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Space product assurance

Quality assurance for test centres

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Foreword

This Standard is one of the series of ECSS Standards intended to be applied together for the management, engineering and product assurance in space projects and applications. ECSS is a cooperative effort of the European Space Agency, national space agencies and European industry associations for the purpose of developing and maintaining common standards.

Requirements in this Standard are defined in terms of what shall be accomplished, rather than in terms of how to organize and perform the necessary work. This allows existing organizational structures and methods to be applied where they are effective, and for the structures and methods to evolve as necessary without rewriting the standards.

The formulation of this Standard takes into account the existing ISO 9000 family of documents.

This Standard has been prepared by the ECSS-Q-20-07 Working Group, reviewed by the ECSS Technical Panel and approved by the ECSS Steering Board.

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Contents

Introduction

This ECSS Standard was developed to ensure that test centres working for European space projects operate a quality assurance system which conforms to the requirements of the ISO 9001 Standard, the requirements of the ECSS-Q-00 and ECSS-Q-20.

This Standard refers to the requirements of the ISO 9001 Standard that are relevant to the mission of test centres working in space projects and provides additional requirements specific to the test centres. The quality management system of the test centre, or that of the organization of which it is part, is to be in conformance with these requirements.

This Standard also incorporates the requirements from ISO/IEC 17025 which are considered applicable for test centres working for space projects.

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Scope

This Standard defines the quality assurance (QA) requirements for the operation, maintenance, management and configuration control of test centres for space applications. It also defines the requirements for the treatment of test specimens and the development of test facilities.

This Standard applies to test centres as self-standing organizations, or those belonging to a parent organization. Separate procedures are not required in the latter case if activities are controlled by the implementation of parent organization procedures.

When viewed in a specific project context, the requirements defined in this Standard should be tailored to match the genuine requirements of a particular profile and circumstances of a project.

NOTE Tailoring is a process by which individual requirements of specifications, standards and related documents are evaluated and made applicable to a specific project by selection, and in some exceptional cases, modification of existing or addition of new requirements.
[ECSS-M-00-02A, clause 3]

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Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revisions of any of these publications do not apply. However, parties to agreements based on this ECSS Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references the latest edition of the publication referred to applies.

ECSS-P-001	Glossary of terms
ECSS-Q-70-01 [1)]	Space product assurance — Cleanliness and contamination control
ISO 9001:2000	Quality management systems — Requirements

1) To be published.

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Terms, definitions and abbreviated terms

3.1 Terms and definitions

The following terms and definitions are specific to this Standard in the sense that they are complementary or additional to those contained in ECSS-P-001.

3.1.1
critical operation
any operation that can result in injury to persons, significant material damage or other unacceptable consequences if not properly performed

3.1.2
modification
any change in the configuration of an existing test facility

3.1.3
QA representative
representative from the test centre management with responsibility for quality assurance

3.1.4
quality policy
overall intentions and directions of the test centre with regard to quality as formally expressed by top management

3.1.5
quality management system
management system to direct and control the test centre organization with regard to quality

3.1.6
QA staff
designated staff of the test centre, or its parent organization, properly trained, with specific responsibilities for quality assurance

3.1.7
safety policy
overall intentions and directions of the test centre with regard to safety as formally expressed by executive management

3.1.8
safety system
test centre organization structure, procedures, processes and resources needed to implement safety policy

3.1.9
test campaign
period of time which begins with the arrival of the test specimen in the test centre and ends with its departure from the test centre

3.1.10
test centre
complete entity including the organization thatwhich provides, develops and operates test facilities for space project and applications including accompanied services

3.1.11
test facility
technical plant (test equipment and associated buildings) to provide specific simulated conditions for testing equipment for space projects and applications

3.1.12
test personnel
staff having the required skills and qualification to maintain and operate the designated processes

3.1.13
test process
all activities necessary to perform a test, or a series of tests, to comply with the requirements specified in the contract

NOTE This includes test design, planning, preparation, acceptance, performance, reports, reviews and records.

3.2 Abbreviated terms

The following abbreviated terms are defined and used within this Standard:

Abbreviation	Meaning
DRD	document requirements definition
IEC	International Electrical Committee
ISO	International Organization for Standardization
FTIR	Fourier transmittance infrared
NCR	nonconformance report
NRB	nonconformance review board
PTR	post-test review
RAMS	reliability, availability, maintainability and safety
TRR	test readiness review

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Requirements

4.1 General requirements

a. ISO 9001:2000, subclause 4.1 shall apply.

b. The quality management system of the test centre, or its parent organization, shall be implemented and maintained in a transparent way to allow effective external and internal revisions or audits by customer or external authorities.

c. The test centre quality manual shall be supported by lower level documents such as:

1. quality and safety procedures;
2. standard operating procedures, work instructions and project plans;
3. records.

4.2 Documentation requirements

a. ISO 9001:2000, subclause 4.2 shall apply.

b. The test centre shall establish and maintain a documented description of the test facilities.

NOTE As shown in Figure 1, three levels of documentation support an effective quality management system.

