STANDARD

PRODUCT ASSURANCE PLAN

For space instruments

Ed	Rév	Date	
1	0	07/11/00	Initial issue

	Function	Name	Date	Signature
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SOMMAIRE

ACRONYMS and ABBREVIATIONS

AIV	**A**ssembly, **I**ntegration and **V**erification
CEA/SAp	**C**ommissariat à l'**E**nergie **A**tomique / **S**ervice d'**A**stro**p**hysique
CNES	**C**entre **N**ational d'**E**tudes **S**patiales
CPPA	**C**o-ordinated **P**arts **P**rocurement **A**gent
DCL	**D**eclared **C**omponents **L**ist
DML	**D**eclared **M**aterials **L**ist
DPL	**D**eclared **P**rocess **L**ist
DSCC	**D**efense **S**upply **C**enter **C**olombus
ECSS	**E**uropean **C**ooperation for **S**pace **S**tandardisation
EEE	**E**lectrical, **E**lectromechanical, **E**lectronic
EID	**E**xperiment **I**nterface **D**ocument
ESA	**E**uropean **S**pace **A**gency
FSE	**F**actory **S**upport **E**quipment
PA	**P**roduct **A**ssurance
PAD	**P**art **A**pproval **D**ocument
PCB	**P**arts **C**o-ordination **B**oard
PDR	**P**reliminary **D**esign **R**eview
PPL	**P**referred **P**arts **L**ist
QPL	**Q**ualified **P**arts **L**ist or **Q**ualified **P**roducts **L**ist
QML	**Q**ualified **M**anufacturers **L**ist
RH	**R**ad **H**ard
SCC	**S**pace **C**omponent **C**oordination

1. GENERAL

1.1. Scope

The present document intends to describe the philosophy and baseline of product assurance (PA) activities on all the projects involving CEA/SAp.

Those PA provisions form the SAp quality system and they are compliant with RD2 and RD3 philosophy.

1.2. Documents

1.2.1. Reference documents

The following documents are used as a basis for building and carrying out the Product Assurance program. They are used for guidance and information. Some selected sections may form the part of this PA plan.

Quality management

RD	Reference	Issue	Title
RD1.	ECSS-P-001	A	ECSS Glossary of terms
RD2.	ECSS-Q-00	A	Space Product Assurance – Quality and principle
RD3.	ECSS-Q-20	A	Space Product Assurance – Quality Assurance
RD4.	ECSS-Q-20-09	A	Non conformance control system
RD5.	ECSS-Q-30	A	Space Product Assurance – Dependability
RD6.	ECSS-Q-60	A	Space Product Assurance – EEE Components
RD7.	ECSS-Q-70	A	Space Product Assurance – Material, Mechanical Parts and Processes
RD8.	ECSS-Q-80	A	Space Product Assurance – Software product Assurance

Cleanliness

RD9.	PSS-01-201	1	Contamination and Cleanliness Control.
RD10.	FED-STD-209	E	Airborne particulate cleanliness classes in clean rooms and clean zones
RD11.	PSS-01-202	1	Preservation, Storage, Handling and Transportation of ESA Spacecraft and Associated Equipment.

EEE Components

RD12.	EPPL	Current	European Preferred Parts List
RD13.	SCC QPL	Current	ESA/SCC Qualified Parts List
RD14.	PSS-01-301	2	Derating Requirements and Application Rules for Electronic Components.

Material and process

RD15.	PSS-01-700	2	The Technical Reporting and Approval Procedure for Materials, Mechanical Parts and Processes
RD16.	ESA RD-01	1	Outgassing and Thermo-Optical Data for Spacecraft Materials
RD17.	PSS-01-701	1.3	Data for Selection of Space Materials
RD18.	ECSS-Q-70-08	A	The Manual Soldering of High-Reliability Electrical Connections
RD19.	PSS-01-709	1	Measurement of Thermo-optical Properties of Thermal Control Materials
RD20.	ECSS-Q-70-26	A	The Crimping of High Reliability Electrical Connections
RD21.	PSS-01-728	2	The Repair and Modification of Printed-Circuits Boards and solder Joints for Space Use

Software

RD22.	PSS-05-0	"lite"	ESA Software Engineering Standards – Guide to applying the ESA software engineering standards to small software projects

1.2.2. Linked documents

The following documents are the procedures of SAp in house quality system used for carrying out the Product Assurance activities.

