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Space systems — Early operations —

Part 2: Initialization plan

Systèmes spatiaux — Opérations initiales —

Partie 2: Plan d'initialisation

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10784-2 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

ISO 10784 consists of the following parts, under the general title *Space systems — Early operations*:

— *Part 1: Spacecraft initialization and commissioning*

— *Part 2: Initialization plan*

— *Part 3: Commissioning report*

Introduction

The three parts of ISO 10784 provide spacecraft (SC) manufacturers and operators with a specific form and format for writing SC initialization plans and commissioning reports required to configure and verify the SC to perform normal mission operations. Often, SC manufacturers and operators have defined these plans and reports uniquely for each programme, or regional, national and corporate organizations have unique initialization plans and commissioning reports. The three parts of ISO 10784 aim at establishing a common language and form for SC stakeholders. The use of one form and format will simplify stakeholder understanding of initialization and commissioning activities.

Space systems — Early operations —

Part 2: Initialization plan

1 Scope

A general definition of initialization is that it begins at separation of the spacecraft (SC) from the launcher. In some cases, a more exact definition will be that initialization begins in flight, upon planned change in mode or state of the SC from the launch configuration. Commissioning is completed when the SC, including its payload, is certified for initial mission operations. Prior to certification for mission operations, the SC is described as a test article in the three parts of ISO 10784. ISO 10784 does not include a requirement for contingency plans, but does include a statement of the need for contingency planning.

This part of ISO 10784 provides SC manufacturers and operators with a specific form and format to write spacecraft initialization plans required to configure and verify the SC to perform normal mission operations. Since the SC is considered a test article at this phase of its operational life, ISO 17566 is used as a normative reference in constructing the initialization plan. It provides SC manufacturers, operators and other stakeholders with a common language and form to verify and document spacecraft initialization prior to normal SC mission operations.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10784-1, *Space systems — Early operations — Part 1: Spacecraft initialization and commissioning*

ISO 17566, *Space systems — General test documentation*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
commissioning
certification of a spacecraft as ready for mission operations

3.1.2
early operations
period from initialization to commissioning for mission operations

3.1.3
initialization
initial functional and operational checkout of a spacecraft following separation from the launch vehicle

3.2 Abbreviated terms

LV launch vehicle

PL payload

SC spacecraft

4 Initialization plan

4.1 Introduction clause of the initialization plan

4.1.1 General

The introduction clause is a preliminary element which shall be used to give general information or commentary about the technical content of the initialization plan and about the reasons prompting its preparation. Because the spacecraft is not yet certified for operations, it is described as a test article. The introduction shall include a brief description of initialization and its objectives. It shall not contain requirements.

4.1.2 Objective

The objective subclause shall specify the desired initialization outcome in terms of SC certification, acceptance or other development. The objective may reference other clauses or subclauses which appear later in the document.

4.1.3 Scope

The scope subclause shall define, without ambiguity, the SC, the range of testing covered by the plan and the applicability of the plan in relation to fulfilling SC initialization objectives.

The initialization plan document shall provide input information for the generation of overall commissioning objectives. The initialization plan document may be a part of the overall spacecraft programme test plan.

4.1.4 Background

The background subclause is optional. If included, it may discuss the background of the spacecraft programme if that information benefits the overall understanding of the initialization plan.

4.2 Referenced documentation

4.2.1 General

This clause shall provide a list of the documents to which reference is made in the initialization plan.

Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

4.2.2 Normative references

Normative references are published standards and specifications that provide requirements or constraints for initialization. The required format for the list of normative references is shown below.

Document number	Document description	Revision level/Release date

4.2.3 Applicable references

Applicable references are programme-related documents that provide requirements or constraints for initialization. The required format for the list of applicable references is shown below.

Document number	Document description	Revision level/Release date

4.2.4 Informative references

Informative references are documents included for information only. Such references amplify or clarify the document content but do not contain requirements applicable to the initialization plan. They can be standards, other publications or drawings, for instance. The required format for the list of informative references is shown below.

Document number	Document description	Revision level/Release date

4.3 Nomenclature

4.3.1 Terms and definitions

The terms and definitions subclause shall provide the definitions necessary for the understanding of certain terms used in the initialization plan. The terms and definitions subclause shall include only those items specific to the initialization plan concerned. In some cases, a project dictionary or glossary may be referenced.