Figure 1: Structure of quality management system documentation

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Management responsibility

5.1 Management commitment

a. ISO 9001:2000, subclause 5.1 shall apply.

b. The test centre shall define its organization and management structure, its place in the parent organization, and the relationships between management, technical operations, support services and the quality management system.

5.2 Customer focus

ISO 9001:2000, subclause 5.2 shall apply.

5.3 Quality policy

a. ISO 9001:2000, subclause 5.3 shall apply.

b. The test centre policy shall include management commitment to achieve full support to the quality management system by all personnel.

5.4 Planning

5.4.1 Quality objectives

ISO 9001:2000, subclause 5.4.1 shall apply.

5.4.2 Quality management system planning

a. ISO 9001:2000, subclause 5.4.2 shall apply.

b. The test centre shall give timely consideration to the following tasks:

1. the preparation of project and quality plans for critical processes;
2. the identification of controls, processes, equipment, fixtures, resources and skills;
3. the updating of quality control, inspection and verification techniques, including the development of new instrumentation or complex facilities;
4. the identification, in sufficient time, to develop the capability of the test centre for any measurement requirements that exceed the current known state of the art;

5. the identification of standards for maintenance and calibration of systems, sub-systems, measuring equipment and items;
6. the establishment and follow-up of clear rules to control conformity to requirements between design and acceptance by means of e.g. calculation test analysis, and simulation;
7. the assessment of risks related to customer supplied products and the required processes.

5.5 Responsibility, authority and communication

5.5.1 Responsibility and authority

ISO 9001:2000, subclause 5.5.1 shall apply.

5.5.2 Management representative

a. The quality organization shall appoint a QA (quality assurance) representative with defined authority to ensure that the quality management system is established, implemented and maintained and to report its performance to the test centre management and any needs for improvement.

b. A safety officer shall be nominated for critical and hazardous operations or tests.

NOTE The responsibility of the QA representative can also include liaison with external parties on matters relating to the test centre quality management system.

5.5.3 Internal communication

ISO 9001:2000, subclause 5.5.3 shall apply.

5.6 Management review

ISO 9001:2000, subclause 5.6 shall apply.

6

Resource management

6.1 Provision of resources

ISO 9001:2000, subclause 6.1 shall apply.

6.2 Human resources

6.2.1 General

a. The test centre shall ensure that all personnel are adequately trained to perform their assigned tasks and to comply with all safety regulations. All test centre staff and customers, conducting or supporting potentially hazardous operations in the test centre, shall receive the appropriate safety training.

b. For each test, in addition to other training, briefings shall be provided for operators on potential risks. These briefings shall include the technical preventive measures to be observed and the precautions to be taken. Briefing of operators should include dry runs of the tasks to be performed and associated emergency actions.

6.2.2 Competence, awareness and training

a. The identification of the training needs and training objectives for the test centre staff shall be carried out on a periodic basis, as a minimum once a year. The identification of needs shall also consider training for personnel being re-assigned to jobs other than those for which they were originally trained.

b. A skills and competences matrix, or an equivalent method, shall be used to identify the required competence profiles and the training requirements.

c. Personnel performing selected handling operations, such as lift and hoist operators, shall be trained and certified by an authorized function or body.

The certification shall be based on recognized (national or international) standards or regulations and granted upon objective evidence of knowledge or proficiency.

The certification shall be granted with a predefined validity and shall be renewed upon expiration after refresher training programmes have been successfully completed.

d. The training or certification records shall be kept and shall be maintained to document
   1. planned training,
   2. training or certification actually received by personnel, and
   3. validity and maintenance of certification.

6.3 Infrastructure and work environment

6.3.1 General

The test centre shall ensure that all processes are carried out under controlled conditions using suitable test facilities, test and measuring equipment (hardware and software), servicing equipment and environmental conditions as required.

In particular, the test centre shall take all the necessary provisions to ensure that the specified environmental conditions are achieved and maintained throughout the test process in order to preserve the test specimen and the test equipment, from acceptance of responsibility to return to the custody of the customer. These actions shall be planned and documented, prior to the beginning of the activities, and recorded during the execution of those activities.

6.3.2 Environmental control

In addition to the basic cleanliness control and to the specific project requirements (particulate and organic contaminants, see 6.3.3), the environmental control should consider other parameters such as inorganic contaminants, temperature, humidity, pressure, light level, electromagnetic radiation, magnetic cleanliness, vibration, ionising radiation, and acoustic environment. All relevant parameters shall be specified in the test requirements of a testing cycle. Moreover, the cleanliness level of supplies like gases and liquids shall be controlled when required by a test process.

