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Space systems — Launch pad and integration site operational documents

Systèmes spatiaux — Documents opérationnels pour aire de lancement et site d'intégration

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This second edition cancels and replaces the first edition (ISO 26870:2009), which has been technically revised.

The main changes are as follows:

— “Terms and definitions” section was updated;

— information, provided in Table 1, Bibliography, was specified;

— Term 3.15 “preventive maintenance” was removed,

— new 5.2 was added.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document establishes a list of documents that personnel are intended to use during operation of the launch pad and the integration site, when multiple nations cooperate and participate in the development or operation of these sites. This document also establishes requirements for the structure and contents of operational documents and rules for their preparation. The purposes of this document are:

— to provide personnel with standardized documents containing the information and procedures necessary for effective and safe operation of the launch pad and integration site;

— to provide a procedure for applying these documents;

— to provide organizations and corporations that develop the operational documents with the common rules of their development.

Space systems — Launch pad and integration site operational documents

1 Scope

This document establishes requirements for the nomenclature, structure and contents of operational documents used at a launch pad or integration site.

When there is international participation, partnership or cooperation in the design, development, installation, test, activation or operation of a launch pad or integration site, this document applies to the development of the operational documents required for the following circumstances:

— installation, testing, activation or operation within the territory of one country of a launch pad or integration site manufactured in another country;

— joint installation, testing, activation or operation when the equipment designed and manufactured in one country is part of the launch pad or integration site designed by another country;

— training of the launch pad or integration site personnel of one country by the experts from another country.

The development and use of the operational documents described in this document are applicable to the following international launch pad or integration site operations:

a) preparation of integration site equipment to receive space vehicles and spacecraft;

b) preparation of launch pad equipment and the space complex for the launch of space vehicles;

c) space vehicle launch;

d) post-launch maintenance of the integration site and launch pad;

e) periodic maintenance of the integration site and launch pad.

2 Normative references

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

ISO 23041, *Space systems — Unmanned spacecraft operational procedures — Documentation*

3 Terms and definitions

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

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

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

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

3.1
assembly, repair and regulation manual
AM
document containing detailed descriptions of the *complex* (3.2), system operations or tests required for assembly, repair and regulation

3.2
complex
launch pad (3.7) or *integration site* (3.6)

3.3
customer
person or organization that could or does receive a product or a service that is intended for or required by this person or organization

[SOURCE: ISO 10795:2019, 3.78, modified — EXAMPLE and note 1 to entry have been removed.]

3.4
data log book
DLB
collection of documents that define the initial and current technical condition of a facility, system or item of equipment

3.5
hazard analysis
HA
determination of potential sources of danger, causes, effects, hazard level, and recommended resolution for those conditions found in either the hardware/software system, the person-machine relationship, or both, that can cause loss of personnel capability, loss of system, or loss of life/injury to the public

[SOURCE: ISO 10795:2019, 3.121, modified — The abbrevaited term "HA" has been added.]

3.6
integration site
equipment and facility designed for launch vehicle storage, assembly and testing, and launch vehicle (space rocket) and spacecraft/payload(s) integration, post-integration testing, and launch preparation, maintenance, servicing and preparation for transportation to the *launch pad* (3.7)

[SOURCE: ISO/TR 17400:2021, 3.1]

3.7
launch pad
equipment and facility designed to provide for the pre-launch and launch operations of spacecraft

[SOURCE: ISO/TR 17400:2021, 3.3]

3.8
main system
constituent part of *launch pad* (3.7) or constituent part of *integration site* (3.6) primarily responsible for providing preparation and launch of a launch vehicle or spacecraft

[SOURCE: ISO/TR 17400:2021, 3.6]

3.9
main system field testing
launch pad (3.7) or *integration site* (3.6) development phase including the testing of an assembled, fully equipped, and checked out (or factory tested) *main system* (3.8), which is conducted at the operational launch pad or integration site to determine the system readiness for further testing or operation

