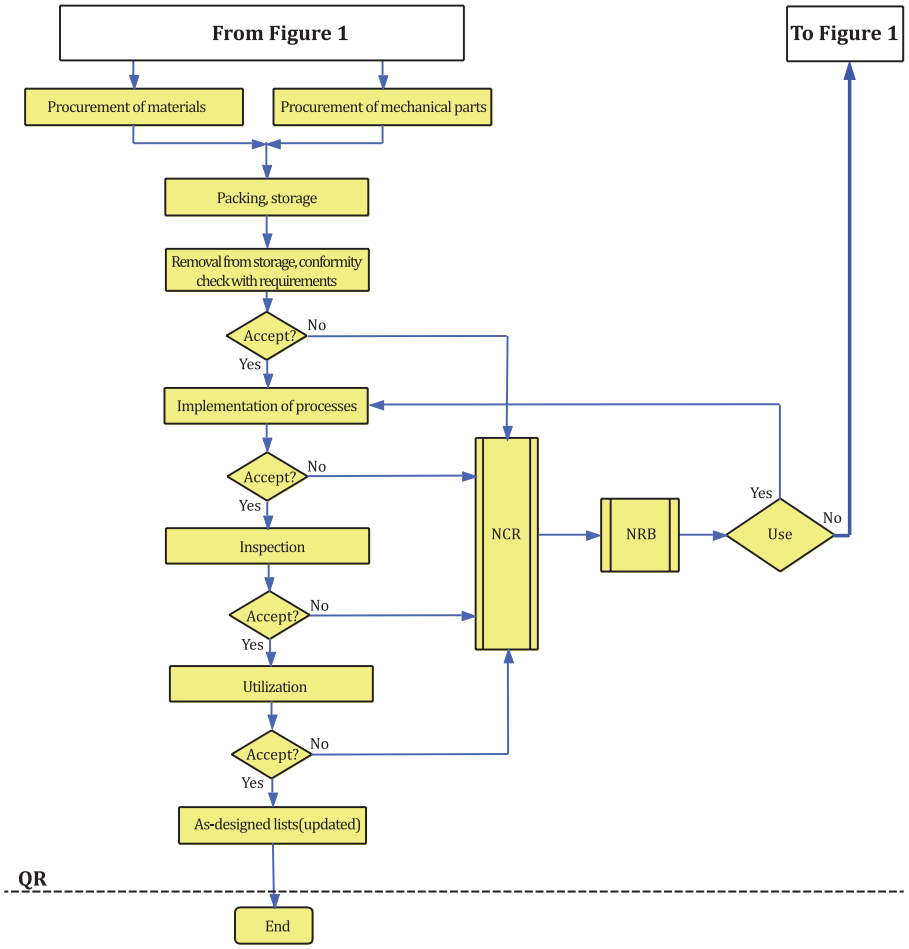

Figure 2 — Materials, mechanical parts and processes flow chart (continued from Figure 1)

Table 1 — Steps to be taken to get approval for materials, mechanical parts and processes

Approval process for materials, mechanical parts and processes (MMPP)						
Phase	Materials		Mechanical parts		Processes	
	Step	Comments	Step	Comments	Step	Comments
Critical analysis	1	—	1	—	1	—
Evaluation (usually by test methods defined by national agency standards)	2	Critical materials are tested, e.g. outgassing, SCC, flammability.	2	Mechanical parts are tested by, for example, vibration, thermal analysis, offgassing and life test.	2	Critical processes are evaluated by testing "technology samples" including all, for example, electrical interconnection processes and painting, adhesive bonding.
Verification/validation/qualification	3	Validation	3	Qualification	3	Verification
Approval	4	By RFA (see Annex E) or DML	4	By RFA (see Annex E) or DMPL/DPL	4	By RFA (see Annex E) or DPL
NOTE 1 Project approval is always by means of the request for approval (RFA) form and the project's declared materials list (DML), declared mechanical parts list (DMPL) and declared processes list (DPL).						
NOTE 2 The details for approvals of MMPP lists are contained in this document.						
NOTE 3 To summarize: Materials are validated.						
Mechanical parts are qualified.						
Processes are verified.						
And in addition: Skills training schools are customer approved.						
Outside test or evaluation laboratories are customer approved.						
Operators and inspectors for critical processes are trained, competent and monitored.						

5.2 Management and consolidation of the activities

5.2.1 Relationship

The relationship between materials and processes activities and programme phases is shown in Annex A.

5.2.2 Establishing and processing of lists

5.2.2.1 Each supplier and lower-level supplier shall establish, collect, review and deliver the declared materials, mechanical parts and processes lists including all the items intended for use in the flight equipment. The lists shall reflect the current design at the time of issue. These lists shall contain the materials, mechanical parts and processes used in the current design. The objectives are as follows:

— compliance with all requirements of the programme;

— verification of the results of equipment supplier activities; and

— control and monitoring the status of materials, mechanical parts and processes in conformance with programme milestones. For additional information, see informative Annex A.

5.2.2.2 The following constraints should be assessed:

— requirements originating from the functional specifications;

— requirements and conditions specific to the project;

— maximum use of the materials and processes described in approved data sources, e.g. national agency standards, and items already approved on similar projects; and

— use of project related preferred lists, if available.

5.2.2.3 An analysis of the criticality of these preliminary lists shall be performed as such that, after checking the conformity of the materials, mechanical parts and processes against all the project requirements, allow them to be classified into three categories:

— critical items, subject to evaluation, validation, qualification, or verification programmes;

— items that are not critical but which do not conform to one or more project requirements; and

— non-critical items.

For items classified as critical, a request for approval shall be submitted in conformance with Annex E. For items classified as not critical but which are not in conformance with one or more project requirements, a justified deviation request should be drafted.

5.2.3 Management of the lists

The supplier shall document all materials in the Declared materials list in conformance with Annex B.

The supplier shall document all mechanical parts in the Declared mechanical parts list in conformance with Annex C.

The supplier shall document all processes in the Declared process list in conformance with Annex D.

The supplier shall process the lists of lower-level suppliers to ensure exchangeability, traceability, searchability, sortability, storability and retrievability for that set of lists, before submitting it to the customer.

These lists shall be updated during the course of the project. The preliminary lists shall include the items from suppliers' preliminary requirements and are used to identify those that are critical (available for the PDR).

The as-designed lists shall include the items from the baseline's various design files, available for the CDR.

Any change after CDR or QR shall be reflected in the list and shall be in accordance with Figure 2.

The MMPP manager is responsible within the programme to ensure that all the information needed is given and that the approval status is consistent with technical and scheduling objectives and that the data are exchangeable.

Where no project requirements exist for a separate DMPL, the mechanical parts can be entered into a separate section of the DML.

The materials of, for example, bearings, screw and nuts that are made up of a few materials, can be listed in the DMPL. The materials (metals and plastics) of complex parts can be listed in the DML with, for example, outgassing, toxicity, flammability, corrosion and stress corrosion values and reference to the DMPL item.

The supplier shall establish, collect, review and deliver the declared materials, mechanical parts and processes lists in an electronic format in conformance with Annex B, Annex C, and Annex D.

The supplier shall demonstrate that the lists have been formally approved prior to their delivery to the customer.

5.2.4 Supplier role and responsibilities

5.2.4.1 The supplier shall be responsible for the following tasks:

— obtaining the correct and complete lists from lower-level suppliers;

— providing provisional and, later, definitive approval for each list; and

— submitting the project declared lists for approval prior to initiation of the hardware phase, before CDR.

The lists specified in the requirement by the suppliers shall include all the information described in this document. Amendments to the lists shall be implemented through established change procedures.

5.2.4.2 The following documentation shall be delivered to the customer upon request:

— RFA with reference and issue in conformance with DRD in Annex E;

— evaluation reports; and

— deviation requests.

The material, mechanical parts or process justification files shall be made available to the customer upon request either on the supplier site, or by any other process agreed by both parties.

NOTE For example, by non-disclosure agreement.

5.3 Technical constraints

Mechanical parts, materials and processes shall satisfy the mission's functional requirements and constraints. Mechanical parts, materials and processes shall satisfy both ground environment constraints (e.g. manufacture, tests, storage, maintenance, transport and integration) as well as flight requirements and flight constraints (launch and orbit).