6.3.3 Cleanliness and contamination control plan

a. The test centre shall implement a plan for cleanliness control of the facility that sets out the ways in which it is intended to achieve, to measure and to maintain the required cleanliness levels throughout the testing, handling and the storage of the test equipment and its ground support equipment (GSE) at the test site. The plan shall include:
   1. the indication of a minimum set of cleanliness levels for the facility when no specific requirements are set by the customers;
   2. the specific cleanliness levels to be verified;
   3. the methods and frequencies of checking the cleanliness levels;
   4. the procedures for the training of personnel;
   5. the cleaning procedures;
   6. the working procedures for achieving and maintaining the required cleanliness levels.

b. With respect to molecular and particulate cleanliness, the cleanliness levels shall be expressed respectively in terms of surface cleanliness and airborne contamination. The measurements shall be carried out with methods that directly measure the relevant parameter (e.g. the obscuration factors for witness plates for surface cleanliness of the test specimen). The measurements of the airborne particles and airborne molecular contaminants should not constitute a demonstration of the specimen cleanliness level, except when agreed by the customer.

c. The results of cleanliness control shall be considered as a quality record.

d. The cleanliness and contamination control programme shall be carried out in accordance with ECSS-Q-70-01.

e. For a facility where spacecraft equipment is handled, the minimum cleanliness levels of the cleanrooms for airborne particles shall be 100 000 (FED STD 209D) or M6.5 (FED STD 209E).

f. When deposited contamination levels need to be considered, the minimum levels shall be:

- deposited particles: 225 parts per million/24 h;
- deposited molecular cleanliness: 10^{-7} g/cm^2/168 h as measured by FTIR spectroscopy according to method ECSS Q-70-05 or equivalent.

Other values shall be agreed on between the customer and the test centre, according to the specific work to be performed.

6.3.4 Control of other environmental parameters

a. The test centre shall implement a suitable programme, similar to the cleanliness control programme or part of it, for environmental control of the test site.

b. The environment control programme shall set out the way in which it is intended to achieve, to measure and to maintain the required environmental control parameters, throughout the testing, handling and the storage of the test specimen and its GSE in the test site.

c. When no specific requirements are defined by the customer, the programme shall cover, as a minimum, the values to be achieved and maintained for temperature and humidity. The levels shall be:

- temperature: (22 ± 3) °C;
- relative humidity: (55 ± 10) %.

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Test process realization [2)]

7.1 Planning of the test process realization

a. ISO 9001:2000, subclause 7.1 shall apply.

b. To ensure that the specified requirements of the customer are met, the test centre shall establish and maintain documented procedures to:

1. control and verify the design of existing and new test facilities;
2. control and verify the modification of test facilities (see 7.3.7 b.);
3. control and verify the software for operating test facilities;
4. verify the operation of the test facilities;
5. verify the test planning, test preparation, test performance and test related hardware (e.g. jigs and tools) and buildings.

Annex B depicts the design and development sequences of a generic test process.

NOTE In the following subclauses, the term "design" applies to each and all collectively of the above processes.

7.2 Customer related processes

7.2.1 Determination of requirements related to the test process realization

a. ISO 9001:2000, subclause 7.2.1 shall apply.

b. The test centre shall maintain an appropriate knowledge of the technical and physical background of the technology that is provided to the customer within the contractual agreements. In addition to the contractual agreements, the test centre should agree on:

1. the support of customer test evaluation processes, e.g. to store, maintain and take care of test-relevant data;
2. the provision of a neutral consultancy service to gain test efficiency as an integrated partnership between customer and test centre skills.

[2)] If the test centre is involved in the design and development of a test facility (or its modification) as the owner or as a supplier, the term "test process" used in this clause is replaced by "test facility".

7.2.2 Review of requirements related to the test process

a. ISO 9001:2000, subclause 7.2.2 shall apply.

b. For review of requirements of routine and other simple tasks, the date and the signature of the person in the test centre responsible for carrying out the contracted work shall be sufficient.

c. For repetitive tasks, the review of the requirements related to a test service may be made only at the initial enquiry stage or on granting of the contract for on-going routine work performed under a general agreement with the customer, provided that the customer's requirements remain unchanged.

d. For review of requirements of new or complex tasks, a comprehensive set of records shall be maintained.

e. The test centre shall maintain a procedure to follow up contractual events.

f. The review shall also cover any work that is subcontracted by the test centre.

7.2.3 Customer communication

ISO 9001:2000, subclause 7.2.3 shall apply.

7.3 Design and development of the test process

7.3.1 Design and development planning

a. The test centre shall, in close cooperation with engineering and QA, identify and plan all phases of the testing process development (design, planning, preparation, acceptance, performance, report and reviews) and related servicing processes which directly affect quality. The test centre shall ensure that these processes are carried out under controlled conditions. Controlled conditions shall include the following:

   1. documented procedures defining test design, test planning, test preparation, test performance and management, test data acquisition and storage, format and contents of test reports, test reviews and inspections, tracking of the test specimen from reception to storage or delivery and test-related services, where the absence of such procedures can adversely affect the quality of the test;
   2. conformance to reference standards or codes, quality plans or documented procedures;
   3. monitoring and control of suitable test (process) parameters and test facility characteristics;
   4. the approval of test processes, procedures, facilities and equipment as appropriate or required by the customer;
   5. criteria for workmanship;
   6. suitable inspection and maintenance of test buildings, facilities, equipment and software to ensure continuing test process capability;
   7. suitable training and (where required) certification of test personnel (see 6.2).

b. The design and development activities shall be assigned to qualified personnel supported by adequate resources. The planning shall be updated as the design evolves.

c. The planning shall consider the compatibility of the design of the test processes with the installation, the execution, the servicing, the inspection and the applicable test procedures.

d. The test centre shall specify the requirements for any qualification of test processes or parts of them, including associated facilities, equipment and

personnel. Records shall be maintained for qualified processes, facilities and personnel, as appropriate or required by the customer.

e. The test centre shall apply process control to subcontracted services for test processes or parts of them as well as for maintenance services.

f. The test centre shall define organizational and technical interfaces between different groups which provide input to the design process (e.g. for engineering support required). The necessary information shall be documented and maintained.

