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GUIDELINES FOR ACCOUNTING FOR THE ENVIRONMENT IN MILITARY PROGRAMMES

Warning

This document does not contain any requirements and cannot form the basis of any contractual implementation clause for the establishment of a market or contract.

Organisation responsible

The present guide is the result of work conducted by the combined forces general environment standardisation commission (CIN-EG) of the French Ministry of Defence, which combines representatives from the general staff, the Délégation Générale de l'Armement (*General Armaments Delegation)* and industry involved in the military field.

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PRESENTATION OF THE DOCUMENT

In order to facilitate reading of the document, on the left-hand pages, in italics, you will find:

- **comments** which are intended to detail the broad lines of the programme directives.
- **notes** referred to in the text or comments which are generally definitions or references. When several notes are linked to a given subject, they are allocated the same number.

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REFERENCE DOCUMENTS

NATO documents

- NATO AAP 20 Handbook on the Phase Armaments Programming System (PAPS)
- AECTP 100 Accounting for the environment in military equipment (STANAG 4370)
- STANAG 4370 Environmental Testing

Military documents

- General Instruction for the Implementation of Military Programmes No. 1514 (Issue 3 dated 5th May 1998)
- GAM-EG-13 General Environmental Testing of Equipment
- Def-Stan 00-35 Environmental Handbook for Defence Materiel
- MIL-STD-810F Test Method Standard for Environmental Engineering Considerations and Laboratory Tests

Civil documents

- RG Aéro 0040A General recommendations for the specification of programme management

NOTES AND COMMENTS

(1)	*A test is characterised by: chronologically co-ordinated and intended actions, on a concrete item for a specified objective (GT AFNOR).*
(2)	*An environmental test (extract CEI-68-5-2) normally consists in the following operations:* • *preconditioning* • *initial examination and initial measurements* • *test* • *retest* • *final examination and final measurements*
(3)	*Test (CEI-68-5-2) : exposure of a specimen to environmental conditions in order to determine the effect of such conditions on the specimen.*

(4)	*AFNOR NF X 07 - 144 -1 : Environmental tests - Part 1 : Basis of the approach : Customisation of the product to its environment*
(5)	*The life profile (service life profile) (GAM-EG13) is the « chronological description of situations – including usage and missions – to which an item is subjected between completion of manufacture and its final withdrawal from service. The life profile is that part of the life cycle which concerns the « live » status of the equipment.*
(6)	*Confirmed by certain elements of Ministerial Instruction 1514 issue 3*
(7)	*The Life Cycle (NF EN ISO 14040) : The consecutive and linked phases of a system of products, from the acquisition of raw materials or the generation of natural resources to final destruction.*

FOREWORD

The «customisation », approach, as presented in GAM-EG-13 in its 1986 edition, covered the customisation of «environmental testing » [1], defined according to the life profile of the equipment.

An « Environmental test » [2] consists of a test [3] and the associated operating measurements.

It would appear appropriate to recall that historically « Environmental tests » were included within the « equipment acceptance testing ». Subsequently, the concept of « Qualification » was introduced at the end of development.

In practice, most of the tests, even if customised, were performed after the design choices had been made, which meant that problems which should have been resolved earlier were only identified later, with serious consequences both for cost and delivery schedules.

The consideration of the first results « in situ » additionally made necessary certain « customised », tests which were not included in the Programmes, hence the systematic cost overruns and delays.

The best way to avoid such pitfalls is to include consideration of features associated with the environment at the equipment design stage.

The first modification led to supplementing the initial « Test Customisation » approach (GAM-EG-13 1986) with design actions (feasibility, expression of requirements, definition and justification of the design) corresponding to the notion of « Customisation of the Equipment to its Environment » [4] associated with the Life Profile [5].

In order to take into account the environment, the current philosophy [6] involves :

- highlighting the operational use of a system from the time it leaves the manufacturer until its withdrawal from service, which we call the « Life Profile » of the equipment,
- introduction of the concept of « Life Cycle » [7] which takes into account the various states of the equipment : designed, produced, active, withdrawn from service and the associated detrimental effect of the environment on the production, operational, support operations, etc. The active Life Profile is that part of the Life Cycle which concerns the « active » state of the equipment.
- guidance of the various State and industrial players to consider the environment in programmes at the lowest adequate level in order to reduce costs.

(8) *The term « Military Programme » is used to describe an operation or a set of operations where the Minister of Defence, at the suggestion of the General Armaments Delegation, in agreement with the Combined Forces Chief of Staff.....has decided to apply the procedures defined in the present instruction (IM 1514 revision 1998)*

The present document has been drawn up with the intention of complying with the habits of the State and Industrial Programme Management specialists, with regard to their methodology and specific vocabulary, in particular:

⇒ *the phasing of the programme :*

- *Preparation*
- *Feasibility*
- *Design*
- *Development /Industrialisation*
- *Production*
- *Operation*
- *Withdrawal from service*

⇒ *the associated documents :*

On the part of the contracting authority (Owner) :

Military operational requirement

- *Chief of Staff Objective*
- *Exploratory Military Characteristics Sheet*
- *Provisional Military Characteristics Sheet*
- *Reference Military Characteristics Sheet*

Programme documents

- *Feasibility File*
- *Orientation file*
- *Development/Industrialisation Launch File*
- *Production Launch File*
- *Realisation Launch File*

Customer/Supplier relationship documents

- *Feasibility File*
- *Functional Technical Specification*
- *Technical Requirements Specification*

On the industrial side (Prime Contractor)

- *Design File*
- *Design Justification File*
- *Manufacturing and Inspection File*
- *Operating Documentation*
- *Withdrawal from service documents.*

Additionally, the « tools » used to design, produce, commission and maintain equipment in service, are principally :

- *methodological tools relating to disciplines (or trades), for example : design, functional analysis (9) (including consideration of the environment in the widest sense), value analysis (10), operational security (reliability, maintainability, availability, safety) (11), logistic support (12) (integrated and maintaining in operational condition), ergonomics,*
- *programme management methodological tools (13) (integrated engineering (14) or design to target cost system (15), cost/effective analysis (16), risk analysis (17), quality assurance (18), tests (19), etc.),*
- *industrial tools (13), for example structures for design, production, testing, management, support (spares, technical support, etc.).*

(9) *AFNOR FD X 50 - 101 : Implementation of functional analysis*

(10) *AFNOR NF X 50 -151 : Value analysis – Functional analysis – Functional Statement of Requirements and Functional Specification*

AFNOR NF X 50 - 153 : Value Analysis – Recommendations for Implementation
AFNOR NF X 50 - 152 : Value Analysis – Fundamental characteristics

For Programme Management, this same change leads to :

- treating the « System » and the « Support System » at the same level,
- involvement of the operational end-user in all the operations required for the elaboration of the equipment,
- preceding the feasibility phase with a preparatory phase,
- including industrialisation within the development phase which then becomes development/industrialisation.

The set of measures taken, the management of the necessary resources, the tasks, the responsibilities etc... are all included within the concept of:

« ACCOUNTING FOR THE ENVIRONMENT IN A MILITARY PROGRAMME*(8)*».

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(11)	*Operational Security : RG Aéro 000 27 : Guide for the Control of Operational Security (in course of preparation).*
(12)	*Integrated logistic support is the set of co-ordinated and iterative management and technical tasks required to :* • *ensure that support is considered in the statement of requirements for the main system and in its design,* • *specify and define the support system whilst optimising the main system/support system together (availability and overall cost),* • *elaborate and implement the support system thus defined and maintain the support system throughout the life cycle of the main system.* *BNAE RG Aéro 000 76 : Programme management – Recommendations for the implementation of integrated logistic support.* *AFNOR X 50 – 420 : Systems management – Integrated logistic support – General concepts* *Maintaining in operational condition (Instruction 7126/DN/EMAT/3/CEP) is intended to preserve or to restore an equipment item to a condition which enables it to fulfil the purpose for which it is designed, in such a way that the condition satisfies, within certain tolerances, the initial specifications and operating criteria.*
(13)	*BNAE RG 000 40 : General Recommendations for Programme Management specification.*
(14)	*Integrated Engineering (AFNOR XP X 50 - 415) : Approach which consists in taking into account simultaneously the requirements relating to different stages in the life cycle of the product.* *This approach involves integrated and simultaneous design of the products and processes associated with the latter, which induces production and support.* *This enables development engineers to consider the entire life cycle of the product from the outset, from the initial statement of requirement until the final withdrawal from service .* *AFNOR X 50 - 415 : Systems Management – Integrated engineering – General concepts and introduction to application methods.*
(15)	*AFNOR NF X 50 - 150 : Design to Target Cost.* *BNAE RG Aéro 000 61 : Programme Management – Cost and Delivery Schedule control in the implementation of a programme.*
(16)	*Guide DGA/AQ 916 : Guide for optimisation of the cost-effectiveness of demonstrations to be provided during the development phase of a military programme.*
(17)	*Guide DGA/AQ 924 : Manual for Risk Management in a military programme.*
(18)	*ISO 9001 : Quality systems – Model for quality assurance in design, development, production, installation and associated services.* *Quality Assurance : BNAE RG Aéro 000 83 : Quality system applicable to the aeronautical and space fields - Model for quality assurance in design, development, production, installation and associated services.*
(19)	*Guide DGA/AQ 918 : Guide for Test Management methods.* *GAM-EG13: General, Test brochures and choice guidance.*
(20)	*BNAE RG Aéro 000 04 : Industrial File – General.*

1. GENERAL

1.1 The « Environment »

For the record « The Environment is that set of physical, chemical, biological etc. properties which are liable to have an immediate or deferred, direct or indirect effect on living beings, human activities and on equipment or their operation ».

It should be stated that :

- the environment, at a given time and place, is the resultant of that received from outside, and that generated locally (for example the internal temperature of operating equipment is directly dependent on the conduction, convection and radiation exchanges of the equipment externally),

- the term « environment » is often associated with an additional term, for example :

  - Technical environment.
  - Detrimental environment.
  - Industrial environment.
  - Ecological environment.
  - Economic environment.
  - Media environment.
  - etc.

In the present document we are concerned in particular with the technical environment, whilst at the same time referring when appropriate to the other types of environment.

1.2 Purpose of the document

The purpose of this document is to act as a precise guide for « Accounting for the Environment in a Military Programme ». It is part of the current Defence approach consisting in reducing the costs of the items produced, commissioned and maintained in service in the armed forces.

It does not lead to the elaboration of new documents, but leads to the inclusion of certain paragraphs, pages, sheets or appendices into the programme management documents which are already planned.

It is intended for :

- State and Industrial Programme Directors and Officers (integrated team), Specifiers, Design Offices, Stress offices, ... who will be able to use it as a reference on the subject,

(21) *The following standards may be quoted :*

- ***American MIL Std 810*** *(customisation appears at version D).*
- ***British DEF STAN 00-35***

- Operational users, who will benefit from specific items regarding their involvement in discussions with other partners throughout the programme,
- « Environment » specialists who will therefore have available the majority of information regarding their trade in order to negotiate with their partners to determine the best compromise between technical performance, cost and delivery schedules.

The suggested arrangements may be adapted according to :

- the magnitude, the complexity and the life cycle duration of the programmes,
- the risks to be controlled,
- the number of participants.

It should also be noted that the process may be simplified for programmes leading to simple tests and even deleted for standard tests.

1.3 Field of application

The present guide may be used for all national military programmes. It covers both the actions to be performed during the design and production of a specific equipment item, as well as those to be conducted when purchasing existing equipment « off the shelf ».

It may also be used as an implementation document for STANAG 4370 - AECTP 100 in the context of European or international co-operative programmes in the military field.

It is additionally compatible with documents issued by other military or civilian organisations which cover the same subject ***(21)***.

No restriction appears to be necessary regarding the use of this document in the civil field. Nevertheless, it is essential to always check the consistency of the actions undertaken, and to adapt these in accordance with the design, production and operating context of the equipment (in particular the environment actually encountered in use).

NOTES AND COMMENTS

(22)	*The life profile (service life profile) (GAM-EG13) is the « chronological description of situations – including usage and missions – to which an item is subjected between completion of manufacture and its final withdrawal from service. The life profile is that part of the life cycle which concerns the « live » status of the equipment.*
(23)	*A « situation » covers principally:* • *environmental factors characterised by their nature and their level,* • *an exposure duration and frequency of occurrence,* • *the arrangement of the constituents employed (operational configuration of the equipment),* • *the combinations of functions activated during the situation (operating mode),* • *the various regimes adopted for each function (operating modes or states).*
(24)	*The Life Cycle (NF EN ISO 14040) : The consecutive and linked phases of a system of products, from the acquisition of raw materials or the generation of natural resources to final destruction.*
(25)	*A Life Cycle Analysis (ACV) is an evaluation tool for the environmental impact of a system which includes a set of activities associated with a product, from the extraction of raw materials to the different methods of waste processing (recycling, concentration, storage of final waste).* *The Life Cycle is linked to the state of the equipment (functional, specified, designed, produced, active, in course of withdrawal from service) and not to its elaboration or operation phases.*

2. REFERENCES

2.1 Reference documents

The reference documents which relate to the approach covered by this document are :

- Ministerial Instruction 1514
- Combined Forces standard GAM-EG-13 : General Environmental Testing
- NATO STANAG 4370 : Environmental testing AECTP 100 : Environmental Guidelines for Defence Materiel
- NATO AAP 20 : Handbook on the Phased Armaments Programming System (PAPS).

The detail of the standard documents which relate to this approach, is provided in appendix A, paragraph 4.

2.2 Definitions of terms employed

The terms employed are generally taken from the following documents :

- BINORM TG 01 : Defence General Terminology
- AFNOR NF X 50 -150 : Value Analysis, Functional Analysis, Vocabulary
- GAM-EG-13 : Terminology
- AFNOR NF L 00-007 : Aeronautical and Space Terminology, General Terms

A supplementary list to the known definitions, and comments are provided at Appendix A paragraph 3, for the following terms :

- Environmental domain where operation (or storage) of the equipment is normal, limiting, extreme
- Operational functions – Technical functions
- Guarantee factor
- Test factor
- Equipment sturdiness

3. METHODOLOGY FOR ACCOUNTING FOR THE ENVIRONMENT IN A PROGRAMME

3.1 Principle

« Accounting for the Environment in a Military Programme » consists in integrating into the programme management actions, those factors which are most specifically related to the actual environment which the equipment is liable to encounter or to generate during its life profile [22] [23] and its life cycle [24] [25].

NOTES AND COMMENTS

(26) The overall cost of ownership includes the acquisition, operating and withdrawal costs.

*For information, the **preparatory phase** is initiated on the authority of the Chief of Staff with respect to a « Chief of Staff Target ». The work performed leads to an « Exploratory Military Characteristics Sheet » which expresses the military requirement, and a « Feasibility File » which is its interpretation in technical terms.*

This phase is intended to :

- *detail the foreseeable military requirement(s) in relation to long-term studies,*
- *study the envisageable means of acquisition (off-the-shelf or specifically produced equipment),*
- *conduct the technico-operational studies required in order to define the overall characteristics of the equipment,*
- *specify the boundaries of the programme, evaluate the technical and technological risks and the solutions envisaged to control them,*
- *estimate the broad lines for logistic support,*
- *enable a first approximation to be made regarding the costs, achievement time-scales and induced operating costs : a rough approximation but which is sufficiently reliable to permit evaluation of the financial feasibility of the programme*
- *provide all the information required for the feasibility phase, including the interfaces with other programmes, partners, etc.*
- *define the context of evolution of the operational requirement.*

This work is conducted in iterative consultation between the operators and the potential prime contractors, with a view to issuing an invitation to tender.