Some paragraphs of the present PA plan will directly refer to those procedures.

Those procedures are used by our people working on these various subjects ; therefore, they are written in french and we don't intend to be translated in english.

In italics, translation to english of the procedure original title.

LD	Reference : SAp-GERES-	Issue	Title
LD1	FM-0297-97	1	Traitement et gestion des anomalies *(non conformances processing)*
LD2	FLo-0309-98	2	Constitution, evolution et gestion des dossiers de fabrication *(Building, evolution and management of manufacturing files)*
LD3	GT-0411-99	1	Lancement en fabrication d'un circuit imprimé *(Bare PCBs manufacturing readiness review)*
LD4	GT-0412-99	1	Lancement en fabrication d'une carte équipée *(Board wiring readiness review)*
LD5	RD-0124-95	2	Traitement des commandes *(Purchase orders processing)*
LD6	FLo-0356-97	3	Constitution d'un ADP *(Acceptance Data package building)*
LD7	GT-1051-99	1	Réception des composants électroniques *(Incoming inspection of electronic parts)*
LD8	FM-0251-96	1.0	Spécification générale de sous traitance d'éudes mécaniques *(General specification for mechanics studies)*
LD9	FM-0094-95	1.0	Specification générale de fabrication mécanique *(General specification for mechanics realization)*
LD10	JFC-0290-97	2	Mise en œuvre, montage, cablage des composants électroniques *(mounting and wiring electronic devices)*
LD11	OM-0384-98		Mise en œuvre des assemblages vissés pour montages électroniques
LD12	FM-0409-99		Spécification de vernissage des circuits imprimés *(PCBs coating general specification)*
LD13	FM-0410-99	1.0	Spécification technique de transport des équipements *(equipments transport technical specification)*
LD14	SB-0340-97	1.0	Procédure d'emballage *(packaging procedure)*
LD15	FM- 0276-97	1.0	Guide pour le choix des conteneurs de boitiers éléctroniques *(guide for the choice of electronic boxes containers)*
LD16	FM-0277-97		Fond de document : Specification de fabrication de conteneurs de boitiers éléctroniques *(template – manufacturing specification for of electronic boxes containers)*

1.3. Definitions and abbreviations

The terms used in this document are defined in the ECSS glossary RD1.

2. PRODUCT ASSURANCE MANAGEMENT

2.1. Organization

For each project, C.E.A appoints a Product Assurance manager (PA manager), within the quality group. The PA manager relies on specialists in or outside the quality group and requests specialists interventions as often as necessary. He can also subcontract specifics PA tasks such as studies or assessments.

The Product Assurance Manager is responsible of CEA product assurance activities on the project and PA relationship with collaborating groups, contractors and suppliers.

The PA manager, in accordance with the project management team :

- prepares in house product assurance plan,
- co-ordinates PA activity,
- monitors PA system,
- defines PA requirements to sub-contractors and collaborating laboratories under CEA management field,
- monitors contractors and collaborating laboratories under CEA management field PA activities,
- reports for the status of PA activities to upper level project team.

2.2. Product Assurance Plan

For each project, PA manager :

- studies the project specific PA requirements issued at PI level,
- compares with in-house practices,
- extracts the specificities of the project (i.e. radiations level, parts quality level, ...).

If a particular PA plan is required, it will be made of the present document enhanced with the specificities of the project.
If required, a compliance matrix with PA requirements is issued.

2.3. Product Assurance progress reporting

Progress and status of PA activities and related matters is fully integrated in the project management and reporting system. Therefore, each progress meeting agenda includes systematically :

- Progress for each major PA tasks,
- Current problems,
- Status of EEE procurement,
- Status list of non conformances and requests for waiver,
- Overview of major events in the forthcoming period.

2.4. Right of access

For purposes of documentation reviews, test observation, hardware examination, inspection points or any PA related business, customer can have access to CEA in-house facilities. Though, security permission is needed, and all related procedures shall be achieved.

Appointment should be made within reasonable notice.

3. QUALITY ASSURANCE SYSTEM

3.1. Traceability

A traceability system is implemented throughout all phases of the project, in order to provide a bi-directional and unequivocal relationship between products and associated documentation and records.

For each project, the required level of traceability is defined by the product breakdown structure. A unique and permanent identification number is given to each unit identified in the product tree (part number). In addition, each individual item is given a serial number.