7.3.2 Design and development input

a. Design input requirements relating to the test process realization, including applicable statutory and regulatory requirements, shall be identified, documented and their selection reviewed by the designated staff of the test centre for adequacy. Incomplete, ambiguous or conflicting requirements shall be resolved with those responsible for initiating these requirements.

b. The assessment of the risks (safety, availability, programmatic) shall be executed with methodologies agreed by the QA representative.

c. Design input shall take into consideration the results of any contract review activities (see 7.2).

7.3.3 Design and development output

ISO 9001:2000, subclause 7.3.3 shall apply.

7.3.4 Design and development review

ISO 9001:2000, subclause 7.3.4 shall apply.

7.3.5 Design and development verification

ISO 9001:2000, subclause 7.3.5 shall apply.

7.3.6 Design and development validation

ISO 9001:2000, subclause 7.3.6 shall apply.

7.3.7 Control of design and development changes

a. ISO 9001:2000, subclause 7.3.7 shall apply.

b. Configuration control of the test facilities

1. The test centre shall define the parts of the test facilities that are under configuration control. This shall include as a minimum all systems used in the test process, and all software used in the test centre.
2. The identified parts of the facilities shall be described by drawings and documents, as appropriate.
3. The test centre shall establish and maintain procedures for
   — configuration identification, and
   — configuration change control of its test facilities.
4. Any modifications of the configuration shall be performed following
   (a) a proposal for modification,
   (b) a technical review board for the evaluation of the proposal, and
   (c) a system for updating and reviewing drawings and documents.

7.4 Purchasing

7.4.1 Purchasing process

a. ISO 9001:2000, subclause 7.4.1 shall apply.

b. Selection of subcontractors should be based upon a defined set of minimum criteria. Exceptions to those minimum criteria shall be approved by the QA representative.

7.4.2 Purchasing information

ISO 9001:2000, subclause 7.4.2 shall apply.

7.4.3 Verification of purchased product

a. ISO 9001:2000, subclause 7.4.3 shall apply.

b. The test centre should include in the contract that the verification by the test centre shall not absolve the subcontractor of responsibility to provide an acceptable product nor shall it preclude subsequent rejection.

7.5 Test process and service provision

7.5.1 Realization and service provision

a. ISO 9001:2000, subclause 7.5.1 shall apply.

b. Test report

The test centre shall ensure that all tests are adequately and suitably documented in test reports. The test report shall be prepared, controlled and distributed according to the clauses relevant to the documentation and data control (see 4.2).

NOTE The DRD for the test report is defined in ECSS-E-10-02.

The test report should include as a minimum:

- name and address of the test centre and location where the test was carried out;
- names of key test centre personnel involved in the test;
- name and address of the customer;
- description and identification of the test specimen;
- date of receipt of the test specimen and date(s) of execution of the test;
- identification of the test specification or description of the method or procedure;
- description of the sampling procedure, where relevant;
- any deviations, additions to or exclusions from the test specification, and any other information relevant to the specific test;
- references to any nonconformances that occurred before and during the test campaign, including the dispositions taken;
- measurements, examinations and derived results, supported by tables, graphs, sketches and photographs as appropriate;
- a statement on measurement accuracy, where relevant;
- the agreed confidentiality level.

7.5.2 Validation of the test process and service provision

a. The test centre shall identify the need for dry-runs, rehearsals, simulations as well as the necessary level of simulation, based on:

- complexity and specificity of the test process;

- evaluation of the risks for the test specimen and the facility in case of test interruption or failure;
- adequacy of qualification's of personnel employed on the test;
- comprehensiveness and effectiveness of the end-to-end verification performed on the test set-up and facility subsystems.

b. The test centre shall follow a quality plan or documented procedure to state the required inspections or tests and the records to be established prior to the actual test run.

7.5.3 Identification and traceability

a. The test centre shall identify by suitable means (e.g. inspection, monitoring of critical parameters) and on a regular basis, the status of test buildings, facilities, equipment, software and the qualifications of responsible personnel. Records of these activities shall be maintained. Where certificates are requested to establish or maintain a defined status, these certificates are part of the records to be maintained.

b. The test centre shall identify by suitable means the development of the status of a test set-up and related documentation for the different phases of the test process, and maintain records of this status.

c. The test centre shall identify by suitable means the status of the test specimen and related documentation from receipt to delivery, and maintain records of the status, type and number of inspections that shall be executed by the test centre, if required by the customer.

d. All the test and process items as well as customer-supplied items shall be identified, if physically practical, and recorded according to a defined procedure. The identification shall be made at the earliest possible stage of the test process and shall be retained throughout all the subsequent stages of work to ensure continued configuration control.