4.3.2 Symbols

The symbols subclause shall provide a list of the symbols necessary for the understanding of the initialization plan.

Unless there is a need to list symbols in a specific order to reflect technical criteria, all symbols should be listed in alphabetical order.

The symbols subclause shall include only those items specific to the initialization plan concerned.

4.3.3 Acronyms

The acronyms subclause shall provide a list of the acronyms necessary for the understanding of the initialization plan.

The acronyms subclause shall include only those items specific to the initialization plan concerned.

4.3.4 Abbreviated terms

The abbreviated terms subclause shall define the abbreviated terms used in the initialization report.

4.4 Purpose of spacecraft initialization plan

4.4.1 Overall description

This clause shall describe the overall process as it applies to the scope of the document concerned and how it relates to the initialization strategy matrix.

4.4.2 Initialization strategy matrix

The initialization strategy matrix (see ISO 10784-1) shall specify the minimum set of operational requirements to be verified within the plan and the verification strategies that will be employed to satisfy these requirements. This matrix shall also be utilized to establish pass-fail criteria within the scope of this plan. Use for the matrix the layout shown in ISO 10784-1:

Event	Time	Operational requirement	SC or PL procedure	Prerequisites or constraints	Notes

4.5 Plan description

4.5.1 General

The plan description shall provide a general description of the initialization approach.

4.5.2 Initialization approach and methodology

This subclause shall contain a description of the logic behind the initialization flow and a general description of the methods used.

4.5.3 Initialization flow

This subclause shall provide information on the flow and sequence of initialization events. Include a flow chart, waterfall chart or spreadsheet, if appropriate.

4.5.4 Spacecraft

4.5.4.1 Identification

This subclause shall specify how the spacecraft is uniquely identified (e.g. in terms of name, registration number, etc.).

4.5.4.2 Description

This subclause shall provide a general description of the spacecraft.

4.5.4.3 General configuration

This subclause shall provide information on the configuration of the spacecraft in general terms. Configuration control methods shall also be included.

4.5.5 Initialization set-up

This subclause shall provide a general description of the initialization set-up, including mechanical and electrical support equipment and facilities.

4.5.6 Specialized tools

This subclause shall describe any specialized tools to be employed in the initialization process. These might include items such as analytical tools, specialized equipment for providing mechanical support to articles, specialized equipment for providing electrical support to articles, and custom simulators and software.

4.5.7 Supporting analyses

This subclause shall provide a general description of the analysis required to be performed in support of set-up definition or plan execution.

4.5.8 Activation input data

This subclause shall provide a general description of the planned input methodology.

4.5.9 Activation output data

This subclause shall provide a description of the data which will be generated during the initialization sequence.

4.6 Initialization configuration requirements

4.6.1 Spacecraft configuration matrix

This subclause shall provide a specific identification of the spacecraft configuration. This might be in the form of the physical and electrical configuration, spacecraft modes and states and/or software versions.

4.6.2 Measured spacecraft parameters

This subclause shall contain information, measured on the SC, which is pertinent to initialization. For example, the measured mass of the SC might be included for a modal survey to aid in model verification.

4.6.3 Functional configuration

4.6.3.1 General

This subclause shall contain a detailed description of the physical and electrical SC system states for initialization.

4.6.3.2 Operational mode

Specify the operational mode in which the SC is configured for each stage of initialization. Specify if the spacecraft is in the launch, the operational or another configuration and how the operational mode is defined (solar arrays deployed, etc.).

4.6.3.3 Electrical-system state

Specify the details of how the electrical system is configured with regard to which systems are powered and operational.

4.6.3.4 Mechanical-system state

Specify the configuration and operational state of mechanical devices.

4.6.3.5 Pyrotechnic-system state

Specify the configuration and operational state of pyrotechnic ordnance devices and associated electrical systems.

4.6.3.6 Propulsion-system state

Specify the configuration and operational state of all propulsion systems and associated electrical systems.

4.6.3.7 State of other systems

Specify the configuration and operational state of all other systems.

4.7 Ground-system requirements

4.7.1 Facility identification and location

This subclause shall specify the location, name and address of the control facility.

