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ISO 2nd Working Draft Revision, ISO/TR 14969:200X, Quality management systems ¾ Medical devices ¾ Guidance on the application of ISO 13485:2003

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2nd Working Draft Revision of ISO TR14969:2003 Quality management systems ¾ Medical devices ¾ Guidance on the application of ISO 13485:2003

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 3.
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.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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

ISO /TR 14969:2003 was prepared by Technical Committee ISO /TC 210, WG1.

This first TR edition cancels and replaces ISO 14969:1999, which has been technically revised.

Throughout this TR, the text of ISO 13485 appears in Times Roman font, enclosed in shaded boxes, preceding the guidance that applies to it.

0 Introduction

0.1 General

This International Standard specifies requirements for a quality management system that can be used by an organization for the design and development, production and installation and servicing of medical devices, and the design, development, and provision of related services.

It can also be used by internal and external parties, including certification bodies, to assess the organization's ability to meet customer and regulatory requirements.

It is emphasized that the quality management system requirements specified in this International Standard are complementary to technical requirements for products.

The adoption of a quality management system should be a strategic decision of an organization. The design and implementation of an organization's quality management system is influenced by varying needs, particular objectives, the products provided, the processes employed and the size and structure of the organization. It is not the intent of this International Standard to imply uniformity in the structure of quality management systems or uniformity of documentation.

There is a wide variety of medical devices and some of the particular requirements of this International Standard only apply to named groups of medical devices. These groups are defined in clause 3.

0 Introduction

0.1 General

This Technical Report provides guidance to assist in the development, implementation, maintenance and improvement of medical device related quality management systems which meet the requirements of ISO 13485. This standard specifies the quality management system requirements for medical devices for regulatory purposes (see annex A). ISO 13485 accommodates the previous ISO 13488 by permissible exclusion as specified in clause 1.2 of the standard.

When judging the applicability of the guidance in this Technical Report, one should consider the nature of the medical device(s) to which it will apply, the potential risk associated with the use of these devices, and the applicable regulatory requirements.

As used in this Technical Report, the term “regulatory requirement” includes any part of a law, ordinance, decree or national and/or regional regulatory requirement which applies to quality management systems of medical device manufacturers.

This document provides guidance related to quality management systems for a wide variety of medical devices. Such medical devices include active, non-active, implantable and non-implantable medical devices and in vitro diagnostic medical devices.

While not intended as requirements to be used as the basis of regulatory inspection or certification assessment activities, the guidance provided by this Technical Report has value for
— organizations seeking to implement and maintain quality management systems which comply with ISO 13485,
— quality management system assessors and Conformity Assessment Bodies having the responsibility to assess the successful implementation and maintenance of such quality management systems, and
— regulatory bodies seeking to enforce regulatory requirements based on the requirements of ISO 13485.

For organizations

The guidance given in this Technical Report is applicable to the design, development, production, installation, and servicing of medical devices of all kinds. It describes concepts and methods which can be considered by organizations which are establishing and maintaining quality management systems.

The organization has the responsibility for determining which guidance contained in this Technical Report is relevant to its operations and will be incorporated in its quality management system. The organization should understand that if it voluntarily incorporates guidance from this Technical Report into its quality management system, the guidance needs to be followed, consistent with the requirements of the organization’s quality management system. Failure to comply with those incorporated guidance can be determined to be a deficiency by those charged with the responsibility of conducting internal or external quality management system assessments, audits and inspections.

The organization should also understand that its quality management system cannot be found deficient for failure to incorporate guidance contained in this Technical Report which the organization determines is not relevant to its operations.

For quality management system assessors, Conformity Assessment Bodies, regulatory enforcement bodies

Guidance contained in this Technical Report can be useful as background information for those representing quality management system assessors, Conformity Assessment Bodies and regulatory enforcement bodies.

The guidance contained in this Technical Report should not be used for identifying specific deficiencies of quality management systems, unless such guidance is voluntarily incorporated by the organization into the documentation describing and supporting the organization’s quality management system, or unless such guidance is specifically made part of the regulatory requirements relevant to the organization’s operation.

0.2 Process approach

This International Standard is based on a process approach to quality management.

Any activity that receives inputs and converts them to outputs can be considered as a process.

For an organization to function effectively, it has to identify and manage numerous linked processes. Often the output from one process directly forms the input to the next.

The application of a system of processes within an organization, together with the identification and interactions of these processes, and their management, can be referred to as the "process approach".