The estimated availability of the parts and products obtained from materials and processes used shall be compatible with the space system's life cycle (tests, storage and mission).

5.4 Cleanliness and contamination control

The supplier shall establish and maintain a contamination and cleanliness control programme including, as a minimum:

— cleaning procedures; and

— cleanliness monitoring procedures or methods.

The risks of chemical or particle pollution generated by parts, materials or processes used shall be identified and reduced in accordance with mission requirements (cleanliness or contamination analysis).

For cleanliness- or contamination-critical applications, a chemical and particle requirement specification and a specific cleanliness control plan shall be established.

5.5 Safety hazardous parts and materials

Mechanical parts and materials with hazardous characteristics shall be identified, managed and processed according to customer standards.

5.6 Optical, mechanical or electrical GSE hardware

When optical, mechanical or electrical GSE materials are used in thermal vacuum or interfacing with flight hardware, possible degradation shall be assessed (e.g. contamination, surface degradation, flammability, electromechanical and chemical effects).

6 Material control

6.1 Technical criteria for selection of materials

Material design data shall be generated for the intended service conditions using test and analysis procedures approved by the customer. Material properties shall be compatible with the environments to which they are exposed during terrestrial testing prior to launch, and during the mission.

The following requirements shall be taken into account only if the environmental conditions of the mission require their application. The agency- or customer-specific requirements, test methods and acceptance or rejection criteria shall be applied.

a) Temperature: Material properties shall be compatible with the thermal environment to which they are exposed. Examples of thermal environment are also the passage through transitions, ductile-brittle temperatures, e.g. phase transitions, ductile-brittle transition temperatures for metals, glass transition (Tg) for polymer materials, and environmental factors which affect these properties, such as moisture.

b) Thermal cycling and thermo optical: Materials subject to thermal cycling shall be assessed for their ability to withstand induced thermal stress and shall be tested according to approved procedures. Thermo optical properties shall be evaluated in conformance technical requirements. Directional effects due to manufacturing or processing shall be evaluated via dedicated testing to be agreed with customer.

c) Vacuum:

   — Outgassing screening tests shall be carried out according to approved procedures. The screening process applied depends on the application.

   — All organic materials for use in space systems shall be evaluated to determine their outgassing characteristics.

   — The need for retest outgassing characteristics of materials used for an extended period of time at a temperature higher than 50 °C should be mutually agreed with the customer.

d) Offgassing, toxicity: Spacecraft and associated equipment shall be manufactured from materials and by processes that do not cause an unacceptable hazard to personnel or hardware, whether on the ground or in space. For materials for the use in manned compartments of a spacecraft or space segment elements, offgassing and toxicity analysis shall be performed. The levels of offgassing and toxicity shall be agreed with customer.

e) Flammability: The materials flammability resistance shall be evaluated for the most hazardous environment envisaged for their use, and be applicable to:

   — unmanned spacecraft or space segment elements launched by a manned space transportation system when powered on launch; and

   — manned spacecraft and space segment elements.

f) Radiation:

   — Materials exposed to radiation shall be assessed to determine their resistance to the radiation dosage expected during the mission.

— Evaluation of materials resistance to radiation shall include the combined effects of particle radiation and ultraviolet radiation in the normal space environment, along with any mission-specific radiation levels.

— The effect of bleaching due to vacuum or air recovery shall be evaluated, in case ex-situ measurements are performed.

— In case synergistic testing is not possible it shall be proven that synergistic effects caused by radiation and temperature are not degrading the materials' properties.

— In case technical limits prevent the synergistic testing approach, it shall be so justified, and the justification for sequential testing shall be provided.

g) Electrical charge and discharge: External surfaces of the spacecraft shall be sufficiently conductive, interconnected and grounded to the spacecraft structure to avoid the build-up of differential charges.

h) Corrosion: For all materials that come into contact with atmospheric gases, cleaning fluids or other chemicals, it shall be demonstrated that the degradation of properties during their anticipated service life is acceptable in terms of the performance and integrity requirements. All mechanical parts, assemblies and equipment, including spares, shall be finished to provide protection from corrosion.

i) Stress corrosion:

— Materials used for structural and load-bearing applications (subject to tensile stress) shall be selected in conformance with approved data sources.

— Any material not covered by an approved standard shall be tested according to approved procedures.

j) Fluid compatibility:

— Materials within the system exposed to reactive fluids, both directly and as a result of single point failures when failure propagation effects cause hazardous operation of interfacing hardware shall be compatible with that fluid in their application. Examples of reactive fluids are liquid oxygen (LOX) and gaseous oxygen (GOX).

— The compatibility of materials which are or can come into contact with LOX or GOX shall be evaluated except the case specified in the requirement.

— In case no compatibility data are available, tests shall be performed for reactive fluids other than oxygen.

k) Galvanic compatibility: When bimetallic contacts are used, the choice of the pair of metallic materials used shall be agreed with the customer. This also includes metal-to-conductive fibre-reinforced materials contacts. Galvanic compatibilities shall be selected in conformance with Table 2. Materials not listed in Table 2 shall be evaluated in a flight-simulated configuration using an accelerated environment to be agreed by the customer.

l) Atomic oxygen:

— All materials for use on the external surfaces of spacecraft for use in low earth orbit (LEO) altitudes, between 200 km and 700 km, shall be evaluated for their resistance to atomic oxygen (ATOX). The flux level varies with altitude, velocity vector and solar activity. Fluence levels vary with the duration of exposure.

— Test procedures shall be subject to the approval of the customer.

The effect of ATOX on thermo optical properties including specularity shall be evaluated.

Table 2 — Compatible couples for bimetallic contacts

Pure metals and alloys in alphabetical order (including carbon)	Aluminium Copper alloys	Al (pure), Al Zinc alloys	Cadmium	Cast iron (austenic)	Chromium	Copper, Brasses	Cupro Nickel, Albronzes, Sibronzes	Gold, Platinum, Carbon, Rhodium	Gunmetal (Cu Zn10 alloy), Pbronzes, Snbronzes	Magnesium	Nickel, Monel, Inconel, Nickel/Molybdenum alloys	Silver	SnPb alloys (all), Tin, Lead	Stainless steel 18/8 (300 series)	Stainless steel 13Cr (400 series)	Steel (carbon, low alloy), Cast iron	Titanium and Tial loys	Zinc, Beryllium
Aluminium Copper alloys		1	1	3	3	3	3	3	3	2	2	3	1	2	2	3	2	2
Al (pure) AlZinc alloys			1	3	3	3	3	3	3	2	3	3	2	3	3	3	3	2
Cadmium				2	2	2	2	2	2	1	2	2	0	1	1	2	2	2
Cast iron (austenic)					1	1	1	2	1	3	1	2	1	1	1	2	1	3
Chromium						1	0	0	1	3	1	0	2	0	0	2	0	3
Copper, Brasses							0	2	0	3	1	1	2	1	1	3	0	3
CuproNickel Albronzes Sibronzes								2	0	3	1	1	2	2	1	3	0	3
Gold Platinum, Carbon Rhodium									2	3	2	0	3	0	1	3	0	3
Gunmetal(CuZn10 alloy) Pbronzes Snbronzes										3	1	1	1	0	0	3	0	3
Magnesium											3	3	2	3	3	3	3	3
Nickel Monel Inconel Nickel/Molybdenumalloys												2	2	1	0	2	1	3
Silver													3	0	0	3	0	3
SnPb alloys (all) Tin, Lead														1	1	1	3	1
Stainless steel 18/8 (300 series)															1	3	0	3
Stainless steel 13Cr (400 series)																3	0	3
Steel (carbon, low alloy) Cast iron																	0	3

Table 2 *(continued)*

Pure metals and alloys in alphabetical order (including carbon)	Aluminium Copperal loys	Al (pure), Al Zincal loys	Cadmium	Cast iron (austenic)	Chromium	Copper, Brasses	Cupro Nickel, Albronzes, Sibronzes	Gold, Platinum, Carbon, Rhodium	Gunmetal (Cu Zn10 alloy), Pbronzes, Snbronzes	Magnesium	Nickel, Monel, Inconel, Nickel/ Molybdenum alloys	Silver	SnPbal loys (all), Tin, Lead	Stainless steel 18/8 (300 series)	Stainless steel 13Cr (400 series)	Steel (carbon, low al loy), Cast iron	Titanium and Tialloys	Zinc, Beryllium
Titanium and Tialloys																		3
Zinc Beryllium																		

Key:

0 - Can be used without restriction.