The result of the work concerned by this phase culminates with a « Provisional Military Characteristics Sheet » and a « Feasibility File ».

These items are used during the preparatory (preliminary requirement statement), feasibility, design, development/industrialisation, production, operational and withdrawal phases.

During each of these phases, there are **design and production actions**, as well as varying degrees of **validation actions** (calculations, simulations, tests).

Equipment (or a system – including the logistic support system) is characterised overall by its performance, cost and schedules.

The process employed is iterative, i.e. the elements are reviewed and enriched as the programme progresses. However, it is essential to stress that, from an industrial point of view, it is not possible to permanently update the associated documents.

Analysis of the impact of new data must be conducted on an individual basis in order to decide on the benefit of including them in the documents, together with the negotiations behind the scenes which this may involve between the various partners concerned by the programme. This process is conducted jointly between the operational end-user (General Staff) and the other technical partners (DGA and industry).

The consideration of the environment from the equipment design stage, and the monitoring of its various aspects throughout the programme life-cycle results in a decrease of :

- the overall cost of ownership **(26)**,
- the time required for entry into service,
- the number of operational failures,
- the cost-effectiveness ratio of the weapon system with its associated logistic support.

3.2 Preparatory Stage and Phase

Specific Environmental actions during the preparatory phase

These actions concern the directing of Environmental tasks and the elaboration of paragraphs, pages, sheets or appendices for inclusion in the Feasibility File. They may also possibly consist in conducting partial validation tasks (calculations, simulations, tests).

These involve :

- analysis of the expressed military requirement and deduction of the life profile that this implies,
- specifying the situations which may, on the face of it, be encountered,
- providing for each situation, on the basis of the existing data-bases, the environmental factors to be considered as appropriate for the equipment concerned,

*For information, the **Feasibility Phase** is initiated on the authority of the Minister in relation to the Feasibility File. The tasks performed result in the « Provisional Military Characteristics Sheet » which expresses the military requirement, the « Orientation File » for the technical aspects and the « Functional Technical Specification » for the initial invitations to tender for industry.*

The tasks performed during this phase are intended :

- *to explore the various envisageable concepts which meet the expressed or estimated requirement, in terms of objectives to be achieved (performance, cost, time-scales),*
- *to formalise the end-user's operational requirement (life profile, missions, operational functions) through a Military Characteristics Sheet which subsequently leads to a Functional Technical Specification ,*
- *to present each concept considered in association with a financial proposal (performance, cost, time-scales),*
- *to evaluate the technical and industrial feasibility and to highlight the critical items for each concept (production flow levels, absence of breaks in production flow),*
- *to specify the broad lines of the logistic support (packaging, storage, transportation methods, and infrastructure requirements),*
- *to define the broad lines of the demonstrations to be conducted during the development phase,*

These tasks are conducted on the basis of the initial version of the Functional Technical Specification on the part of the contracting authority. On completion of the phase, the Functional Technical Specification is used as a reference for consultation purposes and for the issue of the Invitations to Tender.

(27)	*The Functional Technical Specification (AFNOR NF X 50 - 150) is a document through which the operator expresses a requirement (or the authority responsible for interpreting it) in terms of operational functions and constraints.* *Comments : For each of these, evaluation criteria and levels must be determined. each level must be associated with a degree of flexibility.*
(28)	*Operational function (NF X 50-150): action expected of equipment (or provided by it) in order to meet an element of the requirement for a given operator.*
(29)	*Evaluation criterion (NF X 50-150): characteristic adopted for evaluating the manner in which a function is fulfilled or a constraint is satisfied.*
(30)	*Evaluation criterion level (NF X 50-150): a magnitude identified in a scale for a function evaluation criterion. This magnitude may be that defined as an objective or that achieved by the proposed solution.*
(31)	*Level flexibility (NF X 50-150): set of indications provided by the operator regarding the possibility of adapting the level sought for an evaluation criterion.*
(32)	*In the field of « Operational security », the term « aggression » is generally used (RG Aéro 701 10): that part of the environment of a system which is liable to reduce its performance and/or increase the risks.*

- supplying for each environmental factor, the rough values (level, duration, frequency of occurrence) to be considered,
- providing a first estimate for the foreseeable life cycle of the equipment,
- studying the broad lines of the environmental regulations (technological risks, ecological damage), which will have to be considered for the life cycle of the equipment (designed state, produced state, active state, withdrawal from service),
- supplying this information in a form which is easy to include within the « Feasibility File » on completion of the phase.

3.3 Design Stage – Feasibility Phase

Specific Environmental actions during the feasibility phase

These actions concern the direction of Environmental tasks and the issue of paragraphs, pages, sheets or appendices which form part of the Functional Technical Specification **(27)** for the equipment. They may also possibly consist in conducting partial validation tasks (calculations, simulations, tests).

These involve :

- examining the existence of the equipment Life Profile, for the various missions and operational functions to be performed during the operational phase,
- identifying the operational functions **(28)** of the equipment which at first sight appear sensitive to the environment, specifying where applicable, the intended configurations and operating modes,
- characterising for each operational function – for each technical solution envisaged with respect to the environment, and in each situation by a rough estimation :
  - the evaluation criteria **(29)** in such and such a situation (e.g. range),
  - the criteria levels **(30)** (e.g. the number of kilometres for each situation),
  - the flexibility of these levels **(31)** (e.g. low flexibility F1, level which provides little room for negotiation).
- characterising each situation in the Life Profile through environmental factors (32) to be adopted on the basis of :
  - the initial behaviour models, whether or not these are validated by experience,
  - overall processing of the return of experience from previous equipment.

(33) *Availability : aptitude of an entity to be in a condition able to fulfil a required function under specified conditions, at a given time or during a given time interval, in view of the support system implemented.*

*For information, the **Design phase** of the requirement is decided by the military authority with respect to the Orientation File. The tasks which lead up to the Development Launch File or Production Launch File and Technical Requirement File of the equipment for industry.*

The tasks in this phase are aimed at selecting between the proposed solutions adopted on completion of the feasibility phase, the solution to be developed and at specifying the requirements to be satisfied. It enables:

- *detailed studying of the technical solutions previously adopted, comparing of the associated performance and risks and therefore helping the choice of solution to be developed,*
- *the provision of a list of operational functions to be fulfilled by the equipment (or the system) based on the Functional Technical Specification , together with the intended operating modes and configurations,*
- *provision for each of the operational functions :*
  - *the evaluation criteria,*
  - *the levels of such criteria,*
  - *their acceptability limits,*
- *establishment of the first level Technical Requirements Specification, and if possible the tree diagram to be satisfied for the specifications as a whole,*
- *definition of the requirements regarding reliability, availability, safety, etc. for the operational functions of the equipment or system,*
- *presentation of the broad lines of the logistic support requirements (technical documentation, provisioning, packaging, handling, storage facilities, transportation, test and support equipment including computing, maintenance, infrastructure, personnel (numbers, qualification, training),*
- *definition of the broad lines of the demonstrations and/or requirements, to be covered during development,*
- *and finally the freezing of the Technical Requirements Specification for the System, Equipment etc.*

(34) *The Technical Requirements Specification (RG Aéro 000 40) is a contractual document drawn up by the operator of equipment intended for the designer, and through which the requirement is stated (or the organisation responsible for its interpretation) in terms of technical requirements. The Technical Requirements Specification also specifies the conditions for checking compliance with these requirements (NF L 006007B).*

BNAE RG Aéro 000 08 : Statement of Requirements - Guide for the elaboration of the Technical Requirements File.

- the determination of each of the environmental factors using :
  - typical values elaborated from previous measurements in real environments (Data Bases),
  - real environment calculation models validated by experience,
  - adapted partial tests,
  - specific « in situ » measurements in a real environment, under conditions representative of the future use of the equipment,
- highlighting the effect of accounting for the environment on each concept for example « availability » [33] (including the technical and economic aptitude for support), etc. and the repercussions on the programme costs and time-scales,
- providing the broad lines of the equipment life cycle,
- drawing attention to the regulatory requirements concerning safety of personnel, protection of property and damage to the environment, in relation to the materials, constituents, production processes, storage, utilisation, withdrawal from service, dismantling, storage of ultimate waste, etc.
- supplying of the environment associated information in a form which can be directly inserted in the Functional Technical Specification .

Certain validation activities (calculations, simulations, tests) associated with the environment may be covered during the feasibility phase leading up to the Functional Technical Specification .

These actions may be used to :

- check a basic concept,
- obtain initial measurements for inclusion in the digital models (for example generation of an induced environment).

3.4 Design Stage – Requirement Definition phase

Specific Environment actions during the requirement definition phase

These actions concern the direction of Environmental tasks and the issue of paragraphs, pages, sheets or appendices which form part of the Technical Requirement Specification **(34)** for the equipment. They may also possibly consist in conducting validation tasks (calculations, simulations, tests).

They consist in pursuing the iterative process for phased accounting for the environment with successive enrichment through newly acquired data, in particular:

(35)	*Environmental domain where operation (or storage) are normal : environmental domain (nature and level) for which the equipment function concerned provides the specified performance (evaluation criteria).*
(36)	*Environmental domain where operation (or storage) are on the limit : environmental domain (nature and level) for which the equipment function concerned provides degraded performance (evaluation criteria), whilst satisfying the safety requirements; this deterioration must be reversible when reverting to the domain where operation is normal.*
(37)	*Environmental domain where operation (or storage) are extreme: environmental domain (nature and level) for which the equipment function concerned provides degraded performance (evaluation criteria), which is irreversible, but which satisfies the safety requirements.*

- validation or completion of the elaborated equipment life profile and support system, in particular the detail of the situations encountered on the basis of the military operational requirement statement,
- updating for each situation, the list of environmental factors considered to be significant and/or relevant,
- alignment of the corresponding values of each of these environmental factors, with respect to the new data acquired :
    - new values derived from previous measurements in the real environment (Data Bases),
    - calculation models which include the real environmental data validated by experience,
    - results of partial tests,
    - new specific « in situ » measurements in the real environment. This determination should, as far as possible, lead to characterisation of the distribution law of the values taken, its mean and standard deviation It should be noted that the distribution in the real environment is not always a Gaussian process.
    - definition of the environmental domains where operation (or storage) of the equipment are normal (35), on the limit (36) and extreme (37) for each evaluation criterion characterising each operational function,
- provide a first approximation of the equipment life cycle and its various states,
- provide a first idea of the regulatory requirements concerning safety of personnel, protection of property and damage to the environment, in relation to the materials, constituents, production processes, storage, utilisation, withdrawal from service, dismantling, storage of ultimate waste, etc.,
- provide guidance for the demonstrations, associated with the environment, at first sight envisaged, in order to obtain the data to be included in the Design Justification File (calculations, simulations and tests), which are to be added as the programme unfolds,
- supply of all these items associated with the environment, in a form which is practical for insertion into the Technical Requirements Specification.

Certain validation actions (calculations, simulations, tests) associated with the environment may also be performed during the requirement definition phase which leads to the Technical Requirements Specification.

They are also part of the iterative demonstration process (calculations, simulations, tests) for checking a concept or a technological solution.

*For information, the **Development/Industrialisation** phase is initiated under the authority of the Minister or the DGA. The tasks are intended to study in detail the solution adopted on completion of the Requirement Definition Phase in order to achieve a qualified design suitable for series production of the deliverable equipment necessary for operational deployment and support of the system. They lead to the elaboration of the following documents*

- *Production Launch File for the State and for industry :*
- *Design File*
- *Design Justification File for the equipment*
- *Manufacturing and Inspection File*
- *Operator documents*
- *Withdrawal from service documents.*

These various documents identify the validations acquired throughout the work : partial development with respect to the technical functions, partial qualification, etc.

All these validations are used to justify the fact that the design does indeed meet the operational functions specified in the Technical Requirements Specification and are included within the Design Justification File.

(38) *BNAE RG Aéro 000 42 : Guide for the establishment and implementation of a development plan.*

(39) *Industrialisation (BNAE RG 000 43) is intended to ensure the manufacturability and the reproducibility of the products to be manufactured. It enables the production and implementation of a suitable industrial tool for the programme, and its validation.*

*For information, the **Design File** is built-up gradually as the design of the equipment progresses. The design is formalised through the following documents :*

- *the list of equipment technical functions (1) and the constituents of the support system, with their identification,*
- *for each technical function :*
  - *the list of evaluation criteria,*
  - *the levels of the criteria,*
  - *the acceptance limits of the levels,*
- *the list of entities (system, ... , equipment, ... , component – with their identification -) which contribute towards the achievement of each technical function and each operational function,*
- *for each entity which provides a technical function, the situation(s) of the corresponding Life Profile,*
- *the list of requirements relating to reliability, maintainability, availability (in view of the arrangements made under logistic support), safety, etc. for the system functions (main system and support system) or the equipment,*
- *the aids for selection of the solution to develop, in view of the financial implications,*
- *the elements associated with the acceptance process,*
- *the elements associated with logistic support :*
  - *technical documentation,*
  - *list of supplies,*
  - *description :*
    - *of the packaging, handling and transport methods,*
    - *of the test and support equipment,*
    - *of the maintenance process,*
    - *of the support for the computer resources (hardware and software),*
    - *the infrastructure required,*
    - *the personnel required (numbers, qualification),*
    - *the personnel training facilities (instructors, equipment, etc.).*

3.5 Manufacturing Stage - Development/industrialisation Phase

Specific Environmental actions in the Development/Industrialisation Phase

These actions concern the direction of Environmental tasks and the issue of paragraphs, pages, sheets or appendices which form part of the various documents elaborated during this phase [38] [39].

They also concern the actual performing of validations associated with the environment (calculations, simulations, tests).

By examining the detail of each document :

3.5.1 Design File

3.5.1.1 Environmental items to be included within the Design File for the equipment [40]

These items (paragraphs, pages, sheets or appendices) are the result of the following actions :

- updating of the completeness, the relevance and the accuracy of the life profile, the missions performed, including safety, the logistic support system, etc.,
- listing for each technical function [41], at each level, of an evaluation criterion and the corresponding environmental factors in each situation, their values, the contractual arrangements for updating these values during the subsequent phases (in particular for certain situations where the levels provided are intimately linked to the design choice, under industrial responsibility),
- providing the items required for classification under environmental domains where operation (or storage) of the equipment are normal, on the limit and extreme and this for each level of evaluation criterion and each operational function,
- providing for each technical function and in relation to each specified value (or deduced from the specified values), the corresponding value adopted [42] (switching from one to another being achieved by applying the guarantee factor),
- specification of the needs with respect to sizing criteria for the equipment with respect to the environment, together with the operational or technical functions concerned, the corresponding evaluation criteria together with their levels and acceptance limits[43], for each situation in the Life Profile considered and the expected variability [44] of the evaluation criteria with respect to the environmental factors which characterise those situations,
- estimation of the likely effects induced by the design choices in determining the values of the environmental factors (environmental factors induced by the entities which perform the technical functions and the corresponding architecture choices : proximity effects, mutual effects, dynamic interactions between the equipment and its support and/or carrier),

	(the notes below refer to the previous page)
(40)	*Design of the product : Set of information defining the functional and physical characteristics of a product, required to identify, produce, use, support, control its configuration and withdraw it from service.* *Note 1 : The information called « Design Data » is contained in the Design File which describes « the designed state of the product »* *Note 2 : The physical characteristics of the product provide the material description of the product, the functional characteristics constitute the performance expected from the product.* *BNAE RG Aéro 000 14A : Definition of the product - Guide for the elaboration of the Design File*
(41)	*Technical function (NF X 50 -150): action internal to the equipment (between its constituents), chosen by the designer-manufacturer, in the context of a solution, in order to fulfil the operational functions.*
(42)	*The values specified for the environment in the Technical Requirements Specification constitute the base reference for the contract. However, because of the variability in performance of the manufactured equipment and the variability of the environment throughout the life profile, different values have to be « adopted » for the development of the equipment: these are the « adopted values ».*
(43)	*Acceptance limit (NF X 50 -150) : level of an evaluation criterion beyond which, or beneath which, as applicable, the requirement is considered not to be satisfied.*
(44)	*Variability : term with no formal definition. Variability is the characteristic of an item to take on different values within a spectrum which follows statistical distribution laws. One hears also of the variability of the resistance of equipment to its environment, and also of the variability of the environment.*
(45)	*This refers to the use of time-dependent behaviour laws for the different constituents of the equipment, or base materials, or assemblies, with respect to each environmental factor.*

- reminder of the accepted probability of failure for each evaluation criterion considered in relation to each environmental factor (or parameter which characterises it) to which it is sensitive.
- listing of the relevant criteria taken into account for the design in order to reduce the sensitivity of the evaluation criteria of the manufactured equipment to deterioration due to the environment (wear, ageing of materials [45], conditions of use),
- supply to other disciplines of the information required for their actions (e.g. ergonomics, etc.),
- listing of the manufacturing processes which may generate a risk of sensitising the equipment to the Life Profile environment and identification of any special recommended checks (statistical process checks, ...),
- specification of the life cycle of the equipment as it is perceived at this stage of development,
- examination of the compliance of the materials and processes employed with respect to the existing regulations in relation to the industrial risks and ecological damage, recycling potential, etc.,
- furnishing of all the information relating to the results of these actions in a form which is practical for inclusion in the design file.