0.2 Process approach

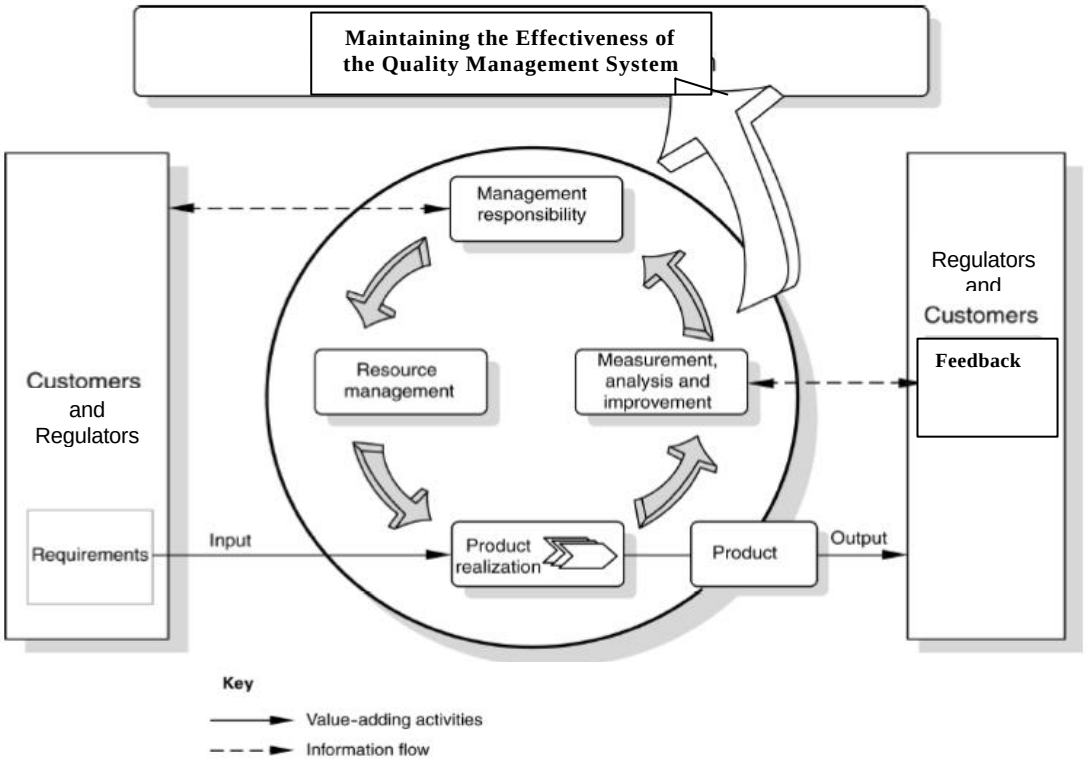


Figure 1 — Model of a process-based quality management system

ISO 13485 promotes the adoption of a process approach when developing, implementing and improving the effectiveness of a quality management system, with the objective of meeting customer requirements and providing safe and effective medical devices.

For an organization to function effectively, it has to identify and manage numerous linked activities. An activity using resources, and managed in order to enable the transformation of inputs into outputs, can be considered as a process. Often the output from one process directly forms the input to the next.

The application of a system of processes within an organization, together with the identification and interactions of these processes, and their management, can be referred to as the “process approach.”

An advantage of the process approach is the ongoing control which it provides over the linkage between the individual processes within the system of processes, as well as over their combination and interaction.

If used within a quality management system, such an approach emphasizes the importance of

— understanding and meeting requirements,
— the need to consider processes in terms of added value,
— obtaining results of process performance and effectiveness, and
— improvement of processes based on objective measurement.

The model of a process-based quality management system shown in Figure 1 illustrates the process linkages presented in clauses 4 to 8. This illustration shows that customers play a significant role in defining requirements as inputs. Monitoring of customer feedback requires the evaluation of information relating to whether the organization has met the customer requirements. The model shown in Figure 1 covers all the requirements of ISO 13485, but does not show processes at a detailed level.

NOTE In addition, the methodology known as “Plan-Do-Check-Act” (PDCA) can be applied to all processes. PDCA can be briefly described as follows.

Plan:	establish the objectives and processes necessary to deliver results in accordance with customer requirements and the organization’s policies.
Do:	implement the processes.
Check:	monitor and measure processes and product against policies, objectives and requirements for the product and report the results.
Act:	take actions to improve process performance.

0.3 Relationship with other standards

0.3.1 Relationship with ISO 9001

While this is a stand alone standard, it is based on ISO 9001.

Those clauses or subclauses that are quoted directly and unchanged from ISO 9001 are in normal font. The fact that these subclauses are presented unchanged is noted in Annex B.