1 - Can be used in a noncontrolled environment (e.g. assembly area and general nonclean room environment).

2 - Can be used in a clean room environment.

3 - Needs specific measures to avoid galvanic corrosion when these combinations are selected.

m) Micrometeoroids and debris: The effect of impacts by micrometeoroids and debris on materials shall be reviewed and assessed on a case-by-case basis and their use shall comply with safety evaluation and assessment results concerning design and application criteria or details. Micrometeoroids and debris analysis and test procedures shall be subject to the approval by the customer.

n) Moisture absorption and desorption: Moisture absorption shall be prevented during manufacture and storage of hygroscopic materials.

o) Mechanical contact surface effects (cold welding, fretting, wear): For all solid surfaces in moving contact with other solid surfaces, it shall be demonstrated that the degradation of surface properties over the complete mission does not prevent to meet the performance requirements. For all solid surfaces, moving or in static contact with other solid surfaces, and intended to be separated it shall be demonstrated that the increase in separation force during the physical contact does not exceed the specified limit.

p) Life: materials shall be selected that they will meet the material performance requirements during all their specified lifetime.

q) Bacterial and fungus growth: Materials selected for manned or fluid systems shall not support bacterial or fungus growth, and be sterilizable. The extent of the degradation by the sterilization process shall be determined to define margins for design implementation. The design and qualification of an equipment to be sterilised shall implement the defined margins for sterilization degradation. The level of bacterial growth and fungus contamination shall be determined on the assembled hardware. Evaluation of organic materials used in the pressurized environment of long-term, manned spacecraft shall be performed prior to selection and verification.

r) Hydrogen embrittlement: The possibility of hydrogen embrittlement occurring during component manufacture or use shall be assessed. The material evaluation shall be performed including the assessment of a protection and control. Based on the assessment protection and control measures shall be implemented to avoid hydrogen embrittlement during both mechanical parts manufacturing and use. Hydrogen embrittlement can be introduced for example during e.g. plating, welding. Mechanical parts subject to fatigue or sustained loading stresses, which are made of material susceptible to hydrogen embrittlement, shall be heat treated after coating.

6.2 Selection

6.2.1 Materials shall be chosen as follows:

— If an identical application in other space programme similar with respect to environment constraints and lifetime to the proposed application exist, use materials used in such an application;

— those for which satisfactory evaluation results have been obtained on samples representative of the application with a sufficient margin as regards conditions of use;

— those included in approved data sources, for example ESA and NASA data banks.

6.2.2 Whether the materials are already validated or remain to be validated, their selection shall ensure that the following criteria:

— continuity of supply;

— reproducibility of characteristics;

— approved supplier/distributor;

— mechanical properties of materials processed according to a specified technique; and

— environmental-stability properties under space conditions, together with mission- or application-specific requirements.

6.2.3 Each critical material shall be validated for the specific application. Critical material should include the ones of approved data sources.

6.2.4 Space-proven materials with heritage covering the specific mission requirements shall be selected at the earliest design stage. The supplier shall be responsible for the selection of materials that are capable of meeting the requirements of his business agreement. The supplier shall be responsible for storing and maintain all materials data in an internal database. The access to the data shall be granted to the customer.

6.2.5 To achieve high reliability and good performance, the use of a material shall be restricted to within its maximum qualified range of physical and mechanical properties.

6.2.6 All test methods and inspection techniques used to verify material characteristics and final products shall conform to standards approved by the customer. All test methods and inspection techniques shall not be used before approval by the customer.

6.2.7 The following constraints should be assessed:

— Pure tin finish with more than 97 % purity shall not be used. This is due to the possibility of whisker growth and transformation to grey tin powder at low temperatures.

— The incoming inspection of each EEE component batch shall include the verification of the termination composition to avoid assembly of pure tin finish.

— Cadmium and Zinc shall not be used as raw material or surface treatment for flight hardware.

— Cadmium and Zinc shall not be used for ground support equipment exposed to vacuum or when in contact with the flight hardware. For example, during thermal vacuum testing phases on ground.

— The incoming inspection of each non-EEE component batch shall include the verification of the metallic surface treatment to avoid assembly of pure tin, cadmium or zinc finish.

— The materials presented in the following shall not be used:

a) beryllium oxide;

b) mercury and its compounds;

c) polyvinyl chloride (PVC); and

d) radioactive material.

NOTE This list is not exhaustive.

— Beryllium shall not be used for structures.

— Beryllium shall not be used in applications other than structures, unless it has been approved by customer and all safety requirements are implemented by the supplier.

6.3 Declared materials list content

The declared materials list (DML) shall be broken down into clear categories to facilitate locating each item in the documentation (an example of such a breakdown is given in the DML DRD). For additional information, see Annex B. The DML shall include the following information:

— issue status of DML;

— unique item number (as the reference of the material in the DML) that shall be the same throughout the duration of the project;

— material designation (commercial identification);

— material keys, e.g. AISI; AA; CDA, UNS, ASTM;

— chemical nature and type of product;

— manufacturer's name and procurement specifications or standards;

— summary of processing parameters (e.g. finish, temper condition, mix ratio and curing);

— use and location;

— environmental code;

— size code, test data (e.g. outgassing, stress corrosion cracking, corrosion and test data references); and

— approval status (with reference to the approval authority, to test report and similar previous applications).

Any coding or acronyms used within the list shall be defined within the document. An example of a suitable completed DML format is given in Table B.4 in the DML DRD. For additional information, see Annex B.

6.4 Criticality analysis

The objective of the analysis is to identify whether further data are required to conform to mission requirements.

a) The supplier shall analyse all the materials contained in his or her preliminary lists with respect to criticality and in correlation with the risk analysis performed.

b) Any material not meeting the project requirements shall be the subject of an RFA that is submitted to the next customer.

c) The RFA shall include the reason and details of the subsequent evaluation and validation that it is necessary to perform. For additional information, see informative Annex E and 5.2.2.

6.5 Evaluation and validation phases

6.5.1 General

Depending on the results of the criticality analysis, the supplier shall perform an evaluation phase before the validation phase for all critical materials with unknown characteristics (new materials) or with major changes in the use or in the configuration.

In case of an extension of an existing application, the evaluation need not be performed if so agreed with the customer.

Guaranteed characteristics of materials and material supplier inspection methods, together with associated documents, shall be available for review at the supplier's premises before the start of evaluation or qualification phases.

6.5.2 Evaluation phase

The evaluation shall assess as a minimum the following:

— the limits of use;

— the material's physical, chemical or functional characteristics along with their values and tolerances;

— behavioural tendencies and degradation processes depending on environmental parameters including sensitivity to pollution; and

— acceptance criteria.

When evaluation is performed, the supplier shall provide an evaluation programme at PDR, and an evaluation report before CDR, in accordance with Figures 1 and 2 and Table 1.

6.5.3 Validation phase

For all critical materials, a validation programme available at PDR shall be drawn up by the supplier and then implemented to check or confirm that the materials satisfy the mission requirements with specified margins as necessary to obtain validation status.

Validation status shall be decided at CDR in view of the available results obtained written in validation report and the review of corresponding documentation.

The validation programme and report shall be approved by the customer.

6.5.4 Approval phase

The material shall not receive an approval identification in the declared material list for the project unless the requirements specified in 6.5.2 and 6.5.3 are satisfied.

If approval is not granted, the supplier in charge of the item shall either

— select another material;

— propose a modified evaluation programme and resubmit for approval; or

— if the above actions fail to achieve positive results, initiate a deviation procedure.

6.5.5 Deviation request

For materials not conforming to project requirements, whether at the end of criticality analysis or of evaluation and validation tests, the supplier shall submit a request for deviation in accordance with ISO 27025.

6.6 Procurement of materials

6.6.1 Procurement specifications

All materials shall be procured to an internationally or nationally specification approved by the supplier quality system or an in-house fully configured procurement specification that defines the material's properties, the material's requirements, the test methods, the acceptance criteria for the specific applications, source inspection (if any) and material supplier inspection.

Where material suppliers do not accept specifications and procurement is by means of a datasheet, the supplier shall introduce internal, in-house receipt inspection to ensure that the validation status of the material is maintained during the subsequent procurements.