[SOURCE: ISO/TR 17400:2021, 3.8]

3.10
maintenance manual
MM
document containing detailed descriptions of the maintenance procedures that are required for a *complex* (3.2) or *main system* (3.8)

3.11
operation and maintenance manual
O&M manual
collection of documents that provide the information necessary to familiarize the personnel with the operation and maintenance of a facility, system or item of equipment

3.12
operational manual
OM
document containing detailed descriptions of the *complex* (3.2), system operations or tests required for space vehicle launch preparation and launch

3.13
original operational document
operational document containing the necessary original signatures or electronic version containing personal codes of the officials signing the document and protected from unauthorized changes

Note 1 to entry: Copies are supplied to users.

3.14
post-launch maintenance
activities required to repair damage to the *launch pad* (3.7) caused by launch of a space vehicle

3.15
spare part
item, part, device, tool or material required to repair and maintain a facility, system or item of equipment

3.16
spare-parts list
SPL
document that identifies all *spare parts* (3.16)

3.17
spare-part use manual
SPUI
document containing detailed descriptions of the operations or tests required to use *spare parts* (3.16)

3.18
system documentation list
SDL
list of all operational documents necessary for a given facility, system or item of equipment

3.19
test, assembly and inspection record file
TAIR file
collection of test operations, maintenance, modification, problem report or inspection documentation of a facility, system or item of equipment

Note 1 to entry: Two or more TAIR files located in the same place can be referred to as a "TAIR station".

4 General requirements

4.1 Operational-document applicability

The operational documents in this document are required for the following activities:

a) personnel training;

b) launch pad and integration site operation;

c) recording the results of launch pad and integration site operation;

d) launch pad and integration site maintenance;

e) logistics.

Operational documents that are generally developed are included in Table 1, along with their applications.

Table 1 — Types of operational documents

Code	Name	Application	
		complex	main system
SDL	System documentation list	a	a
O&M	Operation and maintenance manual	a	a
OM	Operational manual	a	a
MM	Maintenance manual	b	a
AM	Assembly, repair and regulation manual	b	b
DLB	Data log book	a	a
TAIR	Test, assembly and inspection record file	a	a
HA	Hazard analysis	b	b
SPL	Spare-parts list	c	a
SPUI	Spare-part use manual	b	b
DWG	Drawing[d]	a	a

[a] The document is mandatory.

[b] The document is optional and is developed, when required, by the customer.

[c] The document is not required.

[d] Drawings can be included in O&M, OI, MI or AI.

Depending on the type of facility, system or item of equipment, the amount of information, operational conditions or national practice, the operational documents and applications listed in Table 1 may be changed as follows:

— to add other operational documents;

— to waive operational documents deemed unnecessary;

— to combine several operational documents into one document (e.g. OM, AM and MM may be combined as a single type of manual);

— to divide an operational document into several separate documents;

NOTE The titles of the resulting separate documents can reflect their contents.

— to waive individual sections from an operational document;

— to add indispensable sections.

The SDL and the contents of operational documents for al complexes and main systems shall be determined by the corresponding developers.

4.2 Overall content requirements

Operational documents shall include the exact parameters, characteristics and other properties included in the corresponding design documents. Parameters, characteristics or properties missing from design documents shall not be included in corresponding operational documents. Operational documents shall be clear and comprehensive, with no dependence on other documents, except as noted in 4.7.

The words “ATTENTION” or “FORBIDDEN” shall precede the description of security measures.

Spelling and appearance in operational documents shall conform with ISO 23041, except in relation to illustrations.

The operational document original shall be stored by the developer of the subject complex or main system.

Each operational document shall include a list of changes or revisions in accordance with Clause 6.

4.3 Publishing medium

Operational documents shall be published and distributed either on paper or electronically, depending on the intended use of the documents, their means of control, the skill of the personnel involved and the requirements of the customer.

The paper on which operational documents are published shall not exceed (210 × 297) mm, except as noted in 4.5.