NOTE The identification can be achieved by a permanent method of marking or engraving on the item or packaging.

e. Records shall be maintained for all items of test and measurement equipment as appropriate. Each record shall include as appropriate

- the name of the item or equipment,
- the manufacturer's name and type identification and unique identifier,
- date received and date placed in service,
- current location, and
- calibration status.

7.5.4 Control of test specimen

a. The test specimen shall be defined in its configuration on the test facility; in particular all interfaces between the test facility and test specimen shall be determined.

b. In case of a transfer of responsibility for the test specimen from the customer to the test centre, this transfer shall be contractually defined.

c. The incoming inspection and, if necessary, the handling, the transport the integration of the test set-up shall be performed following agreement with the customer.

d. Any intervention carried out by the test centre on the test specimen shall be authorized by the customer.

e. All operations performed on flight or similarly critical development items shall be covered by dedicated and detailed procedures.

f. During the period that the test centre has responsibility for the test specimen, the treatment and management of the test-specimen-related documents shall be defined and agreed by the customer.

g. For critical applications, in cases where regular pre- and post-test interventions on the specimen are required, those shall be performed by using step-by-step procedures.

7.5.5 Handling, storage, transportation, preservation and delivery

a. The test centre shall implement and maintain documented procedures, in agreement with the customer, engineering and quality assurance, which cover the safe handling, storage, transportation, preservation and delivery to the test centre of the test specimen and associated test equipment, while maintaining the required environmental conditions and taking into consideration all safety and security aspects (see clause 9).

   The procedures shall cover as a minimum:

   1. methods for handling and storage of equipment and products that prevent damage or deterioration;
   2. critical handling such as the test specimen handling;
   3. definition of responsibilities between the customer and the test centre for handling of the equipment and the test specimen;
   4. incoming inspection;
   5. transport and delivery.

   Prior to critical operations affecting the test specimen, the handling sequences shall be approved by the customer.

b. All lifting and hoisting equipment, including slings and accessories, shall be certified by an authorized body and covered by a valid certificate. The certificates and their validity periods shall be readily available to the customer.

c. The operators of lifting and hoisting devices shall be designated and certified as competent. The methods of certification shall be documented and a list of certified operators shall be maintained (see 6.2.2). Only certified operators shall be entitled to perform lifting and hoisting operations.

   Designated personnel shall brief customer personnel involved in lifting and hoisting operations inside the test centre.

d. The storage area for the test specimen and equipment shall be a designated area, clearly separated from the working area. Access control to the storage area shall be established in order to provide an adequate degree of security, as in working areas.

e. Transportation operations shall be planned and documented, as needed.

f. The test centre shall control packing, packaging and marking processes to the extent necessary to ensure conformance to specified requirements.

g. The test centre shall apply appropriate methods for preservation of the test specimen when the latter is under the test centre's control.

7.6 Calibration and maintenance control

7.6.1 Calibration control

a. ISO 9001:2000, subclause 7.6 shall apply

b. A suitable indicator for calibration status can be a label on the equipment, indicating the expiry date of the calibration. A label of a different colour should be attached to non-calibrated equipment or equipment out of calibration in order to indicate clearly the non-calibrated status.

7.6.2 Maintenance control

a. The test centre shall establish a maintenance plan for buildings, test facilities, test equipment and related software. The plan shall include the kind and the extent of activities, resources needed as well as planning of dates of performance.

b. Records of the performance of the maintenance activities shall be kept.

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8

Measurements, analysis and improvements

8.1 General

ISO 9001:2000, subclause 8.1 shall apply.

8.2 Monitoring and measurement

8.2.1 Customer satisfaction

ISO 9001:2000, subclause 8.2.1 shall apply

NOTE Suitable techniques such as questionnaires can be used to incorporate customer's perceptions and experiences to improve the quality of work.

8.2.2 Internal audit

a. ISO 9001:2000, subclause 8.2.2 shall apply.

b. The schedule of the internal audit shall be arranged so that the complete quality management system shall be audited once a year as a minimum.

c. For each internal audit, a question check-list shall be issued.

8.2.3 Monitoring and measurement of processes

ISO 9001:2000, subclause 8.2.3 shall apply.

8.2.4 Monitoring and measurement of the test activities

a. The test centre shall establish and maintain documented procedures for the inspection of the test facility and the necessary test set-up during the test execution in order to verify that the applicable requirements are met.

b. A test centre representative shall participate in the following reviews systematically held before the start of and after a formal test:

- test readiness review (TRR);
- post-test review (PTR).

c. For each test review the test centre shall define, as a minimum,

- objectives,
- input data,
- outputs,

- test centre's tasks and responsibilities, and
- customer's tasks and responsibilities.

d. The test centre shall define the minimum participation in the test review boards for TRRs and PTRs. Records of the above reviews shall be kept.

e. The test centre shall present the status of readiness of the facility to the TRR board convened to release the test activity.

f. The test centre shall assess the readiness of the facility by reviewing the following, as a minimum,

- test documentation,
- test facility, including: environmental conditions, equipment calibration, maintenance status, and facility nonconformances,
- personnel qualification and availability,
- ground support equipment (GSE) and infrastructures,
- test specimen (in case responsibility has been contractually transferred to the test centre),
- results from pre-tests (dry-runs, rehearsals), and
- final test preparation.

g. Before the PTR, the test centre shall review the following, as a minimum,

- test data packages and logbooks,
- test errors, nonconformances and related dispositions,
- certification that test data meet requirements and clearance to end-of-test phase or further testing, and
- lessons learned via the specific test (lessons learned review).