4.7.2 Equipment

This subclause shall specify the facility equipment to be used for initialization. Equipment name, description and model numbers should be included.

4.7.3 Instrumentation

This subclause shall contain a description and listing of facility instrumentation required for the physical set-up. A table should be included containing instrumentation description, the parameters measured, model numbers, quantities, etc.

4.7.4 Interfaces to the spacecraft

This subclause shall specify the interfaces between the control facility and the SC.

4.7.5 Software

This subclause shall contain a description and listing of specific facility initialization software required for the physical set-up. Examples are software for sequence control, data analysis, data transmission, data display and plotting.

4.7.6 Data acquisition and analysis systems

This subclause shall specify the facility equipment to be used. Equipment name, description and model numbers should be included.

4.7.7 Other infrastructure required for initialization

This subclause shall specify any other facility hardware not covered in other subclauses of the document.

4.7.8 Ground-system constraints

This subclause shall specify any control facility constraints that might affect the operation, such as physical access, hours of operation or manpower availability.

4.7.9 Operational limitations on the ground system

This subclause shall specify any operational limitations on the control facility, such as test equipment load limits, crane/lifting limits, cleanliness levels, etc.

4.7.10 Ground-system safety limitations

This subclause shall specify any control facility characteristic that might produce personnel or hardware safety issues due to the characteristics of the test article or the initialization requirements.

4.8 Procedural initialization requirements

4.8.1 Set-up

4.8.1.1 General description

This subclause shall provide a general description of the set-up, including mechanical and electrical support equipment and facilities. A sketch or photo may be included for clarity.

4.8.1.2 General description

This subclause shall provide a description of how the SC and control facility are integrated for the execution of the initialization plan.

4.8.1.3 Drawings

This subclause shall specify, and if practical include, the drawings needed.

4.8.1.4 Figures

This subclause shall specify, and if practical include, the figures needed.

4.8.1.5 Schematics

This subclause shall specify, and if practical include, the schematics needed.

4.8.2 Initialization sequence

This subclause shall identify steps needed to prepare for execution of the initialization plan.

4.8.3 Supporting analyses

This subclause shall provide a general description of the analyses required to be performed in support of initialization set-up definition or execution.

4.8.4 Spacecraft operations after initialization

This subclause shall specify the operations that will occur after the initialization sequence is completed.

4.8.5 Spacecraft initialization software

This subclause shall contain a listing and description of required test software unique to the SC.

4.8.6 Calibration

This subclause shall specify the appropriate calibration reference and describe the calibration techniques.

4.8.7 Initialization conditions for contamination control on orbit

4.8.7.1 Control of contamination due to non-volatile residues

If applicable, specify the maximum non-volatile residue that is allowable during initialization.

4.8.7.2 Control of particulate contamination

If applicable, specify the maximum particulate contamination that is allowable during initialization.

4.8.8 Activation input parameters, tolerances and limits

4.8.8.1 General

This subclause shall provide a description of the planned input parameters and their limits.

4.8.8.2 Activation input levels

This subclause shall specify the initialization input levels, if applicable. A table of levels may be included for clarity of presentation.

4.8.8.3 Activation level tolerances and limits

This subclause shall specify initialization level alarm and abort limits.

4.8.9 Activation output data

This subclause shall provide a description of the data which will be generated during initialization.

4.8.10 Data acquisition

This subclause shall specify how data will be acquired and what form the data will be in. Parameters such as digital sample rates, storage parameters and full-scale ranges may be given here.

4.8.11 Data processing

This subclause shall specify how data will be processed and what the analysed output data will be. Parameters such as digital sample rates, storage parameters and full-scale ranges may be given here.

4.9 Spacecraft initialization team

4.9.1 General

Different organizations structure their teams to meet their own requirements through this complex phase. This part of ISO 10784 does not lay down requirements for team structure. However, there are functions that need to be performed for initialization to be successful. The descriptions in this subclause describe those functions and the associated personnel requirements.

4.9.2 Personnel

Key personnel shall be specified for execution of the initialization sequence of events, using the following format.

Title	Name	Phone	Email
Mission director			
Test conductor			
Systems/engineering leader			