The paper and stitching chosen shall have a long term of service. The customer shall determine the means of electronic publishing and distribution.

4.4 Approval and delivery

Operational documents shall be approved in accordance with national practice and shall be delivered to the operational site before main system field testing has begun. If the subject operational document contains references to other operational documents (see 4.7), those referenced operational documents shall also be delivered to the operational site.

4.5 Illustrations

Operational documents shall include illustrations of all components mentioned in the technical description. Each component shall be identified by a number and called out in a legend in the illustration. The illustrations may be placed in the text of a document or in attachments.

A sheet dimension of (297 × 210) mm, of (297 × 420) mm or of (297 × 630) mm shall be used. On sheets of width 420 mm or 630 mm, illustrations shall be placed toward the outside margin.

4.6 Attachments

Information required for launch or launch preparations shall be included in the main text of the operational document, not in an attachment. Supplemental or minor information may be included in attachments and may be bound together with or separately from the main text of the printed operational document. Attachments may be included in the electronic files of operational documents or may comprise separate files.

EXAMPLE Suitable material for attachments include illustrations, information security requirements, requirements for spare parts and instructions for specialists.

4.7 References

If it is necessary to refer to an operational document of another main system, the reference shall identify:

— the main system;

— the code of the operational document (see Table 1);

— the document title;

— the document number;

— any other specific information that helps identify the other document.

If the operation process does not accommodate a pause or stopping point in the process, references to operational documents of other main systems are prohibited.

If it is necessary to refer to a structural element of the main system, the reference shall identify the design document for the main-system structural element.

If the components and materials used in the main system are required to conform to an established standard, the reference shall fully identify that standard.

5 Specific content requirements

5.1 System documentation list (SDL)

The operational documents developed for the facility and system shall be indicated in a facility SDL. All operational documents developed for the main system and SDLs for the components are indicated in a main system SDL.

The SDL shall reflect the number and title of each operational document exactly as they appear in the original operational document.

The location of the operational document shall be indicated explicitly. The location may change depending on the activity being performed (e.g. one site – at transportation and the other location is where the main system is operated).

5.2 Material Review Board (MRB)

In addition to procedures and management processes for nominal operations, a Material Review Board or equivalent operating construct shall be created as a standard anomaly handling mechanism to remediate any off-nominal situations that are deemed by the decision authority to have potentially introduced unacceptable risk at the launch site, to operations, and/or to the mission.

NOTE The MRB then negotiates a path forward jointly between involved programs and their supporting contractors. MRBs may then elevate in participation and/or scope depending on the nature of the non-conformance, level of damage, or impact to operations/launch.

5.3 Operation and maintenance (O&M) manual

The O&M manual shall be provided by the developer of the complex or the main system, and shall consist of the following sections:

a) “Introduction”, which shall include the following subsections and, if necessary, other general information:

   1) “Technical description of use and structure”;

2) “Main-system modifications” (if any);

3) “Hazards”, if the complex or the main system can create them;

b) “Description of the design and principles of the operation”, which shall include the following subsections:

1) “Technical characteristics”;

2) “Use”, which shall identify the facility, system or item of equipment, and the scope;

3) “Operating parameters” of the facility, system or item of equipment;

EXAMPLE Maximum number of launches per year or required fuelling duration.

4) “Structure”, which shall identify the main components and their configuration, complete sets of spares and fittings, and any modifications;

5) “Design description”, which shall include the design of the facility, system or item of equipment and its parts, describing the interaction and connection of the parts and their interfaces with the other systems or items of equipment;

NOTE 1 It can be beneficial to divide some information and present it in separate subsections in accordance with personnel function or discipline (e.g. operation, maintenance, quality assurance).

6) “Operation principles”, which shall include operation principles of the facility, system, item of equipment and parts;

NOTE 2 It can be beneficial to divide some information and present it in separate subsections in accordance with personnel function or discipline (e.g. operation, maintenance, quality assurance).