8.3 Control of nonconforming product

a. The test centre shall establish and maintain documented procedures to ensure that a test facility or test service that does not conform to specified requirements is prevented from unintended use or installation.

b. All test personnel shall be able to identify a nonconformance and issue a nonconformance report (NCR).

c. The control of the nonconformances shall be under the responsibility of the QA representative and shall provide for

- identification,
- documentation (by issuing a NCR),
- notification to the staff concerned,
- treatment in an evaluation board when relevant,
- criteria for the review and dispositions,
- collection of the NCRs for statistical evaluation, and
- lessons learned from the NCRs and their dissemination.

d. The test centre shall define the responsibilities and the authorities for the disposition of nonconformances relevant to the test centre.

e. The treatment and dispositions of the NCRs affecting the test specimen shall be performed in an evaluation board with participation of the customer's test representative, the test leader and the QA representatives.

NOTE See also ECSS-Q-20-09.

8.4 Analysis of data

ISO 9001:2000, subclause 8.4 shall apply.

8.5 Improvements

8.5.1 Continual improvement

ISO 9001:2000, subclause 8.5.1 shall apply.

8.5.2 Corrective action

ISO 9001:2000, subclause 8.5.2 shall apply.

8.5.3 Preventive action

a. ISO 9001:2000, clause 8.5.3 shall apply.

b. The outcome from the lessons learned review (see 8.2.4) shall be used to determine appropriate preventive actions.

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9

Safety and security

9.1 Scope

a. The test centre, in cooperation with safety assurance, shall define and implement a safety programme to assure the safety of all personnel as well as the customer, the test specimen and the test facilities.

b. The safety programme shall include, as a minimum,

- systematic hazard identification,
- systematic hazard elimination or reduction,
- risk analysis associated to safety,
- risk prevention measures associated to safety,
- assessment, acceptance and control of the residual risk,
- systematic identification and control of safety-critical functions, items and operations,
- definition of the necessary safety provisions, equipment and resources,
- required training of personnel,
- preparation of the associated safety and emergency procedures and instructions,
- systematic verification of safety requirements implementation, and
- planning of regular safety reviews.

c. The safety programme shall be in accordance with the applicable laws and regulations.

d. The safety programme shall be documented and supported by procedures and instructions as appropriate.

9.2 Safety policy

The management of the test centre shall be responsible for the definition and for the documentation of the test centre safety policy and objectives for, and commitment to safety. The management of the test centre shall ensure that safety is an essential part of all test-centre-related activities.

Through its safety policy, the test centre shall state that the safety programme shall be fully supported throughout the test centre and shall apply to all personnel.

9.3 Safety manual of test centre

The test centre, in cooperation with safety assurance, shall establish and maintain a safety manual that shall include the following information:

a. reference to the applicable standards and regulations;

b. responsibilities for the implementation of the safety programme;

c. safety policy;

d. references to the applicable safety and emergency instructions and procedures;

e. procedure for accident reporting.

9.4 Safety planning

9.4.1 Preparation

An effective safety plan shall be systematically developed and established for tasks where safety aspects are relevant and are not covered by the safety manual.

Safety planning can be divided into three sections, as detailed below.

9.4.2 Preventive activities

The test centre, in supporting the reliability, availability, maintainability and safety (RAMS) analysis, shall systematically identify the "critical operations" expected during all the test phases, including maintenance. The critical operations shall be performed under the surveillance of the safety staff, or designated trained staff. The test centre shall establish provisions to ensure that the safety staff, or designated trained staff, are regularly informed of all planned and ongoing test activities.

The safety staff, or designated trained staff, shall have defined authority in case personnel safety, test specimens or test facilities are at risk, to stop the test or to advise the responsible manager to stop the test.

The test centre shall systematically identify (e.g. by safety analyses) all hazards and associated risks which relate to the test centre activities.

The output and results of these analyses shall be documented and should cover, as appropriate:

a. maintenance and inspection instructions, with respect to the safety-critical items of the test facilities;

b. customer's specific safety requirements;

c. hazardous activities related to a specific test campaign. The test centre should gather information on the use of hazardous items and operations, requesting the customer to fill in a questionnaire [see annex C];

d. identify the need for specific medical, rescue or other specialized personnel to be on stand-by at the test facility during hazardous operations. Develop with the specialists and customer the contingency procedures under which the specialists intervene in the hazardous operations;

e. training and briefing rules to ensure that all employees and customer personnel are informed about the safety aspects of their working environment, the possible risks and the emergency procedures;

f. a summary and description of hazardous activities of the facility;

g. first aid management to ensure that sufficient test centre staff are adequately trained in first aid;

h. rules or procedures for operation of safety-critical items, equipment or systems;

i. instruction in the labelling of safety critical items, equipment or systems.