The complete identification is marked on the product (serigraphy on PCBs, sticker on mechanical, or any other marking solution compatible with the nature of the item).

Depending on the needs of the project, additional traceability actions can be defined and achieved.

3.2. Non conformances and waivers system

The non conformance control system is compliant with RD4 requirements.

3.2.1. Classification :

The non conformances are classified “major” or “minor”, according to the severity of their consequences.

- **Major non conformance** are those which have an impact on the customer’s requirements and this affects one or more of the following parameters :
  - safety of people or equipments,
  - operational, functional or contractual requirements,
  - performances,
  - interfaces,
  - quality, reliability, durability, maintainability, availability,
  - changes or deviations from approved qualification or acceptance test procedures.

- **Minor non conformance** are those which are not classified as major.

In case of doubt, a non conformance is classified as major.

3.2.2. Processing

Non conformances are processed trough the procedure LD1.

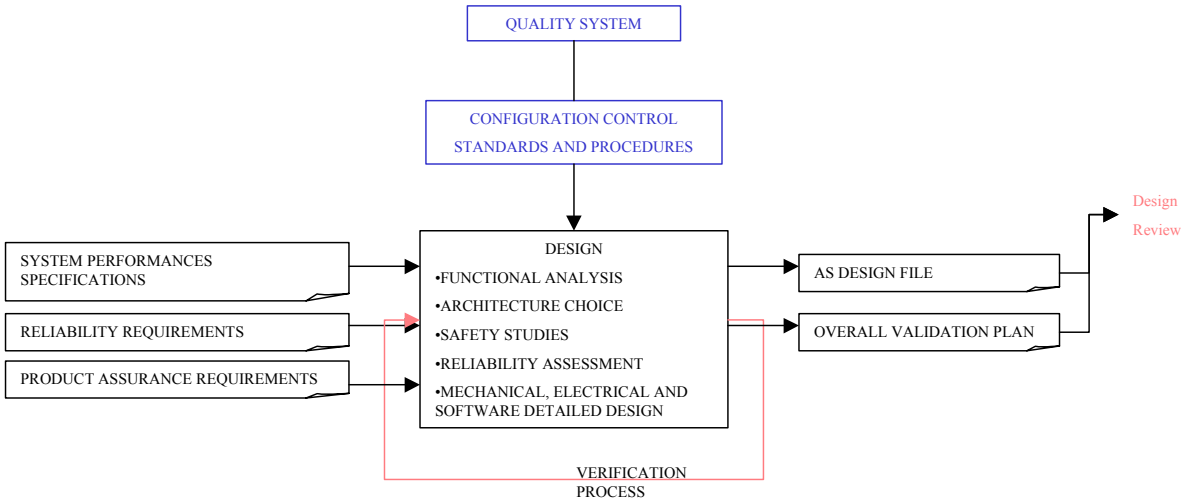
Internal non conformances reviews boards are organised by PA manager as often as necessary.

3.3. Alert system

CEA systematically participates in the alert system established on the project by the final customer.

4. QUALITY ASSURANCE DURING DESIGN PHASE

4.1. Design process



4.2. Quality assurance during design process

Consists in :

- verifying the presence of all necessary inputs,
- supporting safety and reliability studies,
- helping the formalization of the functional analysis,
- verifying interactivity between mechanical-electrical and software design,
- verifying presence and compliance of “as design” files and documents.

4.3. Detailed design

If some detail design studies cannot be performed in-house, they are sub contracted. In this case :

- General specification LD8 defines the rules to be applied for mechanic studies. If necessary, an additional particular specification is issued.
- For electronic design study, a particular specification is issued including product assurance requirements.

4.4. Design verification process and reviews

Design verification process includes verification of related documentation and is formally closed by a review performed through procedures LD3 and LD4 to allow manufacturing launching.

The review report is fulfilled and archived.

4.5. Design evolutions

At design review, the “as design” file is validated and configuration control starts (c.f. procedure LD2).

Any further evolution is systematically processed through non conformance or modification request, according to procedures LD1and LD2.

4.6. Procurement

All procurements are made in accordance with CEA administrative rules.

4.6.1. Procurement sources selection

Each supplier of EEE or non-EEE components, of material, equipment or services is carefully selected.

Suppliers are selected on following criteria :

- supplier has a current approval to furnish items or services of the type and quality level to be procured.
- supplier has furnished items or services and has demonstrated his ability to furnish items of required type and quality level. Project team decides of the opportunity of an evaluation prior to contract.