Materials with long lead times or long procurement delays versus the project schedule shall be identified before the formal subsystem PDR. Procurement shall be planned, documented and implemented to obtain reliable product assurance provision at CDR. Back-up plans shall be prepared and initiated whenever there is evidence of possible delays or technical problems.

The material requirements shall be accepted by the material supplier or manufacturer.

6.6.2 Incoming inspection procedure

All materials shall be submitted to an incoming inspection.

An incoming inspection procedure shall define the inspections and tests to be carried out, particularly for materials that are known to have variable in their final properties.

6.7 Use of materials

6.7.1 Validation status of materials

The supplier shall verify that all critical materials are validated before being used in the manufacture of qualification or flight products. Any modification, change of condition or configuration of application shall lead to a re-evaluation in conformance with the process shown in Figure 1.

6.7.2 Traceability of materials

The supplier shall apply the traceability rules defined in ISO 27025 to all materials.

Materials shall be identified by a unique reference number, code or a lot number to provide traceability.

NOTE The traceability allow to reconstruct the materials history, either individually (individual traceability) or by the manufacturing lot of which it was a part (lot traceability) in case of an incident or nonconformance, or a need for a technical investigation following failure or damage.

6.7.3 Packaging, storage, removal from storage

The supplier shall define provisions for packaging, storage and removal from storage for materials.

Measurements and inspections used to guarantee the material integrity and monitoring during storage and removal from storage shall be identified.

6.7.4 Limited-life materials before implementation

The supplier shall ensure that all materials that have limited-life characteristics have their date of manufacture or date of delivery and shelf-life expiry date identified and clearly marked on each lot or batch.

Materials that have exceeded their shelf-life expiry date shall not be recertified until the physical and chemical characteristics are inspected and the parameters, subject to deterioration, are evaluated for continued acceptability according to the acceptance and rejection criteria.

6.7.5 Limited-life materials after implementation

Materials with limited life after implementation shall be identified and controlled in conformance with requirements.

NOTE 1 Propellant is an example of material with limited-life after implementation

NOTE 2 Storage and mission life are criteria for the assessment and control of those materials.

6.7.6 Materials' non-conformances and alerts

Non-conformances and alerts shall be managed in accordance with ISO 27025.

6.7.7 Health and safety

Material safety data sheet or equivalent shall be available for all materials.

7 Mechanical parts control

7.1 Verification of mechanical parts

The supplier shall verify that all materials and processes used in the mechanical parts satisfy the mission technical requirements.

7.2 Selection

Mechanical parts shall be chosen from those successfully used for an identical application in other space programmes similar with respect to environment constraints and lifetime.

Type reduction actions shall be implemented at all levels of the programme.

Whether the mechanical parts are already qualified or remain to be qualified, their selection shall ensure that the following criteria are met:

— durability of supply; and

— reproducibility of characteristics;

The supplier shall be responsible for storing and maintain all mechanical parts data in an internal database. The access to the data, shall be granted to the customer.

7.3 Declared mechanical parts list

The declared mechanical parts list (DMPL) shall be broken down into distinct categories to enable easy identification of each item in the documentation. (A breakdown is given in the DMPL DRD. For additional information, see Annex C.)

The DMPL format shall include the following information:

— item number (as the reference of the part in the DMPL); it shall be the same throughout the duration of the project;

— part designation (commercial identification);

— type of part;

— manufacturer and procurement specifications or standards;

— summary of functions and characteristics;

— use and location;

— environmental code; and

— approval status (with reference to the approval authority, to test report and similar previous applications).

Any coding or acronyms used within the list shall be defined within the document. Only those mechanical parts procured to a specification as a finished product shall be entered on the DMPL. An example of a suitable DMPL format is given in the DMPL DRD. For additional information, see Annex C.

7.4 Criticality analysis

The objective of the analysis is to identify whether further data are required to conform to mission requirements.

a) The supplier shall analyse all the mechanical parts contained in their preliminary lists with respect to criticality and in correlation with the risk analyses performed.

b) Critical parts shall be identified in the DMPL and included in the critical items list.

c) Any critical part shall be the subject of an RFA in conformance with Annex E submitted to customer.

7.5 Evaluation and qualification phases

7.5.1 General

Depending on the results of the criticality analysis, the supplier shall perform an evaluation phase before the qualification phases for all critical parts with unknown characteristics or with major changes in the use or in the configuration.

In case of an extension of an existing application, the evaluation need not be performed if so agreed with the customer.

Guaranteed characteristics of materials and material supplier inspection methods, together with associated documents, shall be available for review at the supplier's premises before the start of evaluation or qualification phases.

NOTE Reference can be made to Table 1 for an explanation of the steps involved.

7.5.2 Evaluation phase

The evaluation shall include the following, as a minimum, for each critical part:

— the limits of use;

— the part's physical or functional characteristics, along with its values and tolerances;

— the behavioural tendencies and degradation processes depending on environment parameters, including sensitivity to pollution; and

— the acceptance criteria.

When an evaluation is performed, the supplier shall provide an evaluation programme at PDR, and an evaluation report before CDR.

The behaviour of the parameters that will be monitored (e.g. variation and change over time) that were also recorded during the evaluation programme tests shall serve as a reference for the analysis of qualification test results.

7.5.3 Qualification phase

For each critical part, a qualification programme shall be drawn up by the supplier of the equipment using the critical part and then implemented to check or confirm whether the parts satisfy mission requirements with specified margins.

Qualification status shall be decided at CDR in view of the available result obtained, written in qualification report, and the reviews of corresponding documentation.

The qualification programme and report shall be submitted to the customer for approval.

7.5.4 Approval phase

The mechanical parts shall not receive an approval identification in the declared mechanical parts list for the project unless the requirements from 7.5.2 and 7.5.3 are satisfied.

If approval is not granted, the supplier in charge of the item shall either:

— select another mechanical part; or

— propose a modified evaluation programme and resubmit for approval; or

— initiate a deviation procedure if the above actions fail to achieve positive results.

7.5.5 Deviation request

For mechanical parts not conforming to project requirements, whether at the end of criticality analysis or of evaluation and qualification tests, the supplier shall submit a deviation, in accordance with ISO 27025.

7.6 Procurement of mechanical parts

7.6.1 General

Mechanical parts with long lead times or procurement delays, versus the project schedule, shall be identified before the formal subsystem PDR. Procurement shall be planned, documented and implemented to obtain reliable product assurance provision at CDR.

Back-up plans shall be prepared and initiated whenever there is evidence of possible delays or technical problems.

7.6.2 Procurement specification

Each part shall be covered by a procurement specification or a standard approved by the supplier quality system. These procurement specifications shall define the part characteristics, requirements, tests methods, acceptance criteria, lot acceptance testing, source inspection and material supplier inspection. The procurement specifications shall be explicitly accepted by the mechanical part supplier or manufacturer.

7.6.3 Source inspection

For complex mechanical parts related to a specific project development, each supplier shall define the nature and frequency of their own source inspection points. Source inspection shall be carried out by the customer on the premises of the supplier, mechanical part manufacturer in accordance with ISO 27025.

7.6.4 Incoming inspection procedure

Each part or batch of mechanical parts shall be submitted to an incoming inspection. An incoming inspection procedure shall be established defining the inspections and tests to be carried out.

7.7 Use of mechanical parts

7.7.1 Qualification status of mechanical parts

The supplier shall ensure that all critical parts are qualified before being used in the manufacture of qualification or flight products. Any modification, change in condition or configuration of application shall lead to a re-evaluation in conformance with the process shown in Figure 1.

7.7.2 Traceability of mechanical parts

The supplier shall apply the traceability rules in accordance with ISO 27025 to his or her mechanical parts. Parts shall be identified by a unique reference number or code and a lot number to provide traceability when there is an incident or non-conformance, or for the purposes of technical investigations following failure or damage to reconstruct the mechanical part's history, either individually (individual traceability) or by the manufacturing lot it was part of (lot traceability).

7.7.3 Packaging, storage, removal from storage

The supplier shall define provisions for packaging, storage and removal from storage for mechanical parts.

Measurements and inspections used to guarantee the part integrity and monitoring during storage and removal from storage shall be identified.