7) “Tools, fittings and means of measurement”, which shall include the use, location and basic activities required for operation;

8) “Marking and sealing”, which shall include content and location;

9) “Packaging”, which shall include systems and components, if necessary.

5.4 Operational manual (OM)

The developers of the complex or the main system, together with the operating organization, shall prepare the operational manual, which shall consist of the following sections:

a) “Introduction”, which shall include the following subsections, as well as other general information, if necessary:

1) “Purpose and structure”;

2) “Personnel training level”;

3) “Hazards”, if the complex or the main system can create them;

b) “Limitation”, which shall quantitatively define and control the parameters required for proper security and operation of the facility, system or item of equipment;

c) “Operation preparation”, which shall include step-by-step procedures to verify and validate the readiness of the facility, system or item of equipment for operation, including the following subsections:

1) “Safety rules and procedures”;

2) “Efficiency of connecting to power systems”;

3) “Oil and lubrication”;

4) “Exterior”;

5) “Workstations”;

6) “Means of measurement”;

7) “Proper positioning of controls”;

8) “Support systems” (ventilation, water supply, etc.);

9) “Problems likely to occur during operation preparation”;

10) “Preparation for various degrees of readiness”;

NOTE It can be beneficial to establish a subsection to address each degree of readiness.

11) “Confirmation of readiness”;

d) “Operation”, including the following subsections:

1) “Initial condition”;

2) “Operation modes”;

3) “Operation procedures”;

4) “Characteristic monitoring”;

5) “Mode sequence”;

6) “Work stoppage procedure”;

7) “Initial-state reduction procedure”;

8) “Problems likely to occur during operation”;

e) “Emergency operations”, which shall include step-by-step procedures for the following subsections:

1) “Fire”;

2) “Explosion”;

3) “Breakdown”;

4) “Failure”;

5) “Emergency evacuations”;

6) “Other hazards”;

f) “Modification”, which shall include the following subsections, if applicable:

1) “Limitations” [see b) in this subclause];

2) “Operation preparation” [see c) in this subclause];

3) “Operation” [see d) in this subclause];

4) “Emergency operations” [see e) in this subclause].

IMPORTANT — In the operational-manual section, references shall not be made to other documents (including the documents on the facility, system or item of equipment).

5.5 Maintenance manual (MM)

The developers of the subject complex or main system, together with the operating organization, shall create the maintenance manual for the facility, system or item of equipment, which shall consist of the following sections:

a) "Specific hazards" to the facility, system or item of equipment being maintained or repaired and to the associated personnel;

b) "Safety measures";

c) "Number, skill levels and training levels required of the personnel involved";

d) "Required tools and materials";

e) "Condition before maintenance or repair";

f) "Maintenance and repair parameters", which shall include the number and types of facilities, systems or items of equipment to receive the particular maintenance or repair activity, the frequency of the activity and the duration and permissible conditions for performing the activities;

g) "Step-by-step procedures";

h) "Performance checks";

i) "Supervision", which shall include the frequency and order of supervisory activities, as stipulated by the particular normative documents;

j) "Conservation", which shall include a list of internal and external conservation activities and materials required for activation;

k) "Storage", which shall include the following subsections:

   1) "Documents" (records of the beginning and ending of storage);

   2) "Components with limited terms of storage";

   3) "Storage preparation activities";

   4) "Duration of storage" (for different climatic conditions);

l) "Transportation", which shall include the following subsections:

   1) "Parameters" (speed, overload, etc.);

   2) "Preparation for transportation" activities;

   3) "Attaching" (methods for different transport devices);

   4) "Loading and unloading sequence";

   5) "Transportation device" (name and mark if a specific transportation device is required).