Any new supplier is evaluated through a pre award audit or activities on item and/or service whose quality level is not critical for the project.

4.6.2. Procurement documentation

The procurement specifications includes the necessary information for the respect of the product quality requirements :

- technical specifications,
- acceptance conditions,
- schedule and costs,
- applicable quality rules,
- monitoring,
- deliverable documentation.

Depending on the item or service, the procurement specification is established either :

- through a specific documentation issued by specialists and validated by project team,
- through supplier catalogue or offer.

4.6.3. Procurement sources monitoring

Procurement is monitored by regular inspection points, during design and manufacturing, as defined in the procurement documentation.

If necessary, special monitoring and/or audits shall be carried out depending on the criticality of the products.

4.6.4. Reception control

Any incoming item goes through an incoming inspection :

- Electrical and mechanical components,
- Bare PCBs,
- Wired PCBs,
- Integrated equipments,
- Glues, coating and potting products.

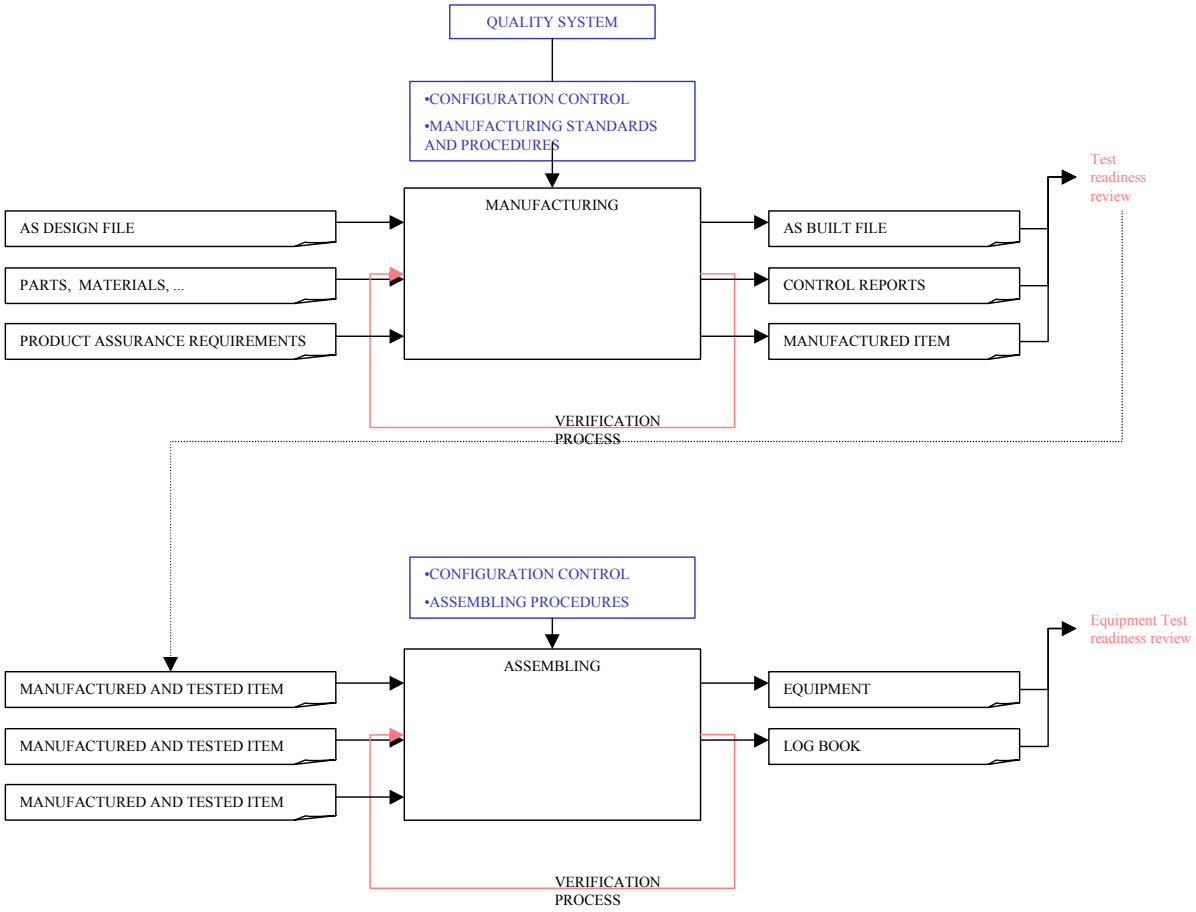
Incoming inspection activities include :

- verification of the packaging conditions and status of environmental sensors,
- visual inspection,
- verification of correct identification and conformance to ordering data,
- certificate of conformance,
- supplier’s inspections and control results,
- remaining lifetime (for products with limited lifetimes).