7.7.4 Limited-life mechanical parts or parts subject to wearout

Limited-life mechanical parts after implementation or those subject to wear out, e.g. mechanisms, pyro initiators and O-rings, shall be identified and controlled, including storage and mission life. These parts shall be assessed as candidates to the critical items list; see ISO 27025.

7.7.5 Mechanical parts non-conformances and alerts

Management of mechanical parts' non-conformances and alerts shall be in conformance with ISO 27025 and ISO 23461.

8 Process control

8.1 Specifications or procedures

Each process being used in the manufacturing or assembly of a product shall be identified by a specification or procedure. Reference shall be made to accept and reject criteria.

8.2 Process selection and training

8.2.1 Processes shall be chosen from already verified processes according to the following order of preference and priority:

— processes covered by space agencies or other governmental organization certification for identical conditions of use;

— processes for which satisfactory evaluation and verification results are obtained on samples representative of the application with a sufficient margin as regards conditions of use; and

— processes already used by the same supplier for other space programmes in the same conditions of use.

8.2.2 Whether the processes are already verified or remain to be verified, their selection shall ensure that the following criteria are met:

— quality and reliability;

— inspectability;

— re-workability of the process item; and

— reproducibility.

8.2.3 The supplier shall store and maintain all processes data in an internal database. The access to the data shall be granted to the customer.

8.2.4 Processes using limited-life materials shall be in conformance with the requirements from ISO 27025.

8.2.5 Operators shall be trained for all processes. Operators performing special processes shall be competent for the activities they perform. Inspectors shall be competent to work on all processes.

8.2.6 Retraining of operators shall be applied in the event of a new process, modification to an existing process or a change of the equipment used. Retraining of inspectors shall be applied in the event of a new inspection procedure, modification to an existing inspection procedure or a change of an existing one. In the case of a process suspension for specified months (ex: 4 months or 6 months) continuously, retraining shall be performed.

8.2.7 Standards relating to the occupational health of operators working with processes resulting in exposure to vapours, dust or debris shall be implemented and controlled.

8.3 Declared processes list content

The declared processes list (DPL) shall be broken down into clear categories to facilitate locating each item in the documentation (a breakdown is given in the DPL DRD). For additional information, see Annex D.

The DPL format shall include the following information:

— item number (as the reference of the process in the DPL); it shall be the same throughout the duration of the project;

— process identification;

— process specification (including specification issue, revision or date);

— process description (with associated materials' designation if possible);

— use and location;

— process supplier;

— associated DML item numbers; and

— approval status (with reference to the approval authority, to the test report and similar previous applications).

Any coding or acronyms used within the list shall be defined within the document. An example of a suitable DPL format is given in the DPL DRD. For additional information, see Annex D.

8.4 Criticality analysis

The objective of the analysis is to identify whether further data are required to conform to mission requirements.

a) The supplier shall analyse all the processes contained in their preliminary lists with respect to criticality and in correlation with the risk analyses performed.

b) Critical processes shall be identified in the DPL and included in the list of critical items.

c) Any critical process shall be the subject of an RFA submitted to customer approval, see Annex E and 5.2.2.

d) Special processes can be identified and controlled. Process control shall be ensured by means of procedures available for customer review.

NOTE Best practice is to implement a statistical process control.

8.5 Evaluation and verification phase

8.5.1 General

Depending on the results of the criticality analysis, the supplier shall perform an evaluation phase before the verification phases for all critical processes which are new or with major change in the use or in the configuration. In case of an extension of an existing application, the evaluation need not be performed if so agreed with the customer.

For confidential processes, the supplier shall prove that the process has been verified, e.g. by presenting a verification certificate from space agencies or other governmental organization that shall check the applicability of this verification.

NOTE Reference can be made to Table 1 for an explanation of the steps involved.

8.5.2 Evaluation phase

The evaluation shall include the following as a minimum for each critical process:

— the limits of use;

— the values, determined by test samples or technology samples, of relevant parameters and their tolerances; and

— acceptance criteria.

When an evaluation is performed, the supplier shall provide an evaluation programme at PDR, and an evaluation report before CDR, in accordance with Figures 1 and 2 and Table 1.

8.5.3 Verification phase

For each critical process, the supplier shall implement a verification programme. The verification programme shall be defined in conformance with existing national agency standards of verification. The supplier shall ensure that mission requirements and that the parameters needed for the product design are defined so as to obtain verification status. Verification status shall be decided at CDR in review of available results written in verification report and the review of corresponding documentation. The verification programme and report shall be approved by the customer.

8.5.4 Approval phase

A process shall not receive an approval identification in the declared processes list unless requirements from 8.6.2 and 8.6.3 are satisfied.

In case approval is not granted, the supplier in charge of the item shall either:

— select other processes; or

— propose a modified evaluation programme and resubmit for approval; or

— if the above actions fail to achieve positive results, initiate a deviation procedure.

8.5.5 Deviation request

For processes not conforming to project requirements, whether at the end of criticality analysis or of evaluation and verification tests, the supplier shall submit a deviation request, in accordance with ISO 27025.

8.6 Use of a process

8.6.1 Verification status of a process

The supplier shall confirm that all critical processes have been verified before being used in the manufacture of qualification or flight products. Any modification, change in condition or configuration of application shall lead to a re-evaluation in conformance with process.

8.6.2 Re-verification of a process

Any prolonged stoppage in manufacturing, any major change of the facilities or procedures or any transfer of production to another entity can invalidate partially or completely the initial verification of a process.

When a process needs to be re-verified, a request for approval (RFA) in conformance with DRD form from Annex E shall be established and a re-verification programme shall be implemented.

8.6.3 Implementation of a process

Before implementation of a process, the supplier shall ensure that personnel are trained in accordance with the training and competency evaluation programme and that environment, means and documentation are adequate.

This verification shall ensure that:

— the manufacturing and quality control tools associated with the process are adequate, calibrated and properly maintained and are used under appropriate environmental and cleanliness conditions; see 5.4;

— the personnel is trained and has reached the competency levels required by the training programme;

— the process's specifications, manufacturing and inspection procedures and workmanship standards including definition of manufacturing operations and clear acceptance criteria exist; and

— visual acceptance criteria are photographically documented, if possible, at the appropriate work and inspection stations.

For planning of manufacturing, assembly and integration operation and inspection, see ISO 27025.

8.6.4 Traceability of processes

Traceability of processes shall be ensured in conformance with ISO 27025.

8.6.5 Process non-conformances and alerts

Non-conformances and alerts shall be processed in conformance with ISO 27025.

8.6.6 Mandatory inspection points (MIPs)

MIPs shall be defined in conformance with ISO 27025.

8.6.7 Packaging, storage, removal from storage

The supplier shall define provisions for packaging, storage, and removal from storage for products or semi-finished products before and after implementation of processes.

Annex A
(informative)

Relationship between materials, mechanical parts,processes activities and programme phase

A.1 Feasibility phase — Phase A

In phase A, the materials, mechanical parts and processes product assurance tasks shall be carried out in order to:

a) identify main programme constraints on materials, mechanical parts and processes;

b) define the policy; and

c) plan the product assurance tasks for the project definition phase.

A.2 Preliminary definition phase — Phase B

In phase B, the materials, mechanical parts and processes product assurance tasks shall be carried out in order to:

a) define or identify requirements;

b) identify main new items needed and plan corresponding necessary actions for phase C;

c) plan the product assurance tasks for the detailed design, development, manufacturing, integration and test phase and prepare the materials, mechanical parts and processes plan as part of the PA plan; and

d) support preliminary design review.

A.3 Detailed definition and production phase — Phase C or D

In phase C or D, the materials, mechanical parts and processes product assurance tasks shall be carried out in order to:

a) identify materials, mechanical parts and processes;

b) issue preliminary lists;

c) identify critical items;

d) establish or review an RFA;

e) support mandatory inspection points identification;

f) establish evaluation programme, perform test or review test results;

g) establish validation, qualification, or verification programmes (e.g. perform tests or review test results);

h) support non-conformance processing (NRB, failure review board);

i) establish the as-designed lists;

j) support the critical design review;

k) support the qualification review;

l) establish the final as-designed (updated) lists;

m) support release of manufacture of flight hardware; and

n) Support final acceptance review.