3.5.1.2 Environmental aspects concerning the definition of validations to be performed (calculations, simulations, tests) – Qualification of the equipment in the environment

These items (paragraphs, pages, sheets or appendices) are the result of the defining actions for the validations associated with the environment – including the definition of the environmental tests (including aggravated tests) – on the basis of the corresponding requirements specifications which appear in the general information in the design file.

In the event of absence of a validation action, these actions consist in :

- listing of the validation objectives not covered by a demonstration.

In the event that the demonstration is a calculation or simulation, these actions consist in :

- listing of the validation actions covering each validation objective (the type of demonstration chosen depends on the cost of validation and the degree of innovation of the equipment being developed.
- listing of the Life Profile situations and the corresponding equipment configurations covered by a calculation or a simulation,
- listing of the input data and their identification,
- providing the values expected through the variability of the equipment with respect to the environmental factors considered in such demonstrations,
- listing of the results of such calculations and simulations, together with their identification.

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(46)	*GAM-EG-13 : General, Test Brochures and Selection Guides* *AFNOR NF X 07 - 144 -1 : Environmental testing - Part 1 : Basis of the approach : Customisation of the product to its environment* *AFNOR FD 07-144 - 2 : Design and performing of the tests – Environmental tests – Guarantee factor* *AFNOR FD X 07 - 144 - 3 : Design and performing of the tests - Environmental tests - Part 3 : Test factor* *AFNOR NF X 07-143 : Relevance and representativity of the tests* *AFNOR XP X 07 -145 - 1 : Design and performing of the tests – Representativity of the specimen - Part 1 : Design case* *AFNOR XP X 50 - 145 - 2 : Design and performing of the tests - Part 2 : Representativity of the test process*

In the event that the demonstration is an environmental test [46] , these actions consist in:

- issue of a requirement specification including :
  - the list :
    - of operational (or technical) functions to be validated by the test,
    - the evaluation criteria, their levels and their acceptance limits
    - the Life Profile situations to be represented by the test,
    - the values expected through the variability of the equipment in relation to the environmental factors which characterise the above situations (value and associated level of confidence),
    - the number of times that each type of test envisaged will be applied successively to the respective representatives of a given equipment definition,
    - the data which justifies the relevance of the validation actions and the results on which they are founded with respect to the technical functions (cf. Design Justification File concerning the technical functions),
  - the definition of the severity of the test. This definition involves the following approach :
    - summary of the environmental factors to be simulated on the basis of the characterisations of the environmental factors adopted, using the summarising methods specific to each factor; any special effects caused by a combination of several environmental factors must also be taken into account,
    - transformation of the environment summary into a test severity by consideration of :
      (a) the test factor,
      (b) the limits imposed by the test facilities (achievable combination of environmental factors, evaluation criteria, etc.),
      (c) the operating procedures existing in the standards (which ensure the repeatability of the tests),
      (d) the state of the art with respect to simulation of the environment concerned,

(e) if applicable, the preferential severities suggested in the standards,

- the possible need for aggravated environmental testing, to explore the safety margins for the evaluation criteria and to increase them by eliminating any defects which may be corrected,
- justification :
  - of the variability of the environment considered both for the establishment of the sizing criteria and for the test severities,
  - that the definition of the environmental sizing criteria does in fact meet the corresponding specification,
  - that the definition of the environmental tests do in fact satisfy the corresponding specification, in particular :
    - the type, quantity and operating procedure for the tests adopted,
    - the choice of the test means,
  - of the equivalence of the real environment planned or actually encountered with respect to the specified environment,
  - of the checking of the existence and of the content of the test documents (programmes, procedures, reports, minutes, etc.),
  - of the validity of the environmental test data (Data Bases).

3.5.1.3 Environmental data concerning the conducting of validations (calculations, simulations, tests)

These items (paragraphs, pages, sheets or appendices) are the result of actions concerning the performing as such of the demonstrations required for the development and qualification of the equipment.

In the event that the demonstration is an environmental test, these actions consist in :

- examining the test requirement, including :
  - ⇒ the purpose of the test,
  - ⇒ the principle and method adopted,
  - ⇒ the input data,
  - ⇒ the severities,
  - ⇒ the expected behaviour of the test specimen,

(47) *BNAE RG Aéro 000 11 : Quality of the tests*

BNAE RG Aéro 000 33 : Logic for the processing of incidents in the context of a programme

⇒ the risks to personnel and to the test means,

⇒ measurements and checks,

⇒ processing and analysis,

⇒ the economic conditions and the schedule,

- negotiation of the economic conditions for the test,
- acceptance of the contract or order from the customer,
- preparation of the test taking into account :

⇒ test facilities,

⇒ safety of personnel,

⇒ adaptation and validation of the tests as a whole and the links,

⇒ the implementation of associated measurements,

⇒ the processing of the measurements,

⇒ safeguarding of the specimen,

⇒ the contractual documents associated with the test,

- elaboration of the test operating procedure,
- performing the test using :

⇒ the operating procedure monitoring sheet,

⇒ recording and resolution of any incidents [(47)],

⇒ termination of the test,

- analysis of the test with :

⇒ the measurements collected and available,

⇒ the processing of the data,

- providing of the contractual documents to the customer.

3.5.1.4 Environmental data concerning the results of these validations

The result (paragraphs, pages, sheets or appendices), enables the establishment of the design file for equipment which is qualified with respect to the Technical Requirement Specification, which is then included either within the Design Justification File see the next paragraph), or in other specific files :

- calculation, analysis, comparison files,

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*For information, the Design Justification File, which validates the equipment design **with respect to the Technical Requirements Specification**, includes the following items :*

- *reminder of the list of operational functions with their identification and the corresponding validation actions adopted,*
- *justification of the relevance of each validation action (including any items omitted)*
- *reminder of the list of demonstration facilities employed and their identification (calculation codes, validated simulation models, ...),*
- *justification of the values used to characterise the variability of the equipment performance parameters,*
- *reminder of the identification of the assembly level applicable to the demonstration,*
- *reminder of the identification of the input data (type, amplitude of the excitation),*
- *reminder of the results of the demonstrations (including technical events).*

(48) BNAE RG Aéro 000 15 : Justification of the Design - Guide for the elaboration of the Design Justification File

- collection of the test execution data (programme, procedure, report, test report),
- reports on the way in which the equipment sizing criteria have indeed been taken into account for the design, manufacturing processes and/or operating conditions linked to the environment,
- status of the validations acquired and which remain to be acquired (and in particular those which can only be obtained at the beginning of the operational phase),
- conclusion of all the demonstrations enabling the operating envelope to be defined (with respect to the environment).
- If, during development, it is found impossible to maintain the status of the Technical Requirements Specification as it is, a proposal must be made regarding a restriction of the operating conditions and/or modification of the Technical Requirements Specification, taking into account the cost-effectiveness required from the equipment.

3.5.2 Design Justification File

Environmental data to be included in the Design Justification File for the equipment

These items (paragraphs, pages, sheets or appendices) **(48)** are the result of the following actions :

- reminder of the validation objectives in relation to the Technical Requirements Specification with their identification, relative to the environment,
- reminder of the probability of failure accepted for each performance parameter for each technical function, with respect to the environments to which they are sensitive,
- reminder of the validation actions covering each validation objective. The type of demonstration chosen depends on the degree of innovation of the equipment under development :
  - ⇒ comparisons and/or calculations performed using behavioural models validated by experience (in the event of equipment with no significant innovation in the design, the technologies, the manufacturing processes employed or the operating conditions),
  - ⇒ simulation tests with actual parts or justified omissions (otherwise),
- inclusion of the return of experience and design modifications resulting in successfully passed qualification tests,
- provision of all these results in a form which is practical for inclusion in the Design Justification File.

In the event that the demonstration is an environmental test :

- identification of the test specification or procedure,

*For information, the **manufacturing and inspection file** is elaborated progressively during the development/industrialisation phase in order to be available at the start of the production phase. It is intended to define and organise the means and tasks for the production process and the acceptance process, enabling the compliance throughout the production phase, of the real condition of each item with respect to the defined equipment reference condition.*

For the manufacturing part, this includes :

- *identification of the resources required by the equipment production process (system and support system)*
- *identification and organisation of the production itself : provisioning, planning, sub-contracting, etc.,*
- *implementation of the procedures for manufacturing, handling, storage, packing and delivering the equipment,*
- *the measures taken to ensure that all the operations have been performed in accordance with the validated processes, the design file, etc.,*
- *the supply of the equipment (system and support system),*
- *follow-up in the event of modification of the design file.*

For inspection, this consists in :

- *the inspection plan,*
- *the inspection layout, in particular to enable the acceptance process tasks to be scheduled within the manufacturing process,*
- *the list of inspection apparatus, specific or non specific,*
- *documentation systems associated with the specific inspection apparatus in order to be able to define, to validate, to produce, to manage, to operate and to support such specific equipment,*
- *the reference to anomaly processing procedures,*
- *the definition of the acceptance process established in the context of customer-supplier relations..*

(49)	*BNAE RG Aéro 000 12 : Manufacturing and Inspection File (in progress 1998)*
(50)	*The life profile used in the Technical Requirements Specification, Design File, Design Justification File concerns the life of the product from its acceptance by the customer, i.e. most often from the moment it leaves the manufacturing plant.*

- supply of the data to justify the relevance of the validation actions and the results on which these are founded with respect to the operational functions,
- justification of the environmental variability considered, on the basis of the real environment forecast or that actually encountered, both for the establishment of the sizing criteria and for establishing the test severity,
- justification that the definition of environmental sizing criteria does indeed satisfy the corresponding specification,
- justification that the definition of the environmental tests does in fact satisfy the corresponding test specification, in particular :
- type, quantity and principle of the tests adopted,
- choice of the test means,
- severity and operating process for the test, based on :
    - the summary of the nature and the values of the environmental factors to be simulated, the guarantee factor and the test factor adopted,
    - the limitations imposed by the test means (achievable combination of environmental factors, evaluation criteria, etc.),
    - the operating procedures existing on the standards (ensuring repeatability of the tests),
    - the state of the art with respect to simulation of the environment concerned,
    - if applicable, any preferential severities proposed by the standards,
- checking the existence and the content of the test documents (programmes, procedures, reports, minutes, etc.).

3.5.3 Manufacturing and Inspection File

3.5.3.1 Environmental data to be included in the equipment Manufacturing and Inspection File

These items (paragraphs, pages, sheets or appendices) **(49)** are the result of the actions defined below.

In the context of the manufacturing part of the Manufacturing and Inspection File, the environmental actions are as follows :

- identification of all the situations encountered during production, including those relating to the various supplies, and use the same approach as that adopted for the life profile as such (50) ,

(51)	*The nature of the environmental factors refers to those which are significant for the product concerned. These are principally vibration, temperature, humidity, impact, etc.*
(52)	*Capability is defined as the ratio between the performance required (for the machine or the process, as the case may be) and the actual performance achieved.*

(53)	*It is important to ensure that the test sequences do not lead to an accumulation of non-representative tests (such as overheating of elastomers).*

- estimation of the environmental factors and their values associated with the production process,
- analysis of the list of relevant criteria adopted for the design and the manufacturing processes, in order to reduce the sensitivity of the evaluation criteria for the equipment produced to deterioration due to the environment (wear, ageing of materials [51], conditions of use),
- listing of the capabilities [52] of the tools and manufacturing processes which may influence the variability of the resistance of the equipment performance to environmental factors,
- analysis of the list of manufacturing processes which may generate a risk of sensitisation of the equipment to the environment encountered during its active life and identification of any recommended specific checks (statistical process control, ...),
- examination of the impact of the production process in relation to the regulations and ecological damage,
- validation of any debugging actions which involve environmental factors,
- elaboration of items linked to the environment to be included in the production process documents :
    - parts lists and manufacturing process sheets,
    - list of specific tooling and environmental test equipment, whether or not these are integrated within the production line,
- documentation systems associated with this tooling and test equipment for their design, acquisition, installation (including acceptance), implementation, technical control, administrative control, economic control, and their updating,
- documents for production launch (provisioning and manufacturing lead times, task sequencing chart, etc.).

In the context of the inspection part of the Manufacturing and Inspection File, the environmental actions are as follows :

- selection of the tests (nature of the environmental factors, the test severity, the test duration, the associated measurements),
- proposal of the equipment adopted on which to perform the tests (single tests, batch sampling, etc.),
- determination of the sequence of operations (test sequences and operating checks) [53].
- participation in the elaboration of the information for the definition of the production acceptance operations, resulting from Customer-supplier negotiation.

(54) *The experience plan is a method for optimising the product parameters before the start of series production. It consists in making a considered choice of combinations of test parameters and specimens using mathematical statistical methods.*

In this context, as seen by the customer, the negotiation items are dependent on certain criteria (degree of novelty, complexity, technical events experienced during qualification, etc.).

It should be noted that these operations are not intended to justify compliance with the Technical Requirements Specification and may therefore be different from those implemented during development.

They consist in :

- seeking (possibly through experience plans) (54) the characteristics to be monitored during production,
- identification of the monitoring methods for those characteristics (such as statistical process control) in order to monitor the status of the production process,
- use of the results of the measurements taken during production to readjust certain models,
- expression of recommendations with respect to equipment service life consumption resulting from the various checks and debugging,
- perform a final overall operation before hand-over to the customer, in order to check for any noteworthy anomalies at the final stage, in particular if the equipment is associated with other items in a system : mechanical interfaces and connections ECM for example.

On the supplier's side, the negotiation items are as follows :

- description of the experience acquired during elaboration of the equipment,
- statement of what has been agreed with respect to the compromise between the effectiveness of certain checks and/or debugging and consumption of service life,
- use of the statement of inspections distributed throughout the production process,
- using of the consideration of technical events and the return of experience.