All reception controls are recorded and archived till the launching of the instrument.

5. QUALITY ASSURANCE DURING MANUFACTURING AND ASSEMBLING PHASES

5.1. Manufacturing and assembling process



For each equipment, a "manufacturing and assembling flow chart" is issued by the AIV responsible, validated by PA manager and Project manager.

The flow chart identifies for each step :

- Action
- Responsibilities
- Procedure to be applied
- Equipments needed to perform action
- Inspection and key points
- Any necessary information

5.2. Manufacturing procedures

Most of the manufacturing operations are sub-contracted.

5.2.1. Mechanics

Manufacturing requirements are defined in LD9.

Manufacturing is performed by an agreed supplier.

5.2.2. Bare printed boards

Bare circuit manufacturing is performed by a CNES qualified manufacturer.

5.2.3. Wiring and coating

Wiring is performed by an agreed supplier, in conformance with LD10.

Coating is performed in accordance with LD12.

If necessary, a particular wiring and/or coating procedure is issued.

5.2.4. Assembling

Assembling is performed in house, according to LD11 or is performed by a qualified manufacturer.

5.3. Manufacturing and assembling verification process

Manufacturing quality is checked through on line controls and inspections during manufacturing at supplier premises. Controls to be performed are specified in the manufacturing contract.

All verification points are identified on the manufacturing and assembly flow chart.

All manufacturing, inspection and assembling operations are recorded in a "manufacturing assembling sheet" (Fiche suiveuse).

5.4. Log book

As soon as the assembling phase is over, the equipment physically exists and the log book is created.

This document is intended to follow the equipment and to ensure its technical management during all ground phases.

Log book includes :

- record of operating time, mating / demating, commutations,
- operating time and cycles,
- appearance of non conformances and corrective actions taken,
- list of tests or controls carried out.

5.5. Cleanliness control

5.5.1. Particulate cleanliness

A clean room is available at SAp's premises, from range 100 to 100 000, as defined in RD10.

All operations on qualification models and flight models are performed in the clean room, currently :

- class 100 000 for electronic boxes,
- class 100 for optical items.

unless otherwise specified.

Cleanliness, temperature and hygrometry are monitored continuously.

5.5.2. Molecular cleanliness

Special care is taken for products that could contaminate climatic facilities.

Dedicated climatic facilities are used.

When manufacturing and handling optical items, cleanliness is defined in particular specifications.

For sub-contracted manufacturing activities, cleanliness is specified within the contract.

5.6. Handling, packaging, storage and transportation

In order to prevent any damage on items during all phases of manufacturing, assembly and integration, testing, storage and transportation, for any item, a study is performed in order to determine the most appropriate container to be used, in compliance with RD11 requirements.

For each equipment, a "handling and storage" procedure is issued and is applied in-house and in any occasion where the equipment has to be used.

Each container is equipped with indicators of shock, temperature and hygrometry.

6. QUALITY ASSURANCE DURING TESTING PHASES

6.1. Validation and qualification strategy

In order to demonstrate the compliance of the equipment to its specifications, a verification strategy is built from :

- upper level requirements and technical specifications,
- model philosophy,
- most suitable verifications methods (i.e. test, analysis, review, inspection, ...) at each level.

Verification strategy is issued through a verification table, including :

- Requirement
- Verification method
- Level of verification
- Model concerned

6.2. Tests plan

The test plan settles all the tests necessary to demonstrate the compliance of the equipment to its specifications.

For each test, it includes:

- the objectives,
- reference of test procedures,
- reference of equipment units definition,
- resources required for the test,
- planned test site,
- organization and responsible,
- specific requirements (i.e. cleanliness, handling, ...).

As possible, test plan will be matrix shaped.

Test plan is elaborated by the Designer in charge of the equipment and validated by System engineer, PA manager and Project manager

6.3. Tests procedure and report

For each test identified in the test plan, a procedure is elaborated.