5.6 Assembly, repair and regulation manual (AM)

The assembly, repair and regulation manual is created by the developers of the facility, system or item of equipment, together with the assembling and operation organizations, and shall contain the following sections:

a) "Introduction", which shall include the following subsections:

   1) "Purpose and scope of application";

   2) "Addendums" (list);

3) “Designations of components delivered for installation”;

b) “General directions”, which shall include general technical and organizational directions on performing tasks;

c) “Safety measures” (fire, explosion, high voltage, etc.);

d) “Assembly and connection preparation”, which shall include the following subsections for each component:

1) “Requirements for transportation to the assembly location”;

2) “Unpacking requirements”;

3) “Inspection and verification requirements”;

4) “Assembly location requirements and validation of conformance”;

5) “Reactivation procedure”;

6) “Verification procedures (before mounting and connection)”;

e) “Assembly and disassembly”, where a sequence of activities is performed to install and remove the component; the necessary equipment, rigging, tooling and materials are also considered;

IMPORTANT — It is not allowed to write: “Sequence of assembly: step 1, step 2, step 3, etc.”, “Disassembly in return sequence”. It is necessary to write: “Sequence of assembly: step 1, step 2, step 3, etc.”, “Sequence of disassembly: step 3, step 2, step 1”.

f) “Adjustment, connection and testing”, which shall include the following subsections:

1) “Adjustment and connection” (list of activities);

2) “Pretest activities”;

3) “Test methods” (procedures);

g) “Testing”, which shall include the following subsections:

1) “Test conditions” (time, work mode, terms and volume of maintenance, etc.);

2) “Test in modes” (operation with or without a load, measurement of operation (hours, kilometres, etc.), rules for load removal;

3) “Measurable parameters” (values for the control: isolation resistance, vibration, beats, oil pressure, noise level, etc.);

4) “Activation and shutdown” (procedures);

5) “Check of serviceability”, which shall include components and definitions of their readiness;

6) “Prelaunch activities” (including inspection);

7) “Launch provision” (consumption of energy, materials, etc.);

8) “Estimation of launch results” (methods);

h) “Control methods and procedures” (sequenced), which shall include the following subsections for each mode of operation:

1) “Control parameters” (conditions at which control is executed: during movement, at stopping, upon attaining or deviating from a specific voltage, etc.);

2) "Control procedure";

i) "Comprehensive test", after execution of control;

j) "Acceptance", which shall include the following subsections:

1) "Control opening" (list of components for control opening);

2) "Sealing" (instruction on fixation and sealing after completion of all operations);

3) "Marking".

ISO/TR 17400 specifies the organization, procedures and documents for delivery/acceptance in operation.

5.7 Data log book (DLB)

The DLB documentation is prepared by the developers of the facility, system or item of equipment, and is included in the DLB as sections. The mandatory sections of, and requirements for, compiling and approving the DLB are as follows:

a) "General directions", which shall include a general statement about what should be included in the DLB and how personnel should use or compile the DLB;

b) "Technical characteristics", which is provided by the developer and shall include the following subsections:

1) "Operational characteristics" (hoisting capacity, pump output, speed, etc.; specified characteristics are identified in design documentation and actual characteristics are observed during tests);

2) "Reliability", which shall include guarantees;

3) "Power supply parameters";

EXAMPLE Voltage; required power.

4) "Commencement of operation" (title, number and date of the document authorizing the operation);

5) Other characteristics necessary for identification;

c) "Hazards", which is identified by the developer and shall include the sources of the hazards (mechanical, electrical, chemical, temperature, etc.);

d) "List of delivered components", which is provided by the developer and shall include the following subsections:

1) "Components" (names, manufacturers' part numbers or other identifiers, and quantities of all components);

2) "Spare parts, tools, fittings and measurement means" (designations, names and quantities);

3) "Limited-life or limited-guarantee components" (designations, names and quantities of components having guarantee periods shorter than that of the system);