Nevertheless, a certain number of non-contractual operations are in the best interests of the supplier, for instance the return of production experience statement, which results in validation of the assumptions made and taken into account by the Design Justification File regarding performance variability in relation to the environment.

For equipment subject to individual acceptance, the severity of the tests must have an acceptable impact on the service life of the equipment. Several solutions are employed :

- identical severity to that used for qualification, but of shorter duration,
- severity and duration less than those employed for qualification,
- severity and duration specific to a given technology.

For those subject to « single-test » type batch testing, qualification levels are usually employed.

*For information, the **user documents** are elaborated during the development/industrialisation phase in order to be provided to the end-user at the same time as the equipment. They are validated or amended in relation to the return of experience from operational use, amongst which one can list :*

- *Operating documentation (technical guide).*
- *Servicing and Repair documentation (operating manual, level 1 and 2 maintenance documentation, level 3 maintenance documentation).*
- *Replenishment documentation (list of associated replenishment items, illustrated catalogue).*
- *This documentation may be provided in the most diverse forms (paper, optical or computerised).*

(55) *Instruction IM 800/EMAT/Etudes*

AECMA 1000D : Operator documentation

One can also list (RG Aéro 000 40) :

- *operating documentation*
- *maintenance documentation*
- *replenishing documentation*
- *training documentation for the use of operators, repair workshops and replenishers.*

(56) *Operators must be made aware of the impact of environmental factors on the equipment, as this enables the elaboration of the precautions to be taken and the minimum arrangements to be fulfilled for optimum utilisation of the equipment including the ecological environmental issues.*

(57) *BNAE RG Aéro 000 23 : Programme Management - Guide for the implementation of configuration control principles.*

*For information, the major choices regarding **dismantling, destruction, storage, conversion or even re-use** in the context of other programmes, are the direct result of the nature and the composition of the materials used in the design.*

The items, once negotiated, become part of the Manufacturing and Inspection File.

3.5.4 User Documents

3.5.4.1 Environmental data to be included in the equipment User Documents

These items (paragraphs, pages, sheets or appendices) are the result of examining the User Documentation from the environmental point of view[55]. This involves :

- validating compliance of the operating instructions with the initial Life Profile specified in the Technical Requirements Specification),
- recommendation of instructions to the operators during their training, regarding « Environmental » issues associated with operating the equipment[56],
- checking the compliance with respect to the intended life profile, of all the actions associated with Integrated Logistic Support including handling conditions, transportation (including safety), and storage of the replenishment items [57],
- ensuring the implementation of the maintenance methods and facilities associated with the environment, as well as their validation to be able to achieve their availability objectives,
- manage all the return of experience information relating to the environment, in order to confirm or to re-adjust the models used for the design of the equipment.

3.5.5 Withdrawal from service documents

3.5.5.1 Environmental data to be included in the withdrawal from service files

These items (paragraphs, pages, sheets or appendices) result from the following actions :

- specification of the regulatory requirements regarding the safety of personnel, safeguarding of property and prevention of ecological damage, with respect to the constituent materials and components of the equipment during destruction, recycling or storage of ultimate waste etc.,
- analysis of the various industrial processes available and their respective costs for processing sensitive materials,
- proposing of the best economical solutions to the problems encountered.

Validation actions (calculations, simulations, tests) associated with the environment may also be included in this phase :

- in order to validate certain recommended operating or support actions,
- in order to supplement the knowledge of certain processes (such as operational ageing).

*For information, the **production phase** is initiated under the authority of the Minister or the DGA, with respect to the Production Launch File . The industrial tasks consist in using the Manufacturing and Inspection File for the equipment, elaborated during the development phase, to produce and supply to the operator the equipment ordered, in compliance with the qualified industrial file (Design File + Manufacturing and Inspection File).*

This includes the following items :

- *checking of the identification, implementation and validation of the means, tooling, processes, etc.,*
- *use of the industrial production means and methods, whilst checking the results obtained by the usual methodological tools applied to this item, such as for example functional analysis, value analysis, failure charts, etc.,*
- *implementation of maintenance operations for the production means,*
- *manufacture of the equipment including any provisioning required,*
- *supply of the equipment through the acceptance process (58).*

(58) *The acceptance process (RG Aéro 000 40) is that set of tasks which contribute to providing the proof that each equipment unit manufactured is compliant with the product definition in the configuration applicable to manufacture.*

3.6 Manufacturing stage – Production phase

Production covers the production process as such and the acceptance process.

The environment is involved, either in the production process as such (definition and implementation of the means (including those aspects associated with safety), handling between operations, partial inspections, integration, storage, packing, waste disposal, ecological damage, etc.), or in the acceptance process [(58)], most frequently through tests (mechanical, climatic, electrical, electromagnetic, etc.) on the production line or « in situ ».

3.6.1 Specific Environment actions in the production process

These actions concern the monitoring and updating of items specified in the Manufacturing File elaborated during the development phase, taking into account the return of manufacturing experience.

For the tests involving the environment, the following tasks must be performed :

- analysis of the definition of the product expected or of the deviations with respect to the design initially adopted during development,
- checking of the compliance of the methods and means (including tooling and test equipment),
- ensuring the implementation and qualification of the industrial facilities associated with the environment,
- checking the choice of tests (nature of the environmental factors, test severity, test duration, associated measurements),
- proper identification of the items selected for testing (unit tests, batch sampling, etc.),
- checking the consistency and the chronological sequence of operations (test sequences and operational checks),
- checking the validity of the test severity and its compliance with the test objective.

In order to update the Manufacturing File, it is useful to check and/or supplement :

- the parts lists and manufacturing process sheets,
- the lists of specific tools and environmental test equipment, whether or not these are integrated within the production line,
- documentation systems associated with these tools and facilities, which enable them to be designed, acquired, installed (and accepted), their implementation, technical control, administrative control and updating.
- launching documents (provisioning and manufacturing lead-times, task sequencing chart, etc.).

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*For information, the **operational phase** is initiated under the authority of the Chief of Staff for « Operational Service Entry ». The tasks are intended to put into service and to support the system and the means required for the accomplishment of operational missions.*

The operational end-user performs the following actions :

- *makes use of the technical documents elaborated with his participation during the development phase,*
- *applies the concepts for implementation, support, instruction methods,*
- *performs certain technical tests,*
- *performs evaluations and experimentation,*
- *establishes operating and organisational rules for logistic support,*
- *decides on the operational service entry.*

Throughout the service life of the equipment, the operator :

- *maintains the condition of the support items (technical documentation, supplies, packing, handling and storage facilities, test and support equipment, maintenance, computer resource support facilities, the necessary infrastructure, personnel and personnel training facilities),*
- *maintains the consistency between the equipment and its constituent parts,*
- *manages the definition and the operating configuration,*
- *provides the operational service return of experience.*

3.6.2 Specific Environmental actions in the acceptance process :

These actions concern the performing and monitoring of tests.

They appear throughout the production process and involve demonstrations which are most often tests (laboratory and « in situ » tests).

The acceptance process naturally concludes the customer–supplier contract. The operational end-user may not be the customer in strict legal terms, however he is involved :

- in each phase of the programme, through the integrated programme team,
- in certain evaluation or test tasks, which he performs, particularly « in situ ».

In this production phase, certain validation actions (calculations, simulations, tests) associated with the environment may also be included :

- inspections between operations on the production line,
- design modifications resulting from technological or other improvements.

3.7 Operational stage and phase

3.7.1 Specific Environmental actions during operational use of the equipment

These actions concern monitoring the return of experience consisting of anomalies and technical events encountered in service. They may also include the performing of demonstrations.

This involves :

- checking the compliance of the actual operating conditions with respect to the intended life profile, as well as the relevance of the life profile situations assumed for Integrated Logistic Support including the conditions for handling, transportation (including safety) and storage of replenishment items,
- monitoring of the application of the various arrangements identified in the Operating Documentation as being linked to the environment,
- ensuring that the operators and support personnel are made aware, during their training, of the « Environmental » issues associated with the use of the equipment,
- ensuring the implementation of the maintenance methods and facilities using the environmental test means, as well as their validation to achieve the availability objectives,
- management of all the return of experience data linked to the environment, in order to confirm or re-adjust the models employed for the design of the equipment, in order to identify as soon as possible any deviation between the assumptions made and the results obtained in service (mean repair times, personnel qualification levels, establishment and optimisation of stocks, administrative and logistic
lead-times),

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*For information, the **Withdrawal from Service** starts with a « Withdrawal from Service » decision taken by the Chief of Staff. The task consists in preparing and executing in a co-ordinated manner and in accordance with the applicable regulations, a total or partial ceasing of use of the system and the dismantling of the equipment and associated facilities. This includes the following operations :*

- *withdrawal from service,*
- *total or partial re-use of the constituent parts (e.g. spares),*
- *dismantling taking into account the applicable regulations with respect to the resulting materials,*
- *processing of waste, recycling,*
- *concentration of waste to the ultimate waste stage,*
- *storage of the ultimate waste, maintenance and traceability.*

- ensuring the proper consideration of the return of experience in the processing of technical events

In this operational phase, certain validation actions (calculations, simulations, tests) associated with the environment may also be involved to :

- understand and resolve anomalies or incidents encountered in service,
- supplement the knowledge of certain processes (for example ageing in service).

3.8 Operating stage – Equipment withdrawal from service phase

3.8.1 Specific Environmental actions during withdrawal from service of the equipment

These actions concern the sub-contracting and monitoring of dismantling operations.

The technical and economic choices concerning the dismantling, destruction, storage, conversion or even re-use of the equipment in the context of other programmes, have already been examined at the design stage of the product. However, in view of the large number of years having gone by since then (equipment service life), it is essential :

- to update and to detail the regulatory requirements concerning the safety of personnel, the protection of property and ecological damage, with respect to the constituent materials and components of the equipment to be dismantled, during conversion, recycling or disposal operations and for the storage of ultimate waste, etc.,
- to participate in the choice of processes used and companies specialised in these techniques,
- to supply all the data to be included in the corresponding technical and administrative files.

It is desirable that this phase should lead to a synthesis of the items associated with the environment in the context of the programme (performance achieved, actual operating profile, situations encountered, actual environmental measurement data, technical events, etc.). This approach is part of the return of experience and can be used to improve subsequent programmes

In this withdrawal from service and dismantling phase, the validation actions (calculations, simulations, tests) linked to the environment may also be used to:

- seek means for the disposal and neutralisation of the materials generated by dismantling,
- check the real impact of the solution envisaged,
- develop the process adopted.

(59)	*A task is the description (RG Aéro 000 40) of that which is to be achieved, under given conditions, in order to obtain an expected and identified result.*

4. ORGANISATIONAL ARRANGEMENTS IN ORDER TO ENSURE ACCOUNTING FOR ENVIRONMENTAL FACTORS IN A PROGRAMME

Application of this approach to the programme management leads to the introduction of tasks [(59)] which involve the Environment in the general Programme actions. The application to specific documents is described in the appendix.

4.1 The specific Environmental tasks in a Programme

The Environmental tasks concern the management of the actions associated with consideration of the environment, the elaboration of documents and the application and execution of their content

Tasks associated with Programme Management :

- To manage the unfolding of the Environmental tasks and to report on their progress.
- To participate in the elaboration of the following documents :
  - Development Plan (RG Aéro 000 42).
  - Task organisation chart (RG Aéro 000 30).
  - Integrated Logistic Support Plan (RG Aéro 000 76).
  - Production Plan (RG Aéro 000 43).
  - Configuration Control (RG Aéro 000 23).
  - Cost Control (RG Aéro 000 61).
  - other documents such as the Qualification Plan, the Environmental Accounting Plan, the Design Justification Plan (AQ 916), the Test Management Plan (AQ 916), etc...
- Participation in the Programme reviews involving the Environment (RG Aéro 000 40).
- Participation in the control of co-operants (RG Aéro 000 40).
- Participation in the return of experience and the processing of technical events (RG Aéro 000 40).

4.1.1 Tasks associated with the design of the equipment (Planning, Feasibility, Definition of the Requirement) :

- Identification of the various « Situations » in the Life Profile of the equipment associated with the intended operating conditions, as well as those corresponding to the various « states » of the equipment.
- Characterising of each Life Profile situation with respect to significant and/or relevant environmental factors.
- Determination of the values of each of the specified environmental factors.

- Identification of the functions required in each Life Profile situation, under operational conditions (main system and support system).
- Identification of the impact of the environment encountered on the accomplishment of the mission and the support for the operational functions required and the technical functions to be fulfilled by the equipment.
- Identification of the evaluation criteria, the levels of the criteria, the acceptance limits for the levels of each function in relation to the environment.
- Grouping and identification of all the useful data for classification of each evaluation criterion for each function, for the environmental domains where the operation (or storage) is normal, on the limit and extreme.
- Participation, from an Environmental point of view, in the elaboration of the programme documents :
    - Functional Technical Specification (Functional Technical Specification : NF X 50-151).
    - Technical Requirements Specification (Technical Requirements Specification : RG Aéro 000 08).

4.1.2 Tasks associated with production of the equipment (Development/Industrialisation, Qualification, Industrial Production, Acceptance) :

- Analysis of the list of entities contributing to the production of each operational or technical function.
- Updating of the environmental factors adopted in order to account for the effects induced by the technical functions.
- Transformation of each specified environmental value into the corresponding value adopted.
- Validation or updating of the environmental factors specified on the basis of the real environment.
- Identification of the risks relative to each source of variability.
- For each function, to list the validation actions in order to validate the achievement of the acceptance criteria (performance).
- Establishment of the list of validation actions adopted.
- Elaboration of the programme of validation actions, distinguishing between the respective shares of calculations, simulations and tests.
- Identification of the equipment required to perform the validation actions.
- Determination of the sequencing and scheduling of the validation actions.
- Summary of the environmental factors to be simulated, required for the validation actions.

- Transformation of the values of the environmental factors to be simulated into test severities.
- Participation, from an Environmental point of view, in the elaboration of programme documents :
  - Design File (RG Aéro 000 14)
  - Development Demonstration File, including tests,
  - Design Justification File with respect to the Technical Requirements Specification (RG Aéro 00015)
  - Manufacturing and Inspection file
  - etc.

4.1.3 Tasks associated with operation of the equipment :

- Analysis of the User Documents initially elaborated during the development phase.
- Participation in the analysis of all the technical events resulting from the return of operating experience.
- Checking of the compliance of the actual operating conditions in relation to the originally intended life profile both for the main system and for the support system.
- Ensuring correct application of the special arrangements involving the environment (storage, handling, transport, etc.).
- Obtaining of the design modification decisions or operating restrictions following anomalies encountered and identified as being associated with the environment.
- Proposing of adjustments and updating of the text in the operator documents (in order to avoid misinterpretation, to fill-in gaps, account for modifications, etc.).
- To ensure the environmental data bases are enriched with all the information considered useful.

4.1.4 Tasks associated with the withdrawal from service and dismantling of the equipment :

- Analysis of the withdrawal from service and dismantling documents, initially elaborated during the development phase.
- Updating and detailing of the regulatory requirements concerning the safety of personnel, protection of property and ecological damage, with respect to the constituent materials and components of the equipment to be dismantled for transformation and recycling operations and for disposal or storage of the ultimate waste.
- participation in the selection of the processes adopted and of the companies specialised in such techniques.

(60)	*Depending on the company, this job title varies. For example some companies use : Programme Director, Head of Programme, etc.*

- Supply of all the information to be included in the corresponding technical and administrative files.