A.4 Utilization phase — Phase E

In phase E, the materials, mechanical parts and processes product assurance tasks shall be carried out in order to:

a) support the series manufacturing of recurring products;

b) support the investigation of operational phase anomalies; and

c) update the as-flown materials lists to incorporate the new materials that can have been added or changed as a result of NCR activities. In particular, the PMP lists should include the actual materials flown on manned and reusable spacecraft and their payloads.

Annex B
(normative)

Declared materials list — Document requirements definition

B.1 DRD identification

B.1.1 Requirement identification and source document

This DRD is provided in this document (5.2.3 and 6.3).

B.1.2 Purposes and objective

The purpose of the DML is to have a detailed record of all the materials used to produce the products of a project or programme.

The data in the DML shall make possible to assess whether the materials are suitable for a specific application, at the supplier and the customer levels (in the approval status column).

The DML is prepared for each "configuration item" at the relevant stages (e.g. at the start, PDR, CDR and QRR) as defined in the flow chart given in Figures 1 and 2.

The following documents are linked to the DML:

— declared processes list (DPL); and

— request for approval (RFA) materials.

B.2 Expected response

B.2.1 Scope and content

a) Materials groups:

1) The DML shall contain the following statements:

— "Materials are classified into 20 groups depending on their type or their main use; see Table B.1."

— "Primers are classified in the group of their associated component."

— "Where no project requirement exists for a separate DMPL, mechanical parts are entered on the DML as a separate group with the corresponding numbers."

2) If new groups are created, for a given project, these shall have numbers over 21.

Table B.1 — Material group numbers

Group number	Description
1	Aluminium and aluminium alloys
2	Copper and copper alloys
3	Nickel and nickel alloys
4	Titanium and titanium alloys

Table B.1 *(continued)*

Group number	Description
5	Steels
6	Stainless steels
7	Filler metals: welding, brazing soldering
8	Miscellaneous metallic materials
9	Optical materials
10	Adhesives, coatings, varnishes
11	Adhesive tapes
12	Paints and inks
13	Lubricants
14	Potting compounds, sealants, foams
15	Reinforced plastics [including printed circuit boards (PCBs)]
16	Rubbers and elastomers
17	Thermoplastics (e.g. non-adhesive tapes and foils [MLI])
18	Thermoset plastics (including PCBs)
19	Material aspects of wires and cables
20	Miscellaneous non-metallic materials, e.g. ceramics

b) Contents of the DML

The DML shall include the information stated in Table B.4, where the header information identifies the list as the declared materials list and includes the issue number and date of issue, as follows:

NOTE If heritage is used as justification for approval, it covers the current hardware configuration and mission profile.

1) Item number (applicable to equipment manufacture level only)

This consists of the material group identifier and the user code. It takes the form of: <group number>. <identifier within the group>.<running number>.<user code>

EXAMPLE 11.5.1.KOF.

Characteristics of the item number are the following.

— The user shall be identified by an agreed user code for the project.

— One per material type.

— Does not change during the life of the materials list (sub-items are permitted when deemed necessary).

2) Commercial identification or standardized designation

Enter the correct and standard designation such as the trade name and the number.

If no trade name exists, enter the manufacturer's name and the number.

For metal alloys, the Aluminium Association (AA) system is recommended for aluminium alloys, and the American Iron and Steel Institute (AISI) system for steel. For other metals or alloys, the main constituent is entered first except in the case of a traditional name (e.g. brass or bronze).

For each material, as designated above, use a unique item number. If several lines are used for different applications or processing, add sub-item numbers.

3) Chemical nature and product type

For metallic materials, add the condition as procured (e.g. rolled and heat treatment), if applicable. Where a semi-finished product is procured, give the relevant state (e.g. form, plate and sheet).

Give the thickness of the material, that can be an important parameter (e.g. epoxy resin, polyurethane adhesive, Ti6Al4V) .

4) Procurement information

Manufacturer or distributor: name of the manufacture and name of the distributor if different.

Procurement specification: provide reference to one of the following:

— the procurement specification with issue, revision and date;

— a national or international specification or standard, if this exists, and identifies the source of procurement (if relevant), with issue, revision and date; and

— datasheet, in which case indication of issue or date is not applicable.

5) Processing parameters

A summary of the process parameters applied by the user of the process shall be listed, e.g. mixture proportions, cure temperature, special cleaning agent, surface treatment, thermal treatment and temperature, and reference to specification number.

6) Use and location

The codes entered shall define the location of the material with respect to:

— the subsystem;

— the particular piece of equipment (box or item); and

— the use of the equipment, e.g. a structural element, thermal control, electrical insulation.

If the CI number is not included in the list header, then a suitable abbreviation of the relevant subsystem is included.

Any restrictions that apply to the use of a particular material shall be included in the corresponding comment column.

7) Environmental code

The environmental code is defined in accordance with Table B.2.

Table B.2 — Environmental code

Environmental code			
Radiation/UV/ATOX (R)[a]		**Ambience (A)**	**Temperature (T)**[b,c]
G: Geostationary	S: Outside shadow	V: Vacuum	1: 0 to 100 K
L: Low orbit	L: Outside light	H: Hermetic	2: 101 to 200 K
B: Radiation belt		M: Manned	3: 201 to 300 K

Table B.2 *(continued)*

Environmental code			
Radiation/UV/ATOX (R)[a]		**Ambience (A)**	**Temperature (T)**[b,c]
I: Interplanetary P: Planetary		E: Elevated pressure	...
[a] For all materials, a letter is selected from the left-hand column. For materials on the surface of the spacecraft, the letter "L" or "S" is added. [b] Thermal cycling to be indicated by two values, e.g. 3/5. [c] "RT" (room temperature) can be accepted as a code between 283 K (10 °C) and 313 K (40 °C). Materials that are at a boundary between environments shall be described by two sets of codes.			

8) Size code

The size code is indicated by an alphanumeric combination, such as A5, V2 or M3 as shown in Table B.3.

Table B.3 — Size code

Size code	Value
0	$0 < A$ or V or $M \leq 1$
1	$1 < A$ or V or $M \leq 10$
2	$10 < A$ or V or $M \leq 100$
3	$100 < A$ or V or $M \leq 1\,000$
4	...
where A is the area, expressed in square centimetres; V is the volume, expressed in cubic centimetres; M is the mass, expressed in grams.	

9) Validation references, justification for approval and prime comments

Reference shall be made to relevant test data that demonstrate the acceptability of the material under the environmental conditions and the application relevant to the particular project concerned. Specifically, in column 9.1, corrosion (CORR), stress corrosion (SCC), flammability (FLAM), offgassing (OFFG) and outgassing (OUTG) data or report references are entered.

Standard abbreviations shall be used to summarize the acceptance status of a material for a particular property.

Column 9.2 is the justification for approval.

B.2.2 Special remarks

a) The change record shall list the successive issues and their release dates since the first formal issue of the document.

b) The change record shall include a brief description of the updates which contributed to each issue or revision.

NOTE Table B.1 of this DRD proposes an example of the format and defines the content within the framework of a project or a programme.

Table B.4 — Example of a realized DML

Declared materials list DML									
Programme name: *ABCDEFG*			**CI no.:** 12345676890		**Doc no.** 001			**Date:** 01.10.2000	
			Group (Title): *abcdefg*		**Issue/Revision:** 1/4			**Page:** 1	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	
								9.1	**9.2**
Item no. and user code	Commercial identification or standard-ized designa-tion	1) Chemical nature 2) Product type	1) Manufacturer/ supplier name 2) Procurement spec. Issue/RevDate	1) Summary of process parameters 2) Applicable process identification	1) Subsystem 2) Equipment 3) Use	1) R 2) A 3) T	1) A 2) V 3) M	Acronym/rating/ Validation Ref. for applicable properties	1) Justification for approval 2) Prime comments
1.2.1.TXES	AZ5GU	1) Al.Zn5.6 Mg2.5 Cdu1.6, Cr0.3 eq. AA7075 2) Plate	1) Almet Pechiney 2) CRB 527 01/02/ 01.02.1996	1) T7351 and Iridit 14 heat treatment 2)	1) PL 2) E4 package 3) Structure	1) LS 2) V 3) 3	1) 2) 3) M3	—	1) Used on ETS2 2)
10.1.1.ETCA	DC93500	1) Silicon 2) Two parts	1) Dow Corning 2) E3846MC10S 02/02/1984	1) Mixture: 10/1 in g Curing: 4 h/65 °C 2)	1) PCU 2) Experiment tray 3) Part potting	1) G 2) V 3) 3–4	1) 2) 3) M3	—	1) ECSS–Q-70–01 2)
11.5.1.KOF	ECCOFOAM EPH	1) Poly-urethane 2) Resin/ Catalyst 1202H	1) Emerson and Cuming 2) SP/FOK/05/684 03/01/ 25.06.1992	1) Resin/Cat: 100/65g 4h/40 °C +48h/100 °C 2)	1) GP 2) Platform 3) Package potting	1) LS 2) M 3) 3–4	1) 2) V3 3)	—	1) DU–96–352 2) Used at T > 100 °C (Risk of distortion beyond)

Annex C
(normative)

Declared mechanical parts list — Document requirements definition

C.1 DRD identification

C.1.1 Requirement identification and source document

This DRD is provided in this document (5.2.3 and 7.3).