9.4.3 Emergency activities

The safety planning shall include activities to be followed in case of emergency. All the test centre staff shall be instructed, as a minimum, about

a. evacuation plan, including escape paths description,

b. acoustic alarm descriptions, including specific test-centre installations,

c. telephone numbers of fire brigade, security and medical service,

d. locations of first aid boxes,

e. locations of fire extinguishing aids,

f. locations of fire alarm actuators,

g. description of the specific test centre hazards,

h. method and content of communication following an incident,

i. emergency procedures related to the test facility and the test specimen, and

j. recovery procedures for the test specimen and the test facility.

9.4.4 Site security and access control

a. The test centre shall define and implement a system for security and access control to restricted areas, such as cleanrooms and all areas where test specimens or hazardous items are stored, handled or tested.

b. The test centre shall maintain a list of authorized persons who have access to restricted areas.

NOTE 1 The test centre can agree with the customer on special provisions for the security and access control of the test specimen

NOTE 2 Access control to the test facilities and cleanrooms can be implemented by:
- guard(s) posted at the entrance(s);
- a magnetic card lock system;
- an electrical door lock system;
- a camera monitoring system;
- a mechanical (normal) key system.

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Annex A (informative)

Cross-references to ISO 9001

This table indicates the cross-references between the ECSS-Q-20-07 clauses and the corresponding clauses of the ISO 9001:2000 and also identifies the deltas (additional requirements).

ECSS-Q-20-07 clause	ISO 9001:2000 clause	ECSS-Q-20-07 clause	ISO 9001:2000 clause
1		7.3.5	7.3.5
2		7.3.6	7.3.6
3		7.3.7	7.3.7 + delta
4.1	4.1 + delta	7.4.1	7.4.1
4.2	4.2 + delta	7.4.2	7.4.2
5.1	5.1 + delta	7.4.3	7.4.3
5.2	5.2	7.5.1	7.5.1 + delta
5.3	5.3 + delta	7.5.2	
5.4.1	5.4.1	7.5.3	
5.4.2	5.4.2+ delta	7.5.4	
5.5.1	5.5.1	7.5.5	
5.5.2		7.6.1	7.6
5.5.3	5.5.3	7.6.2	
5.6	5.6	8.1	8.1
6.1	6.1	8.2.1	8.2.1
6.2		8.2.2	8.2.2 + delta
6.3		8.2.3	8.2.3
7.1	7.1 + delta	8.2.4	
7.2.1	7.2.1 + delta	8.3	
7.2.2	7.2.2 + delta	8.4	8.4
7.2.3	7.2.3	8.5.1	8.5.1
7.3.1		8.5.2	8.5.2
7.3.2		8.5.3	8.5.3 + delta
7.3.3	7.3.3	9	
7.3.4	7.3.4		

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Annex B (informative)

Typical process sequence

Project Step	Task	Link to subclause
Kick-off	Initializing of project, agreement and commitment with customer and project team.	7.1 Planning of the test process realization 7.2.1 Determination of requirements related to the test process realization
Planning	Preparation of a plan for the design and development activities. Typical contents: Schedule, milestones, work packages description, cost planning, and quality assurance planning.	7.1 Planning of the test process realization 7.3.1 Design and development planning
Review	Performance of documented reviews to ensure that the design concept meets the requirements. Typical review: Predesign review facility meeting	7.2.1 Determination of requirements related to test process realization 7.3.4 Design and development review
Development	Identification and description of the requirements needed for the process to be developed, including applicable laws, safety regulations and technical standards. Typical output: Definition, description of the process provided by e.g. drawings, technical notes and documents, plans and procedures for realization, verification and validation, and safety plan.	7.3.2 Design and development input 7.3.3 Design and development output 7.3.5 Design and development verification 7.3.6 Design and development validation 7.3.7 Control of design and development changes

Project Step	Task	Link to subclause
Review	Performance of documented reviews to ensure that the design output and the planned realization meets the requirements. Typical review: Design review pre-test review	7.2.1 Determination of requirements related to the test process realization 7.3.2 Design and development input 7.2.2 Review of requirements related to the test process
Purchasing	Purchasing of items or provisions to be supplied for the designated process in accordance with the planning under consideration of terms of verification and validation.	7.4 Purchasing
Integration	Where necessary, realized software and hardware shall be integrated into the specified requested system. Typical output: Test set-up, system, program, operation manual, and safety procedures	7.3.7 b. Configuration control of the test facilities 7.5.1 Realization and service provision 7.5.2 Validation of the test process and service provision 7.5.3 Identification and traceability 7.5.4 Control of test specimen 7.6 Calibration and maintenance control
Implementation	Implementation of the realized system, hardware or software. Typical output: Pretests, test readiness, acceptance reports, and inspection records	7.3.5 Design and development verification 7.3.6 Design and development validation 7.5.1 Realization and service provision 7.5.2 Validation of the test process and service provision
Realization	Realization, manufacturing or test execution in order to meet and fulfil the given tasks and requirements in accordance with the planning. Typical output: Test reports, inspection records, and operation	7.5 Test process and service provision 7.2.3 Customer communication 7.5.4 Control of test specimen 7.5.1. b. Test report
Review	Performance of documented reviews to ensure that the realized product (e.g. test, hardware, or software) is in conformity with the requirements. Typical review: Acceptance review, and post-test review	7.2.1 Determination of requirements related to testing the process realization 7.3.4 Design and development review