4.2 Responsibility for accounting for the environment

For information, this responsibility is attributable both to the State Customer « Contracting Authority » (Operational units + DGA) and the industrial suppliers « Prime Contractors ».

4.2.1 Responsibility of the State Customer « Contracting Authority »

The overall « Contracting Authority » responsibility belongs to the Programme Director within the integrated team, assisted by specialists in the « Environmental field » to:

- perform the general and specific actions described in the paragraphs covering the Functional Technical Specification , Technical Requirements Specification, Design Justification File in the present document and that for the highest level of assembly,
- provide approval for the Design Justification File established for the supplier for the highest level of assembly,
- check that Environmental issues are covered during the reviews.

4.2.2 Responsibility of the Industrial Supplier « Prime Contractor »

The overall « Prime Contractor » responsibility belongs to the Programme Manager[(60)], and it is up to him to call upon the specialist services of the « Environment trade » to :

- perform general and specific actions, such as those described in the Design File, Design Justification File, ... at the highest level of assembly and the Technical Requirements Specification, Design File, Design Justification File, for the lower assembly.
- optimise, from the invitation to tender stage, the tasks relating to accounting for the Environment, and estimate their corresponding costs and lead-times,
- identify the resources needed, check they can be satisfied by the resources available
- define those to be established,
- analysr the implementation of the organisational arrangements needed to account for the Environment,
- propose arbitration for the choices between resources, costs and risks, associated with accounting for the Environment.
- provide permanent updating of all the Environment data related to the Programme and decide on whether or not they are to be taken into account according to the importance of the issue (cost/effectiveness ratio),

(61) *They are qualified essentially as generalists trained in the field of experimental physics and moreover having very good human relations capabilities. Their means of action are most often linked to persuasion, which they use abundantly in order to help the various negotiators to arrive at the most useful compromises.*

These specialists must be sure to keep up to date – and to progress – in relation to the trade teams and to do this by making use of all opportunities to meet the various specialists (meetings, conferences, exhibitions, etc.).

- Ensure that for the sub-contracted and/or bought-out items, the Environment is taken into account in a homogeneous and consistent manner in relation to the system as a whole. This involves
    - including accounting for the environment in the Technical Requirement Specifications for the sub-contracted or bought-out items,
    - including environmental issues in the reviews with co-operants and sub-contractors :
        - study reports,
        - progress reports,
        - programmes, procedures and test reports,
    - providing to the co-operants and sub-contractors the environmental test results and return of operating experience for their products with respect to the major assemblies,
    - checking of the existence of the means and the organisation required for the co-operants and sub-contractors to process environmental problems,
    - organising with the co-operants and sub-contractors, the gathering, analysis and processing of technical events involving the environment.

4.3 The « Environment Specialists »

Irrespective of the organisation applicable to each State or Industrial sector, the « Environment » actions – as for any trade – require a certain number of specialists **(61)** of the « Environment field » and the appropriate technical means. Depending on the case, these specialists may be company employees (integrated in a specialised field or detached to the Programme team), or be members of specialised companies or State or Industry centres or organisations.

The tasks to be performed by the Environmental specialists are the specific Environment tasks defined throughout the present document. They may be summarised as :

- leading the accounting for the environment, specifically by :
    - being present and participating actively in meetings,
    - the elaboration of documents (paragraphs, pages or appendices) for the environmental aspects,
- leading the validation operations associated with the environment, specifically by :
    - organisation, scheduling, negotiation of priorities,
    - validation of the documents used for the test (reference, issue, etc.)

monitoring of the tests, obtaining decisions in the context of incident processing,

- conducting of tests (within laboratories, or environmental test organisations),
- keeping of environmental data bases.

With respect to environmental testing in particular : once the test principle has been accepted, its correct execution (from its elaboration and preparation to its execution, as well as the resulting report are the responsibility of the Laboratory Manager or the test organisation, who has to report on the results to his customer (or the customer's representative).

With respect to updating and validation of the Data Bases, this is the responsibility of the manager of the area(s) controlling the Data Bases, assisted by the co-operants or organisations who supply the information required to enrich their content.

APPENDIX A

ADDITIONAL EXPLANATIONS AND DEFINITIONS

1. REPRESENTATION OF A LIFE PROFILE

The chart provided on the following page is included to give an idea of how the "Life" of a product unfolds between its leaving the manufacturing plant and its entry into service. The example concerns a missile which may be fired from ships, land vehicles or aircraft.

The Product, on leaving the manufacturing plant is first of all transported to its destination. This may be achieved by road, rail, sea or air.

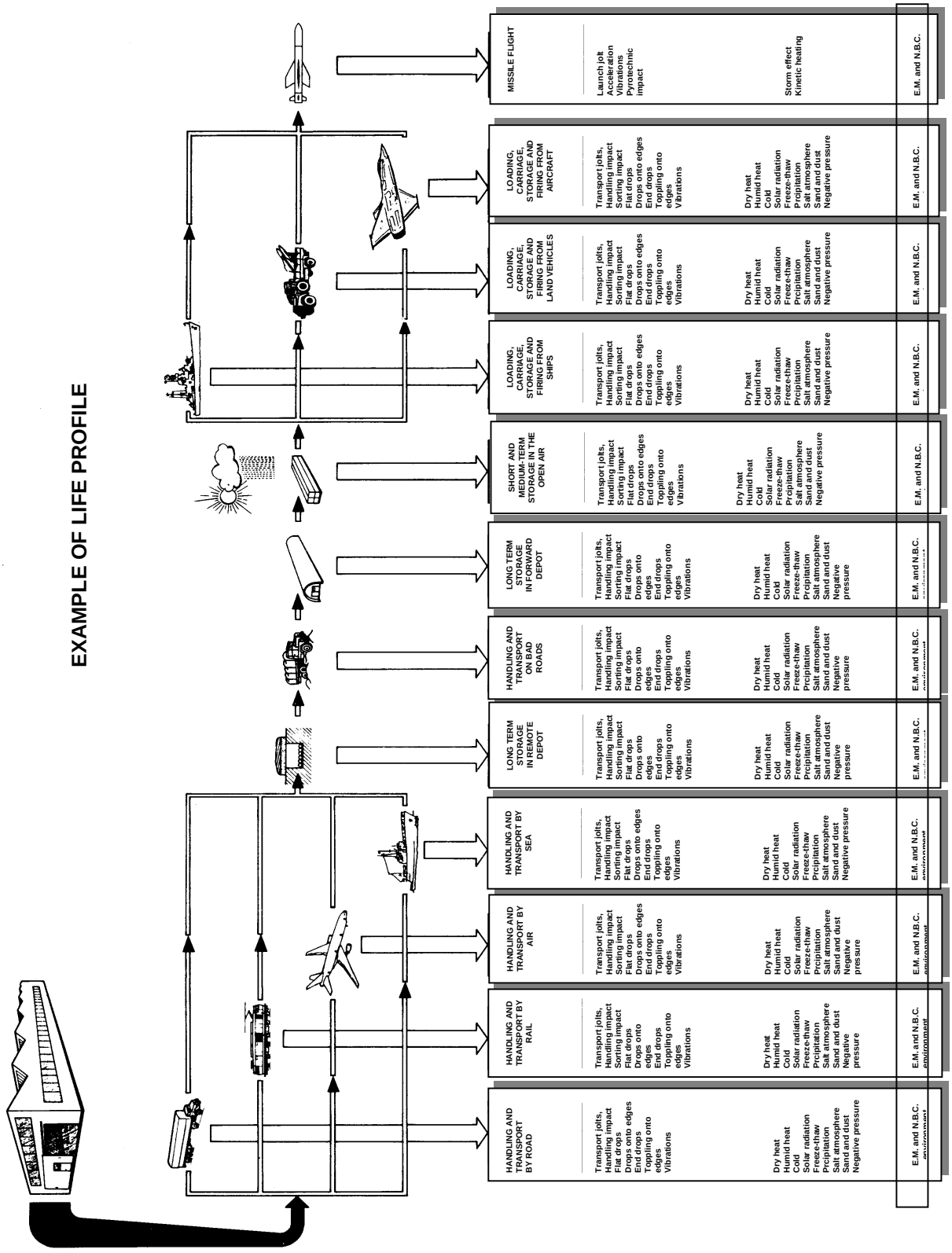
The product is then stored initially, then it is transported to the operating theatre by land (logistic transport), then again stored or held open-air (rain, sun, etc.).

Then it is installed on the launch platform, from which it will be fired.

During these various stages, called "situations", it is subjected to aggression by various environmental factors, which are defined by their nature and their value. Three major classes are used:

- the mechanical environment, which covers everything associated with handling (impact, dropping, toppling, etc), logistic transport (vibration, jolts, impact, stacking, etc.), installation on the operational carrier (impact, dropping), operational carrying (vibration, impact, etc.), launch (departure jolt, etc.), impact on the target (impact, etc.).
- the climatic environment, which at first sight is different for each situation (dry heat, humid head, cold, solar radiation, depressurisation, salt atmosphere, freeze-thaw, etc.),
- electrical and electromagnetic environment, which depends on the proximity and the power of the various sources to be taken into account,
- nuclear, biological and chemical environments.

It should be noted that this representation can easily be extended to cover the complete "Life Cycle" by taking into account the upstream provisioning of materials and the downstream disposal of unused products, their recycling and storage of the ultimate waste.


EXAMPLE OF LIFE PROFILE
HANDLING AND TRANSPORT BY ROAD
HANDLING AND TRANSPORT BY RAIL
HANDLING AND TRANSPORT BY AIR
HANDLING AND TRANSPORT BY SEA
LONG TERM STORAGE IN REMOTE DEPOT
HANDLING AND TRANSPORT ON BAD ROADS
LONG TERM STORAGE IN FORWARD DEPOT
SHORT AND MEDIUM TERM STORAGE IN THE OPEN AIR
LOADING, CARRIAGE, STORAGE AND FIRING FROM SHIPS
LOADING, CARRIAGE, STORAGE AND FIRING FROM LAND VEHICLES
LOADING, CARRIAGE, STORAGE AND FIRING FROM AIRCRAFT
MISSILE FLIGHT
Transport jolts, Handling impact Flat drops Drops onto edges End drops Toppling onto edges Vibrations
Dry heat Humid heat Cold Solar radiation Freeze-thaw Precipitation Salt atmosphere Sand and dust Negative pressure
Transport jolts, Handling impact Sorting impact Flat drops Drops onto edges End drops Toppling onto edges Vibrations
Launch jolt Acceleration Vibrations Pyrotechnic impact
Storm effect Kinetic heating
E.M. and N.B.C. environment

2. REPRESENTATION OF GENERAL ACTIONS RELATED TO SPECIFIC "ENVIRONMENTAL" ACTIONS AND REPRESENTATION OF SPECIFIC "ENVIRONMENTAL" ACTIONS.

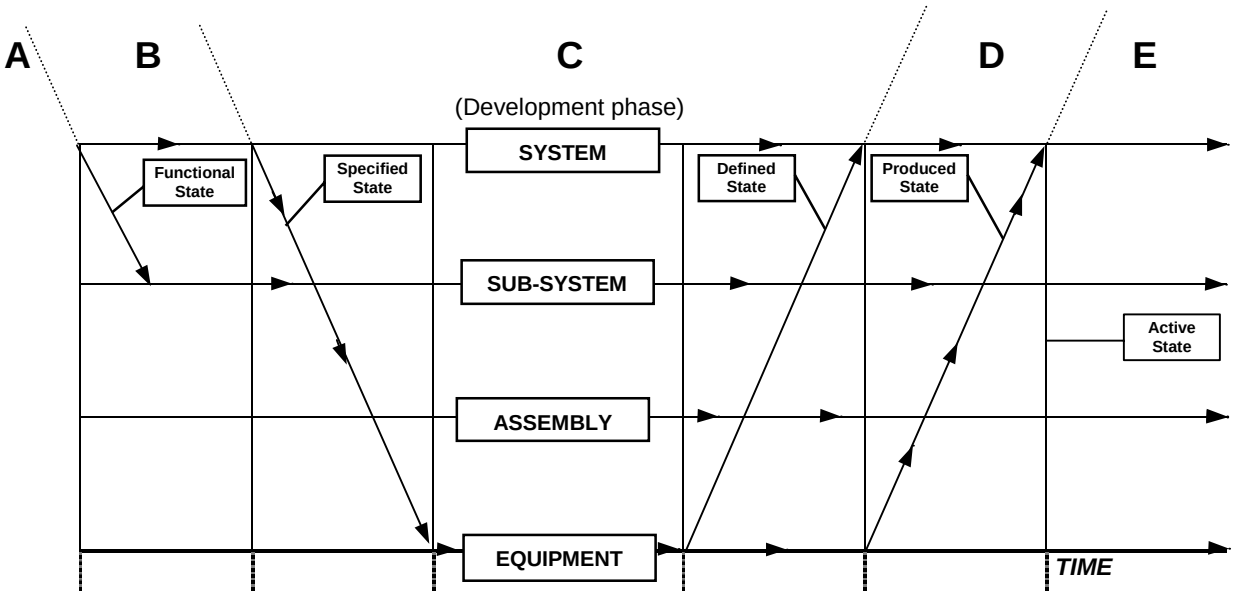
Two charts are provided which show the various actions and interactions between the different elements which are involved in the design, development and production of equipment, assemblies, sub-systems and systems.

The "V"-shaped lines indicate the acquisition of the various states in the descending branch (statement of requirement process, preliminary design) and in the ascending branch (detail design, production process). The change from one given reference state to the next reference state is achieved by the implementation of one or more processes (e.g. qualification process, production process, etc.).

Each change of state results in a set of documents; the part associated with the environment has already been described. This presentation is derived from that appearing in RG Aéro 000 40 and has been supplemented with "Environmental" type information.