4) "Operational documentation", which shall include a list of the operational documents for the facility, system and components, if any;

e) "Customer opinion", which is provided and signed by the customer and shall include the opinion about the conformity of the facility, system or item of equipment to the design documentation;

f) "Developer opinion", which is provided and signed by the developer and shall include the opinion on the possibility of the next test complex (main system) or its operation;

g) "Technical resource and guarantee", which is provided by the developer and shall include the following subsections:

   1) "Service life" (either the total anticipated duration of service, or the total anticipated number of cycles of complex or main-system operation, or both);

   2) "Lifetime" (duration of complex or main-system efficient operation, which shall include the periods between launch and storage);

   3) "Guarantee", which shall include the following items of information:

      i) one or more of the following guaranteed by the manufacturer:

         a) a time interval,

         b) a total duration,

         c) a number of cycles;

      ii) a list of components (designations, names, warranty values, terms of component replacement) that have a guarantee shorter than that of the main system;

      iii) conditions of guarantee action;

      iv) storage duration and conditions;

h) "Conservation", which shall include the information on conservation, activation and reconservation during shipping or storage (the first record is made by the manufacturer; subsequent records are made by the organizations executing conservation, activation or reconservation);

i) "Certificate of packing and sealing" (the first record is made by the manufacturer; subsequent records are made by the organizations executing packing);

j) "Certificate of acceptance", which shall include records about acceptances at all testing stages (signed by the officials approving acceptance); see ISO/TR 17400;

k) "Transfer", which shall include the information on the transfer to another user who is stipulated by the sender;

l) "Duration of operation", which is completed by the operating organization and shall include the start and end dates and times, as well as the duration of each operation;

m) "Maintenance", which is completed and signed by the operating organization and shall include records about the performed maintenance [type, date, value of resource, work-authorizing document (WAD)];

n) "Modifications or changes", which is completed by the operating organization and signed by the developer and operating organization, and which shall include the WAD, designation of the modified part or component and date of change implementation (beginning and end);

o) "Storage", which is completed by the operating organization and shall include the WAD, place and condition of storage, and start and end dates of storage;

   NOTE Conditions of storage can be indicated by references to other documents.

p) "Problem reports (PR)", which is completed and signed by the operating organization and shall include the following information for each problem:

   1) date of problem detection;

   2) designation of the problem component or part;

3) problem description;

4) possible cause;

5) developer's problem resolution recommendation (signed by the developer);

6) any corrective or preventive measures undertaken;

7) problem resolution date;

q) "Inspection", which is completed by the operating organization and signed by the official performing the inspection, and which shall include type and date of inspection and results;

r) "Repair", which is completed by the operating organization and shall include dates of repair and return to service (requires official signature from repairing organization), type of repair, designation of component under repair, and repair beginning and ending dates;

s) "Salvage", which is completed by the operating organization and shall include salvaged-item identification, date of dispatch to salvage and WAD; the organization executing salvaging shall indicate the beginning and ending dates of salvaging (official signatures are necessary);

t) "Data log book approval", which is completed and signed by the supervising officials and shall include dates, reasons and results of actions.

5.8 Test, assembly and inspection record (TAIR) file

A TAIR file shall be established if there is a large volume of DLB documentation for tests and operation, maintenance, changes or modifications, problem reports and inspections. The operator shall create the TAIR file. The TAIR file may be considered part of the DLB.

5.9 Hazard analysis (HA)

The HA shall be created by the developers, together with the operating organization. The HA shall include the following:

a) hazards (including possible emergency procedures) to which personnel are exposed during use of the facility, system or item of equipment;

b) the factors creating the hazards;

c) the means specified in the design documentation for preventing or decreasing the hazards;

d) controls ensuring implementation of safety measures;

e) marking of safety measures, or controls, or both;

f) procedures for eliminating the consequences of hazards [see also e) in 5.3].

5.10 Spare-parts list (SPL)

The SPL shall be created by the developer and shall include the following sections (which reflect designations, names, numbers, use locations and storage of spare components):

a) "Spare parts";

b) "Tools";

c) "Fittings";

d) "Materials".