Annex C (informative)

Questionnaire on the use of hazardous items and operations

The customer shall be supplied with the following questionnaire, the aim of which is to identify and describe possible hazardous operations during all testing activities. The questionnaire should be used as soon as possible in the contract process.

The information from this questionnaire should be recorded and processed as input data for the design and verification of the testing process, in addition to the standard safety precautions.

On request from the test centre, the customer shall provide any certificate and training records that are required by law, e.g. pressure vessels, pyrotechnics, and lifting devices.

QUESTIONNAIRE

PART I

Do you know of any safety hazards coming from the test specimen as

a. radioactive sources and generators,
b. explosive or pyrotechnic devices, jettisonable devices,
c. mechanical energy,
d. pressurized vessels including vacuum vessels,
e. high voltages,
f. high intensity light sources and lasers,
g. radio-frequency sources,
h. toxic or aggressive chemicals,
i. outgassing products and components,
j. biological hazards,
k. low- or high-temperature devices,
l. noises, and
m. others (specify)?

PART II

Is your test specimen sensitive to major deviations from the normal environmental conditions as

a. vacuum (range of authorized pressures),
b. contamination (particles and organic),
c. light levels with spectral distribution and geometry,
d. sound levels with spectral distribution,
e. temperature ranges,
f. mechanical sensitivity (e.g. vibration, shocks, and gravity-sensitive devices),
g. humidity,
h. chemicals,
i. biological contamination,
j. electric, magnetic and electromagnetic fields, and
k. others (specify)?

All questions should be answered by YES or NO. Where the answer is YES, the following details shall be given by the customer, where applicable.

PART III

a. Brief description of each task or operation with identification of those operations considered as being hazardous.
b. Identification of the operating location for the hazardous operations within the testing area or departing and arriving areas.
c. Specific hazards to which personnel are exposed during the operation (e.g. pyrotechnics, and propellants).
d. Configuration of the test specimen prior to, during, and at completion of each hazardous operation, including all the necessary GSE.
e. Identification of the failure tolerances (e.g. redundancies, safety devices, inhibits) and the means for verifying that the failure tolerances are in place and operational.
f. Identification of any conditions that cause the operation to be considered hazardous.
g. Identification, where possible, of the safety precautions to be taken for each activity, hazardous or not, where specific guidelines shall be observed or actions taken to prevent or limit hazards.
h. Identification, where possible, of procedures involving manually controlled pressurization of systems where the maximum operating pressure can be reached.
i. Identification of organizational elements and facilities required to support the operations (e.g. safety officer, security, and medical).
j. Identification, where possible, of tools, equipment, and clothing required for the safe performance of a hazardous operation or as required by emergency procedures associated with the operation.
k. Initial identification of the emergency or contingency actions for each hazardous operation. These can contain the following information:
    - specific actions necessary to cope with emergency or contingency conditions and identify the individual directing the actions;
    - hazards unique to the operation and steps for rendering safe (e.g. pressure relief, and operation abort) to protect personnel and equipment.

l. Evidence of customer's past experience in the handling of hazardous items. Reference to previous safety procedures and hazard analyses carried out for other projects.

m. Recommendation of special provisions to be furnished by the test centre or possible test facility upgrading in order to minimize risk.

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Bibliography

ECSS-E-10-02	Space engineering — Verification
ECSS-Q-00	Space product assurance — Policy and principles
ECSS-Q-20	Space product assurance — Quality assurance
ECSS-Q-20-09	Space product assurance — Nonconformance control system
ECSS-Q-40	Space product assurance – Safety
ECSS-Q-70-05 [3)]	Space product assurance — Detection of organic contamination of surfaces by infrared spectroscopy
ECSS-M-00-02A	Space project management — Tailoring of space standards
ECSS-M-40	Space project management — Configuration management
FED STD 209	Airborne particulate cleanliness classes in cleanrooms and clean zones
ISO/IEC 17025:1999	General requirements for the competence of testing and calibration laboratories

3) To be published.

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ECSS Document Improvement Proposal

1. Document I.D.	2. Document date	3. Document title
ECSS-Q-20-07A	31 July 2002	Quality assurance for test centres

4. Recommended improvement (identify clauses, subclauses and include modified text or graphic, attach pages as necessary)

5. Reason for recommendation

6. Originator of recommendation

Name:	Organization:	
Address:	Phone: Fax: e-mail:	**7. Date of submission:**

8. Send to ECSS Secretariat

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Note: The originator of the submission should complete items 4, 5, 6 and 7.

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