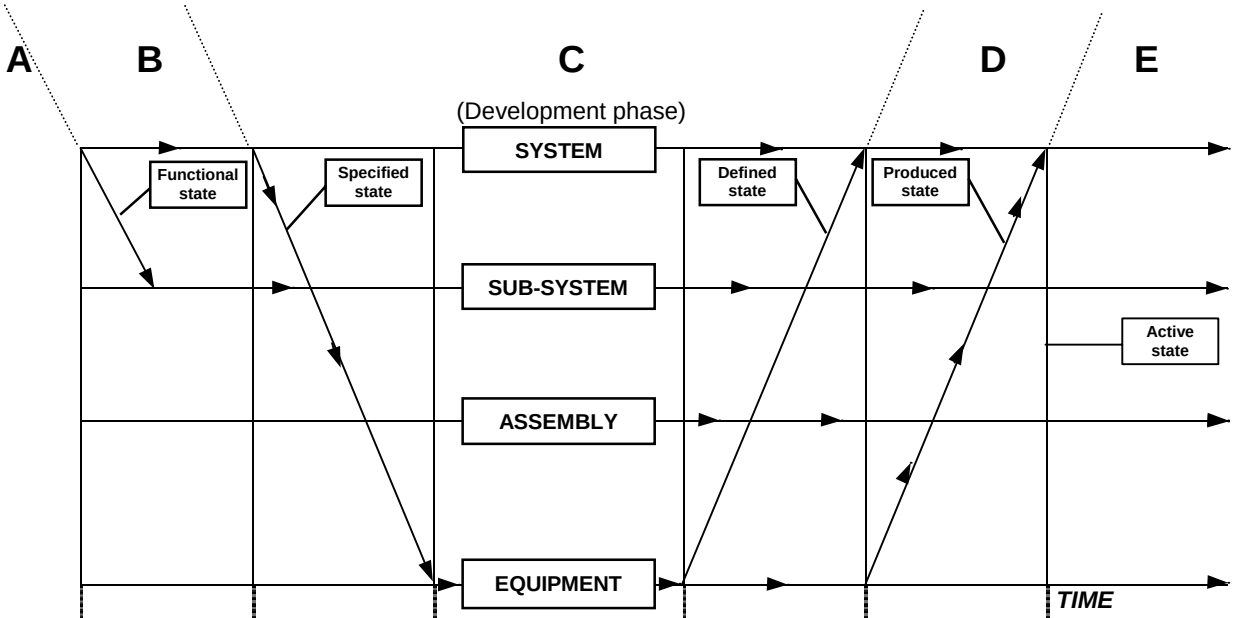
GENERAL ACTIONS

related to specific environmental actions



Functional Specification	Technical Requirement Specification	Design File Qualification File Design Justification File, Manufacturing File, Inspection File, Operating File	Inspection registers Design File Changes	Log Books	
• simplified definition of the life profile of the product (at system level) • identification of the operational functions of the product (at system level) • characterisation of each operational function • etc. (cf. 3.3.1)	• listing of the various situations of the life profile at system and equipment level • listing of the operational functions of the product (at system and equipment level) • etc. (cf. 3.4.1.)	• all actions associated with the product definition process • all validation actions during design • etc. (cf. 3.5.1)	• all general design justification actions associated with specific environmental actions • etc. (cf. 3.5.3)	• all general production actions associated with specific environmental actions (cf. 3.6.1)	• validation of the initial life profile • management of all the return of experience for confirmation or re-adjustment of the models used • etc. (cf. 3.7.1)

SPECIFIC ENVIRONMENTAL ACTIONS



Functional Specification	Technical Requirement Specification	Design File Qualification File Design Justification File, Manufacturing File, Inspection File, Operating File	Inspection registers Design File Changes	Log Books	
• identification of the feasibility items which are sensitive to the environment • characterisation of each life profile situation by environmental factors • determination of the values of the environmental factors • evaluation of the technical and industrial feasibility of each design • etc. (cf. 3.3.2)	• identification of the relevant environmental factors • determination of the corresponding values • definition of the normal, on-limit and extreme operating envelopes • etc. (cf. 3.4.2)	• all actions contributing to the product design process • all validation actions for the technical functions • etc. (cf. 3.5.2)	• justification of the variability of the environment • checking the content of the test documents (cf. 3.5.4)	• all actions associated with the production process • all actions associated with the adaptation process (cf. 3.6.2)	• enriching of the data bases • re-adjustment of models • modification of test methods • modification of debugging • etc. (cf. 3.7.2)

3. SUPPLEMENTARY DEFINITIONS OF TERMS EMPLOYED

3.1. Normal, on-limits and extreme domains

Normal domain[1]: environmental domain (nature and level) for which the considered function of the product is provided at the specified performance (evaluation criteria).

On-limit domain: environmental domain for which the considered function of the product may be provided at degraded performance (evaluation criteria), whilst meeting the safety requirements; this deterioration being reversible as soon as the domain reverts to normal.

Extreme domain: environmental domain for which the considered function of the product may be provided at irreversibly degraded performance (evaluation criteria), whilst meeting the safety requirements.

The environmental factors in this domain generally have an accidental or malicious cause, for this reason they are referred to as "aggression" in the Safety vocabulary.

3.2. Operational Functions – Technical Functions

Operational Function: Action expected of a product (or performed by it) in order to satisfy an item of a given operator requirement (NF X 50-150).

Technical Function: Internal action of the product (between its constituents), chosen by the designer-manufacturer, in the context of a solution, to achieve the operational functions (NF X 50-150).

Comments:

With respect to a given technical organisation level[2] [3], the set of operational functions for which a constituent may contribute towards the achievement, includes :

- the contributions of that constituent to the operational functions for the next assembly,
- the contributions of that constituent to the technical functions generated by the architecture of technical solutions adopted for the lower assembly. These technical functions become operational functions for the lower assembly level.

[1] The domain is fully defined in terms of environmental factor values; but is linked to normal, on-limit or extreme operation (and/or storage) of the product. The term "normal environment" is an improper shortening which although often employed, should be avoided. The correct title should be : environmental domain in which the operation (and/or storage) of the product is normal, on-limit or extreme.

[2] Organisation function (RG Aéro 000 30): structural representation of the breakdown of functions expected from the system in terms of elementary functions to be fulfilled at various levels.

[3] Product organisation (RG Aéro 000 30): structural representation of the breakdown into successive levels of the system and its constituents.

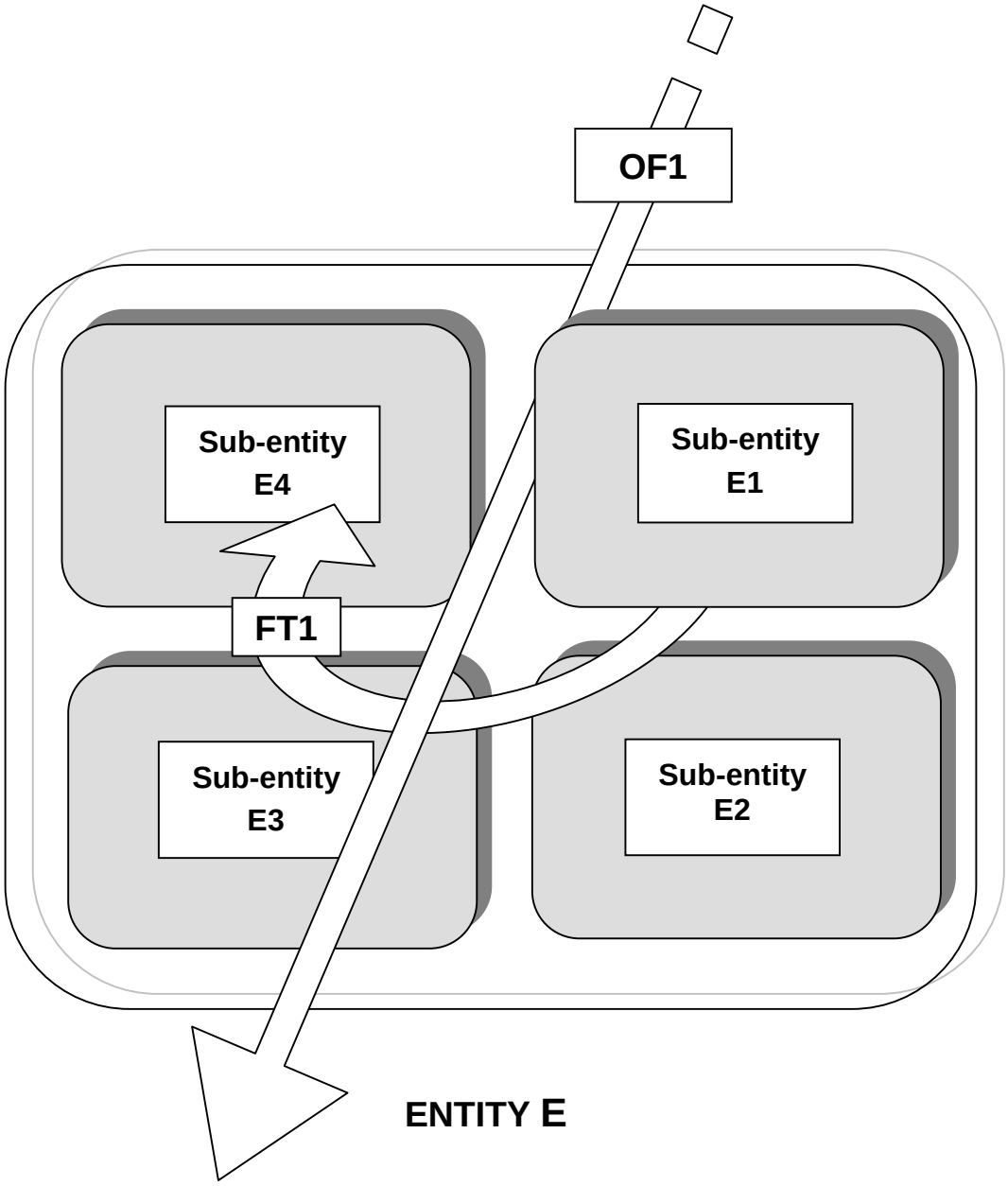
Example :

Entity E consists of sub-entities E1 to E4.

E1 contributes towards the operational function OF1.

A technical function TF1 becomes necessary due to the choice of technical solution adopted.

The contribution of entity E2 to OF1 is associated with its contribution to TF1 which for E2 constitutes an operational function.



3.3. Guarantee Factor

Definition [1] :

The Guarantee Factor is a magnifying coefficient which is used to switch from the specified environment to the environment adopted. It takes into account two factors:

- the variability of the environment encountered in a given situation of the Life Profile at various instants which are repeated in time,
- the variability of the resistance of the performance considered to the environment concerned.

Comments :

The environmental factor characterising a situation is not repeated identically when the situation recurs : its variability is expressed by a distribution law which may be characterised, by measurement on-site, of the statistical parameters (mean and standard deviation).

The limit for maintaining the performance considered of the equipment with respect to this environmental factor, is also subject to random variation between one sample and another of the equipment produced. In the absence of measurements to characterise such variability, it is generally possible to estimate the variation coefficient for the corresponding distribution law (but not its mean value)[2].

These two variabilities, which respectively characterise (for simplification purposes) the environment and the resistance[3] of the equipment to the environment, result in a probability of failure for which an indication is provided by the intersection of the two graphs of the density of probability which characterise these two variables. The precise value of the probability of failure is calculated mathematically from the respective probability density functions.

As we do not know at this stage the mean value of the resistance of the equipment, a scalar value is determined which when multiplied by the value representing the environmental factor concerned, provides the mean value which should be achieved with respect to the resistance of the performance considered for the equipment in order to attain the specified reliability objective, taking into account the known variation coefficients (σ/m) for the two variabilities. This scalar is known as the "Guarantee Factor".

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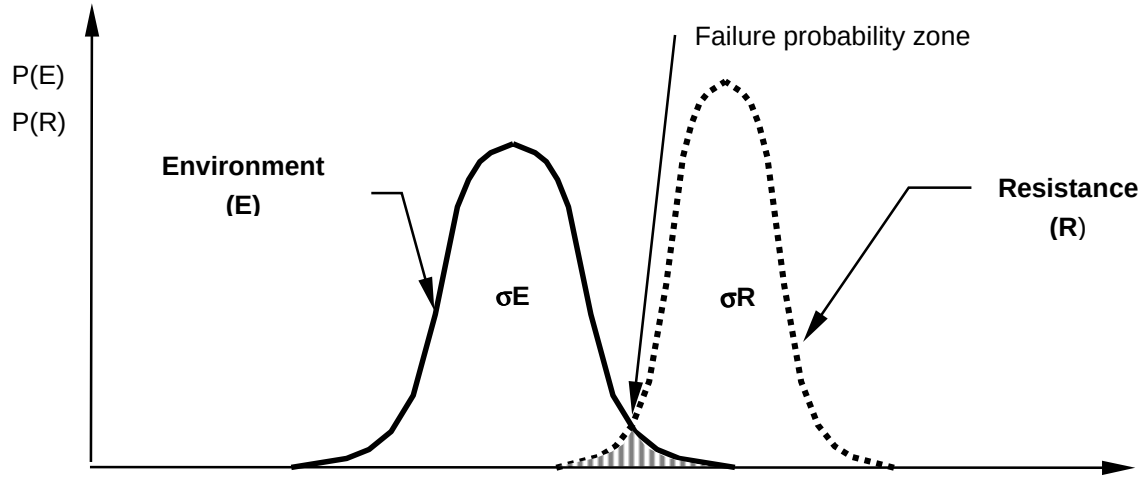
1 Documentation leaflet AFNOR FD X 07 144-2: Gurantee Factor

2 The notion of limit of resistance to the environment must be taken in the broadest sense as being the value of the environment which results in the performance considered at the tolerance limit.

3 Each trade uses its own name for these terms, for example: « aggression » instead of environment and susceptibility instead of resistance to the environment.

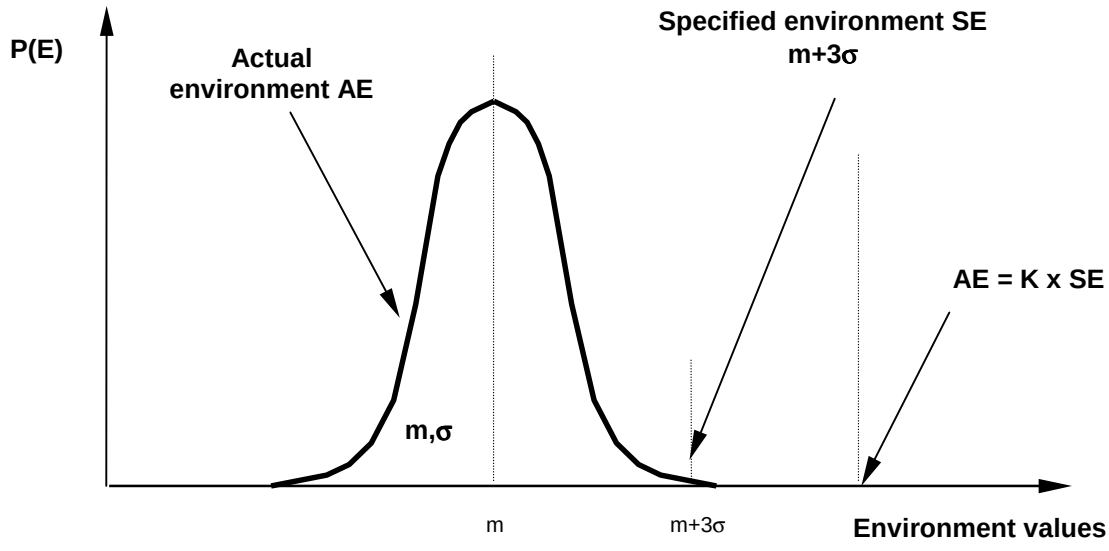


The conversion of the specified environment into the environment adopted involves choosing the magnitude(s) which represent or characterise the environment considered and on which the guarantee factor is to be applied. This choice is essentially dependent on the sensitivity of the performance considered to such magnitudes. This sensitivity is linked to the design choices (design, components, processes, special operating conditions).

The dotted curve is generally an indication of the relative probability of failure. It is obtained by the intersection of the areas defined by the densities of probability of the magnitude which represents the environmental factor concerned and that which represents the resistance limit to the performance concerned for that magnitude.

The exact probability of failure assumes that the two probability densities are fully taken into account.

Illustration of the notions used



The value of the environmental factor adopted for AE is deduced from the value representing the specified environmental factor SE via a multiplying guarantee factor k :

AE = k x SE

$$\mathbf{k} = \frac{\text{Value of the representing environment factor which characterises the mean product resistance}}{\text{Specified value of the same environment representing factor}}$$

The calculation of this ratio takes into account [1]:

- the maximum acceptable probability that the limit of resistance to the environment considered for the performance concerned of the manufactured product, must be less than one of the values taken for the environmental factor considered,
- the value distribution law for the environmental factor concerned (characterised by the type of law, the mean value and the standard deviation) from one sample to another with respect to that environment,
- the value distribution law taken for the limit of the performance resistance considered from one sample to another of the manufactured product with respect to the environmental factor concerned (characterised by the type of law and the variation coefficient (ratio of the standard deviation to the mean)).