It includes :

- the test objective,
- reference or description of the test facility,
- operational mode (detailed description of the test implementation),
- parameters to be measured before, during and after the tests,
- expected values and acceptance and refusal criteria for each parameter.

Whenever possible, test procedure will be matrix shaped, so test results can be registered on the same support and become the test report.

Test procedure is elaborated by the Designer in charge of the equipment and validated by System engineer, PA manager and Project manager.

6.4. Test readiness review

Before each test or set of tests, a review is carried out to confirm the test requirements to be reached, the implementation of the test resources, the condition of non conformances, the availability of the test resources, the configuration of equipment to be tested, etc.

6.5. Tests performance

During operations, tests results are systematically recorded under the most appropriate form (paper record, magnetic file, ...).

A member of the quality group is present or represented, to ensure that the application of the procedures and the recording of the test operations and results is respected.

Any modification or deviation from the test procedures and any test non-conformance is recorded.

6.6. Tests results

A test report is systematically issued by the test responsible, and validated by PA manager and Project manager.

Whenever possible, test report will be made of fulfilled test procedure.

7. QUALITY ASSURANCE FOR ACCEPTANCE AND DELIVERY

7.1. Acceptance data package

ADP is provided with each equipment delivered. ADP is built in compliance with procedure LD6

7.2. Delivery review board

In order to authorise delivery of the equipment, a DRB meeting is held.

DRB report is elaborated by PA manager and delivered with ADP.

8. RELIABILITY

Reliability is an inherent characteristic of system or equipment and is therefore fully integrated in system design.

8.1. Reliability design

During the design phase, a reliability analysis is performed from the functional analysis, in order to determine the architecture :

- meeting the reliability requirements,
- offering the best reliability/complexity compromise.

Study consists in :

- Building reliability bloc diagrams of the different functional modules of the system,
- Assessing reliability for each functional bloc (empirical from the estimated reliability value of the parts implementing the function),
- Simulating different redundancies configurations and computing the overall resulting reliability.

The results of reliability analysis are integrated by System engineer as an element of choice of architecture.

8.2. Failure mode analysis

The usual design requirements ask that :

- Single point failures are avoided,
- Any failure in an equipment must not propagate to the other equipments.

During the design phase, a failure mode analysis is performed, in order to identify early the critical items and potential single point failures. In order to integrate mechanical, electrical and thermal aspects, it is performed with the following methodology :

- Functional description of the equipment detailed at functional block level,
- Relationship matrix between function and parts,
- Functional chain failure mode identification and analysis (gravity, consequences, preventive actions, ...).

Failure mode analysis is detailed at component level for the interfaces.

If a component appears to be critical, further investigations are performed, using the appropriate dependability tools (fault tree, ...)

If required, a detailed quantitative assessment can be performed. In this case, it will be based on data from MIL-HDBK-217-F.

9. COMPONENT SELECTION AND CONTROL

CEA joins systematically the co-ordinated procurement system, if such organization is set for the project.

As possible, components are procured through the Co-ordinated Parts Procurement Agent (CPPA) employing by the Prime contractor.

9.1. Components selection

For costs reasons, preference is given to components from sources which would need the least evaluation / qualification effort.

CEA tries to have the minimum amount of procurement sources and types of components.

9.1.1. Qualified components

The in house standard list includes all the parts families, in order to provide the system engineers with a full range of parts in which they can select parts matching their needs.

At the beginning of each project, the standard list is updated to include newly qualified components and to remove the oldest ones.

Appointment is made with space agencies CNES and ESA in order to overview the latest improvements and technologies available that could be selected.

The component quality level shall generally be in accordance with ECSS-Q-60A.

This list is built by selection in the following preferred parts lists :

- Projects Preferred Parts List if available
- European Preferred Parts List (RD12)
- ESA/SCC Qualified Parts List (RD13)
- DSCC Qualified Products Lists
- DSCC Qualified Manufacturers List: QML-38538 for Microcircuits, QML-19500 for discrets and transistors and QML-38534 for hybrids.

A study of project requirements documents (EID A, PA plan, ...) is made as soon as they are available, and the list is made compliant with those requirements.

In particular, project requirements for radiations are taken into account.

System engineers select in the list the parts matching their functional needs. With the help of PA part manager as often as necessary.

When different parts are matching the need, priority is given to the qualified sources among :

1- French components,

2- European components,

3- Components assembled in France or in Europe,

4- American Components

5- Others components.