C.1.2 Purposes and objective

The purpose of the DMPL is to have a detailed record of all the mechanical parts used to produce the products of a project or programme.

The data in the DMPL shall make possible to assess whether the mechanical parts are suitable for a specific application, at the supplier and the customer levels (in the approval status column).

The DMPL is prepared for each "configuration item" at the relevant stages (e.g. at the start, PDR, CDR and QRR) as defined in the flow chart given in Figures 1 and 2.

The following documents are linked to the DMPL:

— request for approval (RFA) materials.

C.2 Excepted response

C.2.1 Scope and content

a) Mechanical parts groups:

1) The DPML shall contain the following statements:

— "Mechanical parts are classified into 11 groups depending on their type or their main use; see Table C.1."

2) If, for a given project it is considered necessary to create new groups, these shall have numbers over 61.

3) Items that appear in the EEE parts list should not be repeated here.

EXAMPLE 1 Heaters, some valves, thermostats, relays, transformer coils and solenoids.

Table C.1 — Mechanical part group numbers

Group number	Description
51	Spacing parts (e.g. washers and spacers)
52	Connecting parts (e.g. bolts, nuts, rivets, inserts and clips)
53	Bearing parts (e.g. ball-bearings and needle bearings)
54	Separating parts (e.g. pyrotechnics, springs and cutters)
55	Control parts (e.g. gears)
56	Fluid handling parts (e.g. diffusers)
57	Heating parts
58	Measuring instruments (e.g. gauges and thermocouples)
59	Optical passive equipment
60	Magnetic parts
61	Other parts

b) Contents of the DMPL

The DMPL shall include the information in Table C.3 where the header information identifies the list as the declared mechanical parts list and includes the issue number and date of issue, as follows:

1) Item number (applicable at equipment supplier level only)

This consists of the mechanical part identifier and the user code. It takes the form of <group number>.<identifier within the group>.<running number>.<user code>

EXAMPLE 2 7.2.1.ACSA.

Characteristics of the item number are the following.

— The subcontractor shall be identified by an agreed user code for the project.

— There is only one item number per mechanical part type.

— The item number does not change during the life of the mechanical parts list.

2) Commercial identification

The correct and standard designation shall be entered such as the trade name plus number. If no trade name exists, then the manufacturer's name and number shall be entered.

3) Type of part

Material and surface treatment (if applicable) shall be described.

4) Procurement information

Name of the manufacturer and name of the distributor shall be given if different.

Reference of the procurement specification with issue, revision and date shall be given. It may be replaced by a national or international specification or standard if this exists and identifies the source of procurement if relevant with issue, revision and date.

5) Elementary function, main characteristics

The function of the mechanical part shall be entered.

The main characteristics of the mechanical part shall be entered.

EXAMPLE 3 Number of revolutions per minute for a ball-bearing.

6) Use and location

The codes entered shall define the location of the mechanical part with respect to:

— the subsystem;

— the particular piece of equipment (box or item); and

— the use of the equipment.

7) Environmental code

The environmental code is defined in accordance with Table C.2.

Table C.2 — Environmental code

Environmental code			
Radiation/UV/ATOX (R)[a]		**Ambience (A)**	**Temperature (T)**[b,c]
G: Geostationary	S: Outside shadow	V: Vacuum	1: 0 to 100 K
L: Low orbit	L: Outside light	H: Hermetic	2: 101 to 200 K
B: Radiation belt		M: Manned	3: 201 to 300 K
I: Interplanetary		E: Elevated pressure	1/4
P: Planetary			

[a] For all mechanical parts, a letter is selected from the left-hand column. For mechanical parts on the surface of the spacecraft, the letter "L" or "S" is added.

[b] Thermal cycling to be indicated by two values, e.g. 3/5.

[c] "RT" (room temperature) can be accepted as a code between 283 K (10 °C) and 313 K (40 °C).

8) Criticality

Enter "C" for critical or "N" for non-critical. If a mechanical part is considered critical, the reason for the criticality and methods of control shall be entered.

9) Supplier reference and prime comments

The supplier reference and prime comments shall be used to enter all additional information that are necessary in order to obtain customer approval.

This information comprises reference and issue of the RFA or approval, mechanical parts justification file, evaluation reports and deviation requests.

Reference shall be made to the relevant test data that demonstrate acceptability of the mechanical part under the environment conditions and the application relevant to the particular project concerned.

Standard abbreviations shall be used to summarize the acceptance status of a mechanical part for a particular property. These shall be defined by the customer.

In order to justify the use of a material for flammability resistance, the material thickness and height of oxygen share shall be listed.

C.2.2 Special remarks

a) The change record shall list the successive issues and their release dates since the first formal issue of the document.

b) The change record shall include a brief description of the updates which contributed to each issue or revision.

NOTE Table C.3 of this DRD proposes an example of the format and defines the content within the framework of a project or a programme.

Table C.3 — Example of realized DMPL

Declared mechanical parts list DMPL									
Programme name: *ABCDEFG*			**CI no.: 12345676890** **Group (Title):** *abcdefg*		**Doc no.: 001** **Issue/Revision: 1/4**		**Date: 01.10.2000** **Page: 1**		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	
								9.1	**9.2**
Item no. and user code	Commercial identification	Type of part	1) Procurement specification 2) Issue/Revision/Date	1) Elementary function 2) Main characteristics	1) Subsystem 2) Equipment 3) Use	1) R 2) A 3) T	1) Criticality 2) Reason and method of control	Supplier reference	Prime comments
51.2.1.ACSA	ESA003521000120	Copper/AL bimetal ring	1) AIEV 2) From catalogue	1) Separator ring 2) Heat conductor	1) TC 2) Plate interface 3) Spacing and heat inspection	1) G 2) V 3) 3–4	1) N 2)	Used on all projects	—
52.2.1.ASAD	A0090TX...XA	Ti6Al4V screws > M4	1) White area 2) ASNA0090 DSN2413	1) Assembly 2)	1) PTANK 2) plate 3) fixing	1) G 2) V 3) 3–4	1) N 2)	Used on TC2	—
60.1.1.ACSA	42908TC/F	Ferrite cores magnetic	1) Magnetics, Data sheet 2) SP/MAGN/003 01.02/03.06.1999	1) Coil core of transformer 2) Magnetic component	1) TC 2) South face 3) Heat regulation	1) G 2) V 3) 3–4	1) °C 2) to be qualified	—	—

Annex D
(normative)

Declared processes list — Document requirements definition

D.1 DRD identification

D.1.1 Requirement identification and source document

This DRD is provided in this document (5.2.3 and 8.3).

D.1.2 Purposes and objective

The purpose of the DPL is to have a detailed record of all the processes used to produce the products of a project or programme.

The data in the DPL shall make it possible to assess whether the processes are suitable for a specific application, at the supplier and the customer levels (in the approval status column).

The DPL is prepared for each "configuration item" at the relevant stages (e.g. at the start, PDR, CDR and QRR) as defined in the flow chart given in Figures 1 and 2.

The following documents are linked to the DPL:

— declared material list (DPL); and

— request for approval (RFA) materials.

D.2 Excepted response

D.2.1 Scope and content

a) Process groups

1) The DPL shall contain the following statement.

i) Processes are classified into 17 groups depending on their type or their main use; see Table D.1.

ii) If, for a given project, it is considered necessary to create new groups, these shall have numbers over 17.