Examples :

- Dry heat or cold: the magnitude used could be the temperature, or the time spent at that temperature, or any parameter which determines thermodynamic exchanges, etc.
- Temperature variation: the magnitude used could be the temperature gradient or the time spent at each temperature value, etc.
- Mechanical shock or vibrational acceleration: the magnitude used could be the acceleration with respect to time, or the extreme response spectrum, or the spectrum of fatigue damage, etc.
- Electric or magnetic field (radiated): the magnitude used could be the amplitude of the electric or magnetic field at a given frequency, the time spent at a given amplitude and frequency, etc.
- Induced current or voltage (in conducting mode): the magnitude used could be the induced current or voltage amplitude at a given frequency, the time spent at a given amplitude and frequency, etc.

[1] Care must be taken to ensure that application of the guarantee factor does not lead ro non representativity due to threshold phenomena, such as:

- exceeding of mechanical preload in vibrations.
- exceeding of the vitreous transition temperature of an elastomer.

3.4. Test Factor TF

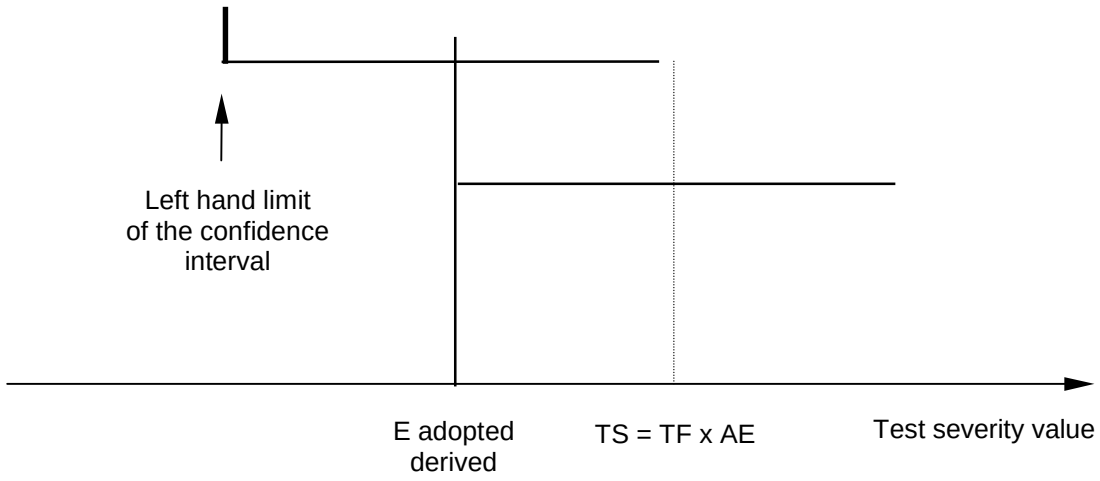
Definition[1] :

The Test Factor is a magnifying factor which is taken into account to demonstrate that the guarantee coefficient is achieved with a small number of tests; it is dependent on the number of samples of the defined product, to which the same test is applied successively, and the variability of the performance resistance limit achieved in the tests. It is all the higher if the number of tests is small.

Comments :

Illustration of the notions employed

The purpose of the test is therefore to demonstrate statistically that the guarantee factor has been achieved. If an infinite number of tests are performed with a severity equal to the assumed mean value (which is in fact not known) for the performance resistance considered, we obtain 50% of failure cases. If the number of tests is reduced, the knowledge which can be obtained for the mean performance resistance will be the result of a statistical estimation, and will therefore be bracketed by a confidence interval associated with a given probability. If we wish to obtain at least the same guarantee with a much reduced number of tests, and assuming 0 failure cases, compared with the case involving an infinite number of tests, it will be necessary to increase the severity of the tests in such a way that the lower limit of the confidence interval considered corresponds to the severity value applied previously. This increase in severity corresponds to the coefficient called the "Test Factor", precisely because its value is dependent on the number of samples of a given design of equipment subjected successively to the same test (of the variability of the resistance to the performance concerned).



1 Documentation leaflet AFNOR FD X 07 144-3: Test Factor

The offset corresponds to a new coefficient, called the Test Factor TF, which after multiplication by the derived environment adopted AE leads to the test severity TS :

TS = TF x AE

Note : The case where the test severity TS can be deduced directly from the environment adopted AE is a special case; as a general rule, the test factor is applied to the result of a synthesis of several environmental factors adopted, each representing a situation in the Life Profile scenario considered in such synthesis.

3.5. Ruggedness of the product

Definition :

The property which characterises a product whose performance (evaluation criteria) are not (or are little) affected by the various source variabilities linked to the design, the materials used, the manufacture or the operating conditions.

The property of ruggedness enables any sample of the product manufactured to maintain at optimum level, throughout its operational life, the specified performance (evaluation criteria), in the normal, on-limit and extreme domains specified.

Comments :

This property is obtained by actions involving :

- application of an approach consisting in Customisation of the product to its real environment, including in particular, taking into account of a guarantee factor for each environmental factor adopted,
- taking into account of the variability of performance (evaluation criteria) with respect to the other sources of variability (excluding the environmental aspects covered above), such as those associated with design, the manufacturing processes or the conditions of use,
- the reduction in sensitivity of performance (evaluation criteria) of the manufactured product to manufacturing dispersion, deterioration (wear, material ageing[1] conditions of use), of the product by selection of relevant criteria with respect to the design and the manufacturing processes,
- the control of manufacturing processes at all stages of assembly,

[1] *This involves using the time-related behaviour laws for the various constituents of the product, or the base materials, or the assemblies, with respect to each environmental factor.*

- the possible implementation of aggravated tests in order to explore the performance margins (evaluation criteria) and to increase these by eliminating the assignable causes of defects,
- the use in all forms, of the return of experience : validated simulation models, technical event data bases, ...

All these actions contribute towards controlling :

- the variation coefficients for the variability sources on the one hand and the performance resistance (evaluation criteria) for these same sources on the other hand,
- the margins which express the ratio between the mean values for each source of variability at the corresponding mean value of the performance resistance.

APPENDIX B

AIDS

1. THE ENVIRONMENTAL ACCOUNTING PLAN

The set of tasks may be co-ordinated through an Environmental Accounting Plan which covers the following domains :

- accounting for the environment,
- control of co-operants, sub-contractors and suppliers,
- Programme reviews,
- return of experience and processing of technical events,
- updating of data bases.

1.1. Objectives

The objective of the plan is to efficiently organise the set of actions required in order to satisfy the tasks intended to take into account the environment. The Environmental Accounting Plan describes this organisation and acts as a framework for the industry actions; it contributes to providing the customer an assurance that the objectives for accounting for the Environment, will be achieved.

1.2. Constituent items

The Environmental Accounting Plan :

- recalls the logic (justified approach) of the overall programme actions for Accounting for the Environment: management actions (personnel, means, data, links), for the technical requirement file, the design file, the design justification file, highlighting the relationships between them and the links with other activities,
- lists the objective Environmental Accounting tasks and for each one of them :
  - ⇒ the person responsible,
  - ⇒ the input data (start date, source),
  - ⇒ identification of the entity performing the task,
  - ⇒ the output data (end date, expected results, intended use of the results, data bases),
  - ⇒ the overall sequencing of the unfolding of the tasks,
  - ⇒ the intended meeting points (internal and with the customer),
  - ⇒ the organisation set up for monitoring these actions (evaluation, reports, corrective actions).

1.3. Purpose

This type of plan is used for :

- establishing an organisation (who does what, how and what with ?) leading to a set of relevant and consistent actions for the system concerned,
- ensuring proper coverage of the various demonstrations (including testing) in order to avoid late discovery of gaps, for example for qualification, or even worse during series production, or worse still after delivery to the customer.
- avoid unnecessary duplication in terms of tasks and the associated means,
- control the risks (validation omissions with respect to the evaluation criteria (performance)) , costs and delivery schedules.

In particular, the Environment Accounting Plan[1] provides overall visibility of the tasks in order :

- to take into account the difficult issues (possible impact on evaluation criteria (performance), cost, delivery schedules),
- to provide the test methods and means, the associated funds and optimise their use:
  - ⇒ regarding the means to be acquired (identification, contribution towards specification and optimisation of the selection of the environmental test equipment, test equipment, tooling and models required),
  - ⇒ regarding the existing facilities (identification of any adaptations required or corrective actions in the event of inadequacy),
- to determine the set of tests to be performed and consequently any subsequent re-adjustment of the simulation models (thermodynamic, mechanical, functional, etc.),
- to facilitate the search for results by being aware of all the Environmental Accounting actions performed,
- to spread out in time the gradual acquisition of the experimental evidence,
- to provide confidence of the quality control of the Environmental Accounting process,
- to list the tasks associated with the environment for their proper incorporation into the development plan and Programme management,
- to help manage the set of documents associated with Environmental Accounting,
- to enable all the members of the Environmental team to be aware of all the Environmental Accounting tasks for the product,
- Other documents

[1] More than the document as such, it is the approach and the thinking to obtain and maintain it which are important from the point of view of planning and anticipation. They enable the preparation, execution, improvement of the environmental accounting actions. The Environmental Accounting Plan is not therefore a document to be elaborated retrospectively.

Other documents are also used but are not specifically covered by this document :

- the System Architecture
- the Functional Organisation resulting from the Functional Technical Specification
- the Product Organisation resulting from the Functional Organisation
- the Overall Qualification Plan
- the Experimentation Plan
- the Configuration Control Plan
- the Integrated Logistic Support Plan

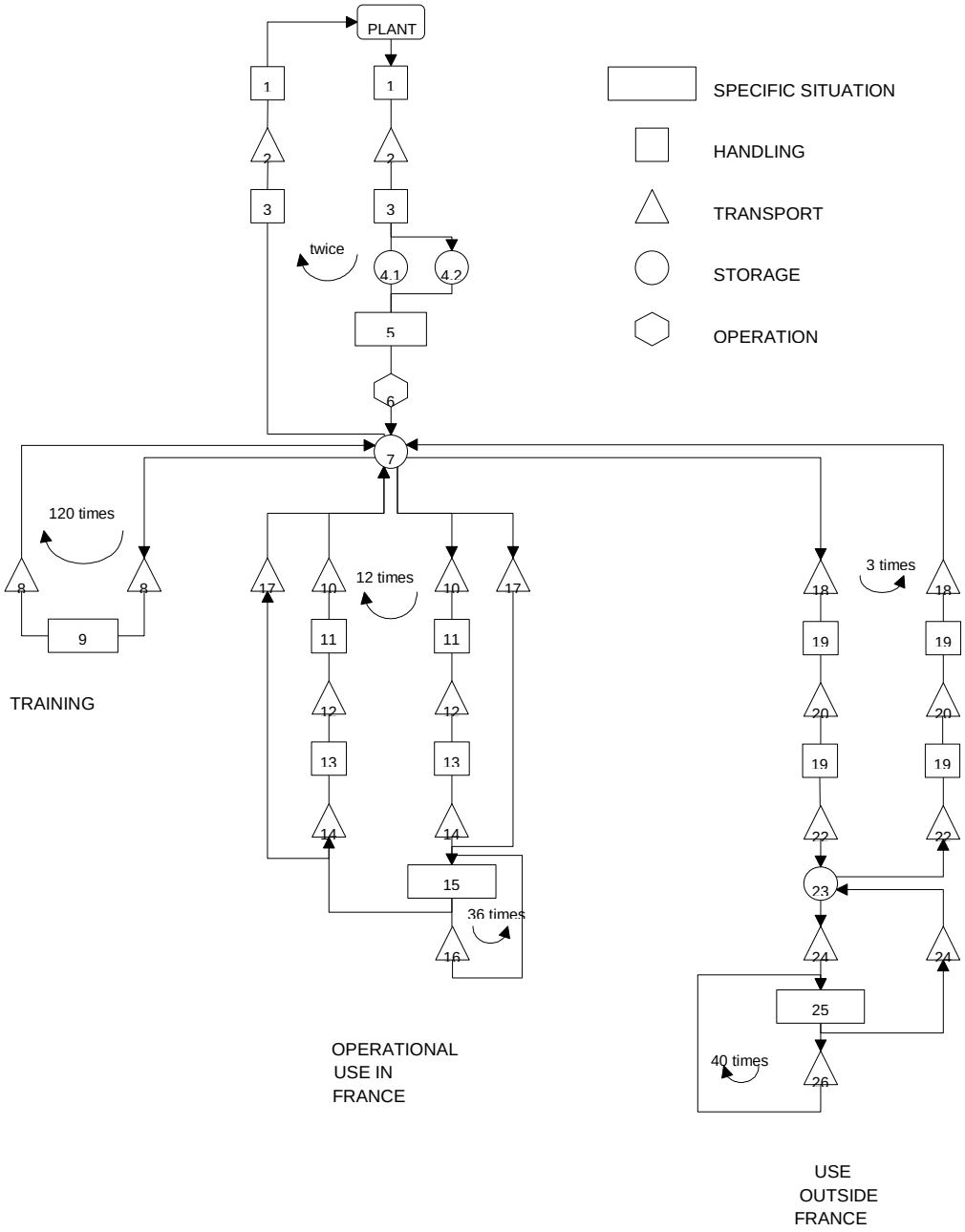
- the Estimates
- the Technico-Administrative management plans
- the financial management plans

- the Documentation Management Plan
- change monitoring (Design File, Design Justification File, Manufacturing File ....)
- control of costs and delivery schedules

- the Product Quality Assurance Plan
- the company or specific area Quality Manual.