9.1.2. Non qualified components

Selection of a component out of the preferred and qualified parts list , or non compliant with required quality level, is made through the following process :

- Selection of the best quality level available for the part,
- Definition of a test program (upscreening + LAT + DPA…) to reach the overall quality level required for the project; in compliance with ESA SCC. CEA requests CNES parts specialist advises and technical validation of the test program.
- Contact is made with the supplier to define the implementation of the tests (who, where and when), with the best cost/efficiency criteria.
- PAD sheet is filled and sent to prime contractor for agreement. PAD format is compliant to RD6.

9.1.3. Radiations

The prime contractor has usually to supply a sector analysis for the spacecraft, which allocates for the individual units the expected radiation environment. With this data, usually calculated for the centre of gravity unit, the radiation specialist in SAp, has to calculate and verify the capability of use a EEE part in CEA specific unit.

Total dose :

Preference is given to parts (all active electronic parts except linear bipolar semiconductor) matching the project criteria, in terms of total dose.

If a part is like to be chosen for its functionality, but not matching the total dose criteria, a detailed radiation analysis giving expected dosage at part location is performed :

- The guaranteed radiation level is compatible with location of part (safety factor x2), the part is selected, and waiver process is initiated (depending on the project rules),
- The guaranteed radiation level is not compatible with location of part and other technical solutions are studied.

If no radiation data is available on specific components, radiation testing (to SCC 22900) shall be performed.

Latch up :

Preference is given to parts designed with latch-up immunity.

All bulk CMOS devices including those with epitaxial layers shall be subjected to latch-up evaluation.

Bipolar, SOS, SOI and DI devices do not need to be evaluated.

Parts showing latch-up below the LET limit given by the Prime Contractor, shall only be used with its approval.

SEU :

For Single Event Upset (i.e soft error) all digital microcircuits containing storage elements (RAM, microprocessor..) shall be characterised so, that an upset rate calculation can be performed.

9.2. Parts list

A DCL for flight models parts, is initiated and maintained throughout the project.

In compliance with RD6 requirements, are included minimum :

- Generic designation,
- Component type, package, and value range,
- Manufacturer name,
- Details Specification reference,
- Procurement (self-procured, agent)
- QPL reference,
- PAD sheets references

This DCL is formally given to prime contractor:

- during decision period of the **P**arts **C**o-ordination **B**oard,
- in the delivery data package of equipment. for review/comment and approval.

For management purposes, same types of lists are initiated and maintained for all models built within the project (engineering model, lab model, qualification model, ...).

The DCL has to be completed stepwise as the selection of components and the approval process progresses.

9.3. Quality levels

9.3.1. Engineering models

Built with parts functionally identical to flight model, standard quality level.

9.3.2. Qualification models

Built with parts functionally, physically and technologically identical to flight model, military temperature range (-55, +125°C).

If RH parts are selected for flight models, RH parts are to be used also on qualification models, in order to be fully representative.

9.3.3. Flight models

Quality level as generally specified by project prime contractor.

The following minimum requirements with respect to ESA/SCC tests levels shall apply:

Part Type	Quality/Screening level
Microcircuits + crystals and filters	ESA/SCC Class B MIL-PRF-38535 Class V MIL-PRF-38510 Class M + upsreenig
Transistors + diodes	ESA/SCC Class B MIL-PRF-19500 Class S
Passive Components	ESA/SCC Class C MIL failure rate R or B
Hybrids	ESA-PSS-01-608 Class B MIL-PRF_38534 Class K

9.3.4. Derating

The derating applicable to each component is selected among the values specified in RD14.

The drifts and degradations specified are taken into account in assessing the electronic circuit.

9.3.5. Attrition rate

Attrition rate is based on the following table :

Net Quantity	Attrition for Chip capacitors & resistors	Attrition for other resistors, capacitors & filters	Attrition for all semiconductor *, relays & connectors with fixed contacts	Attrition for ** connector bodies, saver bodies & crystals
1 to 5	10	4	3	2
36to 8	10	5	4	2
9 to 15	10	6	5	3
16 to 25	15	7	6	4
256 to 40	15	10	8	5
41 to 60	20	13	10	6
61 to 101	30	17	15	10%
101 to 150	40	25	20	8 pieces10%
151 to 250	50	37	28	9 pieces10%
> 251	20%	15%	11%	10%

* for high cost semiconductor parts, the attrition may be reduced on a case by case basis.