Table D.1 — Process group numbers

Group number	Description
1	Adhesive bonding
2	Composite manufacture
3	Encapsulation/moulding
4	Painting/coating
5	Cleaning
6	Welding/brazing

Table D.1 *(continued)*

Group number	Description
7	Crimping/stripping/wire wrapping
8	Soldering
9	Surface treatments
10	Plating
11	Machining
12	Forming
13	Heat treatment
14	Special fabrication: processes developed specifically for the programme
15	Marking
16	Miscellaneous processes
17	Inspection procedures

b) Contents of the DPL

The DPL shall include the information in Table D.2, where the header information identifies the list as the declared processes as declared processes list and includes the issue number and date of issue.

NOTE If heritage is used as justification for approval it covers the current hardware configuration and mission profile.

1) Item number(applicable to equipment supplier level only)

This consists of the process identifier and the user code. It takes the form of <group number>.<identifier within the group>.<running number>.<user code>

EXAMPLE 1.2.1. SSEX.

Characteristics of the item number are the following:

i) Identify the subcontractor by an agreed user code for the project.

ii) One only per process type.

iii) Does not change during the life of the process list.

2) Process identification

Indicate the correct and standard identification of the process, e.g. the process name or title: bonding, coating or soldering.

3) Specification

Identify the name or abbreviation of the process executor.

Make a reference to the associated procedure, e.g. national, international, EN, ISO, ECSS or company in-house, together with the issue, revision and date.

4) Process description

Enter here a short description of the process.

5) Use and location

Use codes able to define the location of the process with respect to the:

i) subsystem;

ii) particular piece of equipment (box or item); and

iii) use of the equipment (e.g. a structural element, thermal control, electrical insulation).

6) This column number is not used.

7) Associated item numbers

Enter the associated material list (DML) or mechanical parts list (DMPL) with the process.

8) Criticality

Enter “C” for critical or “N” for non-critical.

If a process is considered to be critical, references to the relevant RFA shall be entered.

9) Supplier reference and prime comments and approval

Use the supplier reference and approval columns to enter all additional information that are necessary to obtain customer approval.

D.2.2 Special remarks

a) The change record shall list the successive issues and their release dates since the first formal issue of the document.

b) The change record shall include a brief description of the updates which contributed to each issue or revision.

NOTE Table D.2 of this DRD proposes an example of the format and defines the content within the framework of a project or a programme.

Table D.2 — Example of realized DPL

Declared processes list DPL								
Programme name: ***ABCDEFG***			**CI no.: 1234567890**		**Doc no.: 001**		**Date: 14.05.2000**	
			Group (Title): ***abcdefg***		**Issue/Revision: 1/5**		**Page: 1**	
1	**2**	**3**	**4**	**5**	**7**	**8**	**9**	
							9.1	**9.2**
Item no. and user code	Process identification	1) User name 2) Associated procedure issue/revision/date	Process description	1) Subsystem code 2) Equipment code 3) Use	Associated DML or DMPL item number	1) Criticality 2) Reason for criticality	Supplier reference	Prime comments
1.2.1.SSEX	Bonding	1) EREMS 2) E/SQ/PI/012 02/01/02.08.1984	Applying a spot of glue with a stainless steel dispenser	1) BE3 2) C5 board 3) To fix parts	6.1.2.ETC	1) N 2)	Used on ANTARES	—
4.3.1.KOF	Coating	1) CERCO 2) E/SQ/PI/023 02/01/08.12.1985	Coating by paintbrush or by immersion in the resin	1) BE3 2) C1 C2 boards 3) Protection of CI and EEE parts	2.1.1.KOF	1) N 2)	Used on PASTEC, ANTARES	—
8.3.1.KOF	Vapour phase soldering of SMDs	1) EREMS 2) E/SQ/PI/026 01/02/09.09.1997	ECSS-Q-70–38	1) BE3 2) C3 3)	15.1.1.AST	1) C 2)	QM/04L123/ BD/MH Table 1	—

Annex E
(normative)

Request for approval (RFA) — Document requirements definition

E.1 DRD identification

E.1.1 Requirement identification and source document

This DRD is provided in this document (6.4, 7.4 and 8.4).

E.1.2 Purposes and objective

The purpose of an RFA is to enable the supplier to request from the customer permission to use a critical mechanical part, material or processes.

The data in the DML shall make possible to assess whether the materials are suitable for a specific application, at the supplier and the customer levels (in the approval status column).

The information provided by the supplier shall make it possible for the customer to assess whether the critical mechanical part, material or process is suitable for a specific application.

The RFA is prepared for each critical mechanical part, material or process at the relevant stages as defined in the flow chart given in Figures 1 and 2.

The following documents are linked to the RFA:

— declared mechanical parts list;

— declared materials list; and

— declared process list.

E.2 Expected response

E.2.1 Scope and content

The RFA should contain the information in Figures E.1 and E.2, as follows:

1) The header information, identifying the document as a request for approval together with the project logo and project name, RFA reference, issue revision and date;

2) Originator;

   originator's name and reference;

3) Location;

   subsystem and equipment codes;

4) Item description;

   Brief description of the item.

5) PMP information;;

The DML, DMPL or DPL item number and list reference;

6) Item status including the following information:

— manufacturer's name and qualification reference;

— supplier's name and qualification status;

— product or material specification;

— procurement specification;

— process or handling specification;

— other related process or handling specifications;

— verification or qualification specification; and

— report on verification or qualification.

7) Reason for the RFA;

Enter the reason for the RFA.

8) Application and exact location details;

Enter heer the details of the application and exact location of the item.

Give the reference in the CIL.

9) Evaluation and validation programme;

Reference and details of main tests.

10) Subcontractor supplier approval for the first issue of the RFA;

11) Customer initial decision, to be entered on first issue of the RFA:

— the decision concerning the proposed material;

— the requirement to perform tests (deviation request as necessary);

— the decision concerning the proposed test programme;

12) Customer's and final customer's (if applicable) signature;

13) Justification results obtained with reference to the supplier's validation report and conclusion;

14) Subcontractor supplier approval on RFA final issue;

15) Final approval status of the RFA by the customer.

E.2.2 Special remarks

a) The RFA shall be completed by the supplier (parts 1 to 10, 13 and 14) and the customer (parts 11, 12 and 15).

1	**Company:**	**Project:**	**Reference: RFA-**								Page 1 of 2			
			Issue											
			Revision											
			Date											
Request for approval (RFA)														
2	Originator: Originator reference:		**3**	Subsystem: Equipment:										
4	Item description:		**5**	PMP list item number: PMP list reference:										
6	**Item status**													
Manufacturer:			Manufacturer qualification reference:											
Supplier:			Qualification status:											
Product/material specification:			Procurement specification:											
Process/handling specification:			Related specification:											
Verification/qualification specification:			Report:											
7	**Reason for RFA**													
8	Application/location details:		CIL reference:											
9	**Evaluation/validation programme (title, reference)**													
Tests														
Plan, procedures, schedule to be attached														

Figure E.1 — Example of an RFA (Page 1 of 2)

1	**Company:**	**Project:**	**Reference: RFA-**								Page 1 of 2
			Issue								
			Revision								
			Date								
Request for approval (RFA)											
10		**Materials and processes responsible**	**PA responsible**			**Project responsible**					
	Supplier approval on RFA first issue										
11	Decision on RFA first issue: Comments: - Request refused: -Submit deviation: -Proceed with validation programme:										
12	**Decision**	**Materials and processes responsible**	**PA responsible**			**Project responsible**					
	Customer agree/disagree										
	Final customer (if applicable) agree/disagree										
13	**Justification results** Validation report (title and reference) Conclusion: **Validation report to be attached**										
14	Supplier approval on RFA first issue	**Materials and processes responsible**	**PA responsible**			**Project responsible**					
15	Decision on RFA final issue	**Materials and processes responsible**	**PA responsible**			**Project responsible**					
	Customer agree/disagree										
	Final customer (if defined in the contract) agree/disagree										

Figure E.2 — Example of an RFA (Page 2 of 2)

Bibliography

[1] ISO 9001, *Quality management systems — Requirements*

[2] ISO 9004, *Managing for the sustained success of an organization — A quality management approach*

[3] ISO 14300-1, *Space systems — Programme management — Part 1: Structuring of a project*

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This Indian Standard has been developed from Doc No.: TED 14 (22329).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Published by BIS, New Delhi