2. EXAMPLES OF ENTRY AID DOCUMENTS

Flow chart



Example of situation sheet

Programme: XXXXXXXXXXX
Sub-assembly:

Situation : S1 HANDLING
Occurrence: 3
Duration: 0.5 h

Loading, unloading, rail, road

TYPE OF HANDLING

- manual
- fork-lift truck
- conveyor belt
- roller
- crane
- overhead crane
- hoist
- remote controlled arm
- specific system means
- platform lift

EQUIPMENT PACKING

TYPE OF PACKING

- wooden or fibreglass crate
- non specific packing
- specific packing
- standard packing
- TIR container
- none

PACKING CHARACTERISTICS

- no sealing or waterproofing (crate)
- waterproofing without sealing

- waterproofing
- water and steam proofing
- air tightness
- pressurised (container)
- NBC
- slight pressurisation

POSITION OF THE EQUIPMENT IN RELATION TO THE CARRIER

- any
- longitudinal X
- transverse Y
- vertical Z
- oblique angle

STAGE OF INTEGRATION

- equipment
- sub-assembly
- complete assembly

CONFIGURATION OF THE EQUIPMENT

- operating (yes/no) : no
- operational (yes/no) : no

HANDLING LOCATION

- outdoors
- open shelter
- lightweight closed shelter
- heavy shelter
- igloo
- container
- air-conditioned store
- luggage compartment
- on carrier

CLIMATIC CONDITIONS

- Geographic zones Appendix GAM-EG13: Z3 Z7 (France)
- Geographic zones STANAG 2895:

ELECTROMAGNETIC CONDITIONS

- electromagnetic environment (yes/no)

NBC CONDITIONS

- nuclear environment (yes/no): no
- bacteriological environment (yes/no): no
- chemical environment (yes/no): no

SPECIFIED CONDITIONS

ACCIDENTAL EVENTS

- fire
- oil fires
- violent impact
- repeated impact
- under tension (yes/no) : no
- free fall 0.3 m < height < 20 m depending on axes:
- impact on walls depending on axes:
- exceptional vibrations depending on axes:
- rapid decompression and/or compression
- gunfire (bore, velocity, range)
- proximity fuse (range, charge)
- electrostatic discharge
- lightning
- corrosion

Example of table of occurrences

Situation No.	CONTENT OF THE SITUATION	Duration	Occurrence
S 1	HANDLING Loading, unloading rail, road	0.5 h	3
S 2.1	LOGISTIC ROAD TRANSPORT From plant to storage location	8 h	3
S 2.2	LOGISTIC TRANSPORT BY RAIL From plant to storage location	8 h	3
S 3	HANDLING Loading, unloading rail, road	0.5 h	3
S 4.1	SHORT TERM STORAGE Pending use	3 months	1
S 4.2	LONG TERM STORAGE Storage on the allocation site	2 years	1
S 5	REMOVAL FROM STORAGE Operational commissioning on the storage site	2 d	2
S 6	CORRECT OPERATION CHECK acceptance by operators	5 d	2
S 7	EQUIPMENT AVAILABLE pending use	12 d	360
S 8	CARRIAGE FOR TRAINING Moved to training site	1 h	240
S 9	TRAINING TYPE OPERATING SYSTEM System training alone, fixed station	2 d	120
S 10	CARRIED FOR MANOEUVRES Move to allocation location for rail loading	1.5 d	24
S 11	HANDLING Loading, unloading for rail transport	0.5 h	24
S 12	LOGISTIC RAIL TRANSPORT Move to manoeuvres location	20 h	24

S 13	HANDLING Loading, unloading for rail transport	0.5 h	24
S 14	CARRIAGE FOR MANOEUVRES Move to unloading site for manoeuvre zone	1.5 h	24
S 15	MANOEUVRE TYPE SYSTEM OPERATION Joint forces operation	5 d	24
S 16	CARRIAGE FOR TACTICAL USE Tactical moving during manoeuvres	1 h	36
S 17	CARRIAGE FOR MANOEUVRES Move from allocation site to manoeuvres site	46 h	12
S 18	CARRIAGE FOR DISPATCH OUT OF FRANCE Move to air/sea loading/unloading site	2 to 8 h	6
S 19	HANDLING Loading/unloading at the embarking site	2 h	6
S 20.1	LOGISTIC TRANSPORT BY SEA Transport by container ship to port of destination	30 d	6
S 20.2	LOGISTIC TRANSPORT BY AIR Transport to operating site outside France	48 h	6
S 21	HANDLING Loading, unloading at the embarking or disembarking site	2 h	6
S 22	CARRIAGE TO THE OPERATING SITE OUTSIDE FRANCE Move from the disembarking site to the operating area	4 h	6
S 23	EQUIPMENT AVAILABLE OUTSIDE FRANCE Pending use	4 d	3
S 24	CARRIAGE TO THE OPERATING SITE OUTSIDE FRANCE Move to the operating site 5 h	6	6
S 25	OPERATION OF THE SYSTEM OUTSIDE FRANCE Tactical use	10 months	3
S 26	CARRIAGE FOR TACTICAL USE OUTSIDE FRANCE Tactical move	2 h	40

Examples of environmental factor summary tables

Environmental factor summary table		MECHANICAL ENVIRONMENT																										
SITUATIONS		Impact	Structural vibrations	Constant acceleration	Static compression	Static distortion	Platform motion	Slope	Acoustic vibrations	Blast																		
S1	Handling	●																										
S2.1	Logistic road transport	●	●	●																								
S2.2	Logistic rail transport	●	●	●																								
S3	Handling	●																										
S4.1	Short term storage																											
S4.2	Long term storage																											
S5	Removal from storage																											
S6	Correct operation check																											
S7	Equipment available																											
S8	Carriage for training	●	●	●																								
S9	Training type system operation																											
S10	Carriage for manoeuvres	●	●	●																								
S11	Handling	●																										
S12	Logistic rail transport	●	●	●																								
S13	Handling	●																										

Environmental factor summary table		CLIMATIC ENVIRONMENT																								
SITUATIONS		Temperature	Humidity	Solar radiation	Thermal shock	Pressure	Precipitation	Snow	**Ice**	Hail	Wind	Sand and dust	Corrosive atmospheres	Fluid contamination	Immersion	Water jet	Mould									
S1	Handling	●	●	●		●	●	●		●	●	●														
S2.1	Logistic road transport	●	●	●		●	●	●	●	●	●	●		●												
S2.2	Logistic rail transport	●	●	●		●	●	●	●	●	●	●		●												
S3	Handling	●	●	●		●	●	●		●	●	●														
S4.1	Short term storage	●	●																							
S4.2	Long term storage	●	●																							
S5	Removal from storage	●	●																							
S6	Correct operation check	●	●	●		●	●	●	●	●	●	●														
S7	Equipment available	●	●	●		●	●	●	●	●	●	●		●		●										
S8	Carriage for training	●	●	●		●	●	●	●	●	●	●		●												
S9	Training type system operation	●	●	●		●	●	●	●	●	●	●		●												
S10	Carriage for manoeuvres	●	●	●		●	●	●	●	●	●	●		●												
S11	Handling	●	●	●		●	●	●		●	●	●														
S12	Logistic rail transport	●	●	●		●	●	●	●	●	●	●		●												
S13	Handling	●	●	●		●	●	●		●	●	●														

Environmental factor summary table		ELECTROMAGNETIC ENVIRONMENT																										
SITUATIONS		Electromagnetic field	Static electricity	Nuclear	EMI Lightning																							
S1	Handling	●																										
S2.1	Logistic road transport	●			●																							
S2.2	Logistic rail transport	●			●																							
S3	Handling	●																										
S4.1	Short term storage																											
S4.2	Long term storage																											
S5	Removal from storage																											
S6	Correct operation check	●			●																							
S7	Equipment available	●			●																							
S8	Carriage for training	●			●																							
S9	Training type system operation	●			●																							
S10	Carriage for manoeuvres	●			●																							
S11	Handling	●																										
S12	Logistic rail transport	●			●																							
S13	Handling	●																										

Environmental factor summary table		MISCELLANEOUS ENVIRONMENTS																										
SITUATIONS		Bacteriological	Chemical	Heavy sea																								
S1	Handling																											
S2.1	Logistic road transport																											
S2.2	Logistic rail transport																											
S3	Handling																											
S4.1	Short term storage																											
S4.2	long term storage																											
S5	Removal from storage																											
S6	Correct operation check																											
S7	Equipment available																											
S8	Carriage for training																											
S9	Training type system operation																											
S10	Carriage for manoeuvres																											
S11	Handling																											
S12	Logistic rail transport																											
S13	Handling																											

3. BREAKDOWN INTO ENVIRONMENTAL BATCHES

3.1. General Principle

For a given set of tasks, it is possible to identify :

- the "Inputs"
  - Raw data applicable to the phase concerned and taken into account by the Environmental specialists.
  - Data applicable to the phase concerned and processed by specialists other than those working in the environmental field, of which some are the result of return of experience.
  - initial specifications for the phase concerned.

- the "Batch of Environmental Tasks"
  - The title and reference of the "Accounting for the Environment" task batch for the phase concerned.
  -

- the "Outputs"
  - The specific environmental items resulting from actions undertaken by the Environmental specialists.
  - Certain of these actions may have been undertaken by specialists in other domains, such as operational safety.

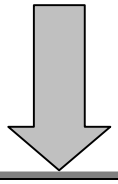
Details of each batch of tasks

The details of each batch of tasks are provided on the following pages.

3.2. Accounting for the environment in the system and equipment Functional Specification

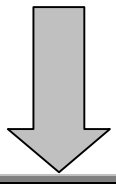
Input

- System life profile.
- Characterised operational functions (evaluation criteria and flexibility).
- Life profile – Operational functions – Evaluation criteria links.
- Broad lines and demonstrations.
- Performance broad lines regarding reliability, availability, safety, etc. for the system operational functions



Batch of Tasks

Accounting for the environment in the system and equipment Functional Specification



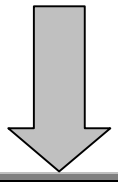
Output

- Identification of the feasibility issues which are sensitive to the environment.
- Determination of the significant environmental factors and their associated values.
- Definition of the probability of failure accepted for each performance item with respect to the environment to which it is sensitive.
- Evaluation of the technical and industrial feasibility of each concept.

3.3. Accounting for the environment in the system and equipment Technical Requirement Specification

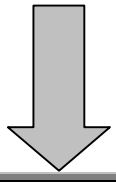
Input

- System and equipment life profile.
- Characterised operational functions (evaluation criteria).
- Life Profile – Operational functions – Evaluation Criteria links.
- Requirements and/or objectives of the demonstrations.
- Requirements regarding reliability, availability, safety of the operational functions for the system or equipment.



Batch of Tasks

Accounting for the environment in the system and equipment Technical Requirement Specification



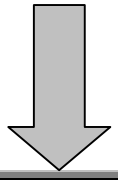
Output

- Significant environmental factors and their associated values.
- Partitioning between normal, on-limit and extreme environments.
- Updating of the environmental values made necessary by the induced effects of the design.
- Definition of the probability of failure accepted for each operational function performance item with respect to the environments to which it is sensitive.
- Updating of the specified values as a result of "in situ" measurements.

3.4. Accounting for the environment in the system and equipment design part of the Design File

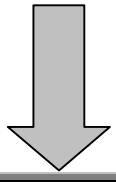
Input

- Characterised technical functions (evaluation criteria).
- Life Profile – Technical Functions (evaluation criteria) links.
- Product organisation – functional organisation links.
- Specification of the requirements in terms of sizing criteria with respect to the environment.
- List of design choices, technologies and manufacturing processes to reduce the sensitivity of the product to the Life Profile environment.



Batch of Tasks

Accounting for the environment in the system and equipment design part of the Design File



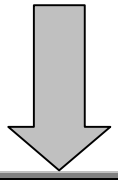
Output

- List of significant environmental factors and their associated values with respect to the SDF type functional and operational performance associated with the technical functions.
- Partitioning between the normal, on-limit and extreme environments.
- Sizing in relation to the environment criteria design files.
- Aggravated test design files.

3.5. Accounting for the environment in the system and equipment validation during design part of the Design File

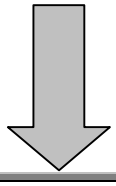
Input

- Validation objectives and corresponding validation actions with respect to the environment.
- - Assumptions made for the calculations and simulations in relation to the environment.
- - Assumptions regarding the variability of the resistance of the performance to environmental factors and regarding the variability of the environment.
- - Specification of the customised test severity requirements and associated assumptions.
- - Requirements regarding reliability, availability, safety of the equipment and system technical functions.



Batch of Tasks

Accounting for the environment in the system and equipment validation during design part of the Design File



Output

- Probability of failure accepted for each technical function performance item with respect to the environments to which it is sensitive.
- For the calculations and simulations, the environment values to be used for the demonstrations.
- Definition of the customised test severities.
- Design Justification File for the technical functions.
- Proposed design modifications resulting in an update of the Design File.

3.6. Accounting for the environment in the Design Justification File for the system and equipment

Input

- Experience and results acquired during testing, simulation, in-situ measurement, etc.

Batch of Tasks

Accounting for the environment in the Design Justification File for the system and equipment

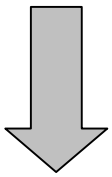
Output

- Justification of the variability of the environment considered for the establishment of the sizing criteria and for establishment of the test severities.
- Checking the content of the test documents.
- Justification that the sizing criteria do in fact meet their specification.
- Justification that the proposed test severities do in fact meet their specification.
- Justification that the real environment is indeed covered by the customised test severities.

3.7. Accounting for the environment in production (Manufacturing file and inspection file)

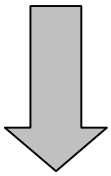
Input

- Unfolding of the manufacturing process at the various levels of assembly.
- Capability[1] of the production tools, processes, etc.
- Special requirements regarding product service life consumption resulting from the various inspection and debugging operations.



Batch of Tasks

Accounting for the environment in production (Manufacturing file and inspection file)



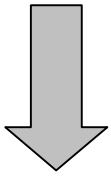
Output

- Confirmation of the assumptions made regarding the environmental factors and values linked to the manufacturing process.
- Proposed changes to the environmental debugging tests.
- Confirmation of the product performance variability tests with respect to environmental factors.
- Proposed changes to the manufacturing processes.
- Proposed changes to the product design.
- Proposed changes to the customised acceptance test severities.

3.8. Accounting for the environment during operation of the system and equipment (Operating file)

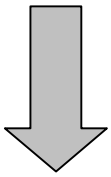
Input

- Validated life profile.
- Technical events and return of experience.



batch of Tasks

Accounting for the environment during operation of the system and equipment (Operating file)



Output

- Enrichment of the data bases (real measured environment, technical events, etc.).
- Re-adjustment of models.
- Updating of the test methods.
- Updating of debugging.
- Proposed modification of the equipment design.

- Environmental values encountered during the various phases of the programme and other values deduced from these (sizing criteria, test severities, etc.).

The environmental values and the values deduced from them adopt different forms throughout the various phases of the programme

The table below provides an overall view, whilst specifying for each phase of the programme :

- - the corresponding level of assembly,
- - the type of function concerned (operational or technical),
- - the information required in order to convert the "input" values into "output" values,
- - any special remarks.

4. ENVIRONMENTAL VALUES ENCOUNTERED DURING THE VARIOUS PHASES OF A PROGRAMME AND OTHER VALUES DEDUCED FROM THESE (SIZING CRITERIA, TEST SEVERITIES ETC...)

Programme phase		Environmental values or values deduced from these		Assembly level	Functions concerned		Information required	Special remarks
		input	output		operational	technical		
Feasibility leading to Functional Specification		standard values taken from manuals, data bases... fall-back values values from calculation models n values measured for a given event or situation	1 value representing each event or situation	system	●		system life profile description of operational functions assumptions for behavioural models level of confidence for the CVE confidence interval	the data are described for a given situation or event, in the form of values, sets of values (spectrum...) associated with a level of confidence and a statistical law, either assumed or estimated on the basis of measured results.
Design leading to Technical Requirement Specification		previous values (Functional Specification) updated with new measurements or evaluations of values taking into account of the effects induced by the design choices indication of whether the value belongs to the normal, on-limit or extreme domain	identical to above these values constitute the specified environmental values	all levels	●		life profile for all levels of assembly then identical to above	identical to Functional Specification
Development	**Design (leading to Design File)**	environment values specified in the Technical Requirement Specification at the various levels of assembly	sizing criteria	all levels		●	description of technical functions tolerated probability of failure determinist CVR taken from manuals or estimated with bracketed level of confidence	the environmental values specified for a situation, an event are synthesised by grouping together of several events or situations leading to the environmental values adopted these values must be used to influence the design choices
	Design validation (leading to Design Justification File for technical functions)	identical to above	environmental values adopted for use in the calculations and simulations customised test severities	all levels		●	identical to above, plus : level of confidence on the confidence level of the mean resistance of the performance item to the environmental factor concerned number of identical product samples subjected to a given test	identical to the above these values are used, either for calculations and simulations, or to elaborate the customised test severities
	Development validation (leading to Design Justification File for operational functions)	identical to above	identical to above but for operational functions	all levels	●		identical to above but for operational functions	identical to the above the updated values are compared to the corresponding values adopted initially. In the event of exceeding them, the deduced values may be updated if necessary.
Production		environmental measurements characterising certain events in the manufacturing process	mean synthetic values adopted per significant event of the manufacturing process acceptance specifications	all levels		●	unfolding of the production process probability of failure tolerated in relation to the significant environments generated by the production process	the values synthesised per significant event of the production process are compared with the synthesised values of the same type in the life profile. In the event of exceeding them, the deduced values may be updated if necessary