** loose contacts for connectors: +100%, for connectors savers: +30%.

9.3.6. LAT

It shall be ensured that all components are subjected to Lot Acceptance Testing (L.A.T.) as defined in the ESA/SCC specifications , or QCI (Quality Conformance Inspection) as defined in the MIL specifications.

9.4. Parts procurement

Parts procurement is made as described in § 4.6.

The quantities of parts procured include needs + attrition + parts for LAT and DPA if required.

All purchase orders shall state parts to be supplied from single manufacturing lot.

All FM parts shall be delivered with a certificate of conformance and supplier's inspections and tests results (LAT, DPA, radiations…) when applied.

9.5. Parts control

Incoming inspection of all parts procured is performed following procedure LD7.

10. MATERIALS AND PROCESSES SELECTION AND CONTROL

10.1. Materials selection

Materials are selected preferentially in those already validated by ESA and already used by CEA.

Preference is made for materials already successfully used in previous space projects and already validated by ESA through the list RD17

If not found in the list, a material is verified to be compliant with thermo-optical properties as defined in RD19.

As possible, CEA avoids the use of critical materials. If this should happen, evaluation would be performed in compliance with the evaluation phase and approval process required in RD7, based on ECSS and PSS relevant documentation.

10.2. Declared Material List

Declared material list is established in compliance with RD7.

It includes :

- Item number,
- Material designation (commercial identification)
- Chemical nature and type of product
- Manufacturer
- Procurement specification or standard
- Summary of processing parameters
- Use and location
- Environmental code
- Size code, test data
- Approval status

The DML is built at early stage of the design, when the first needs are identified. The DML evolves through the design process.

When a material in the list is no longer used, it is not to be removed but identified as "Abandoned" or "Deleted"

DML is delivered with each item data package.

10.3. Process selection

Processes are selected preferentially in those already validated by ESA and already used by CEA.

In case of a new process, evaluation and validation is performed in compliance with RD7 requirements.

10.4. Declared Process List

Declared process list is established in compliance with RD7.

It includes :

- Item number,
- Process designation
- Process specification
- Process description
- Process supplier
- Use and location
- Associated DML item numbers
- Approval status

The DPL is built at early stage of the design, when the first needs are identified. The DPL evolves through the design process.

When a process in the list is no longer used, it is not to be removed but identified as "Abandoned" or "Deleted"

DPL is delivered with each item data package.

10.5. Mechanics parts realisation and control

Most of the time, mechanics parts realization are subcontracted to industry.

General specification for mechanics realization, describes all the rules to be applied by the subcontractor in order to obtain the required quality level.

In addition, a particular specification is issued for each realization, including controls to be performed.

11. SOFTWARE DEVELOPMENT

Instruments on board software enters usually the "small software project" category in the ESA meaning. Therefore, all the software developments are made in compliance with RD22 philosophy.

The baseline for software development is the following :

11.1. Design and code

From the users requirements, an analysis is performed in order to define what the software has to do. This analysis leads to the SRD (software requirement document) produced by software designer and validated by system engineer.

From the SRD, the architecture analysis is performed by software designer. If necessary, depending of the complexity of the project, an architecture design document is produced. Otherwise architecture informations are included in the SRD.

Detail design and code is performed, and code is annotated to the most appropriate extent. Listings are produced.

11.2. Tests

Software designer is in charge of defining the tests to be performed. The philosophy is :

Local tests are performed during the coding phase, in order to validate the code. As far as possible, these tests are carried out automatically. Test files are recorded by designer. They are not deliverables.

Local tests are maintained as long as necessary, at least till higher level tests (software coupled with hardware on equipment or FSE) are available.

All tests set and result with FSE are recorded. They are not delivered unless otherwise required.

When a software issue is integrated on an equipment model, software tests are a part of equipment tests. Thus they are covered in the equipment test plan and test report; i.e. § 6

11.3. Software User Manual

If necessary and requested, a software user manual is produced. As possible, it should not be a document on its own, but a part of the instrument user manual.

11.4. Software configuration management

Software configuration management is performed by the software designer trough a software configuration status list, including

- Software issue identification (reference and date of issue),
- Functions included in the issue,
- Reference of the documents originating the software evolution (change request reference, user requirement, non conformance report, ...)

The software configuration status list is issued and delivered with each delivery of software.