Where ISO 13485 has changed in any way the text of ISO 9001, the affected sentence, or indent, as a whole is shown in italics font (and blue for electronic versions). The nature and reasons for the text changes are noted in Annex B.

0.3.2 Relationship with ISO/TR 14969

ISO/TR 14969 is a technical specification intended to provide guidance for the implementation of ISO 13485.

0.3 Relationship with other standards

0.3.1 Relationship with ISO 13485

The relationship between the standards for quality management systems for medical devices (ISO 13485 and ISO TR 14969) and the general standards for quality management systems (ISO 9001 and ISO 9004) is summarized as follows

— ISO TR 14969 provides implementation guidance on ISO 13485;
— ISO 13485 specifies a quality management system targeted at regulatory compliance in the medical devices industries. It follows the format, structure and process approach of ISO 9001. It differs from ISO 9001 in which it specifies additional regulatory requirements but excludes certain requirements for continual improvement and customer satisfaction;
— ISO 9001 is a general standard for a quality management system;
— ISO 9004 “Quality management systems – Guidelines for performance improvements” gives guidance on a wider range of objectives of a quality management system than does ISO 13485, particularly for the continual improvement of an organization’s overall performance and efficiency, as well as its effectiveness. ISO 9004 is suitable as a guide for organizations whose top management wishes to move beyond the requirements of ISO

13485, in pursuit of continual improvement of performance. However, it is not intended for certification or for contractual purposes.

The requirements standard ISO 13485 includes the generic quality management system requirements contained in ISO 9001 which are relevant to a regulated medical device organization. ISO /TR 14969, however, does not include guidance with respect to these generic quality management system requirements. Such guidance can be found in the ISO TC 176 SC2 N564-2, ISO 9001 for Small Businesses

Guidance provided in this Technical Report has taken into consideration requirements and guidance contained in documents from the following organizations
— Global Harmonization Task Force (GHTF)
— International Organization for Standardization (ISO)
— European Committee for Standardization (CEN)
— National regulatory bodies

Many of these documents are listed in the Bibliography section at the end of this document.

0.4 Compatibility with other management systems

This International Standard follows the format of ISO 9001 for the convenience of users in the medical device community.

This International Standard does not include requirements specific to other management systems, such as those particular to environmental management, occupational health and safety management, or financial management. However, this International Standard enables an organization to align or integrate its own quality management system with related management system requirements. It is possible for an organization to adapt its existing management system(s) in order to establish a quality management system that complies with the requirements of this International Standard.

0.4 Compatibility with other management systems

Conformance to ISO 13485 quality management system requirements does not automatically constitute conformity with national or regional regulatory requirements. It is the organization's responsibility to identify and establish compliance with relevant regulatory requirements.

1.0 Scope

1.1 General

This International Standard specifies requirements for a quality management system where an organization needs to demonstrate its ability to provide medical devices and related services that consistently meet customer requirements and regulatory requirements applicable to medical devices and related services.

The primary objective of ISO 13485 is to facilitate harmonized medical device regulatory requirements for quality management systems. As a result, it includes some particular requirements for medical devices and excludes some of the ISO 9001requirements that are not appropriate as regulatory requirements. Because of these exclusions, organizations whose quality management systems conform to this International Standard cannot claim conformity to ISO 9001 unless their quality management systems conform to all the ISO 9001 requirements (see Annex B).

1.0 Scope

1.1 General

This Technical Report provides guidance for the application of the requirements for medical device quality management systems contained in ISO 13485. It does not add to, or otherwise change, the requirements of ISO 13485. This guidance can be used to better understand alternative methods and approaches among many (not specifically included here) for applying the requirements of ISO 13485.

Where the term “medical devices” appears in this subclause, it has been modified to include “and related services.” This has been done because, although the definition of “product” includes “services,” the definition of “medical devices” does not. The term “related services” is restricted to those services referred to in ISO 13485.

1.2 Application

All requirements of this International Standard are specific to organisations providing medical devices, regardless of the type or size of the organization.

If regulatory requirements permit exclusions of design and development controls (see 7.3), this can be used as a justification for their exclusion from the quality management system. These regulations can provide alternative arrangements that must be addressed in the quality management system. It is the responsibility of the organization to ensure that claims of conformity with this International Standard reflect exclusion of design and development controls (see 4.2.2a and 7.3).

If any requirement(s) in clause 7 of this International Standard is not applicable due to the nature of the medical device(s) for which the quality management system is applied, the organization does not need to include such a requirement(s) in its quality management system (see 4.2.2a).

The processes required by this International Standard, which are applicable to the medical device(s), but which are not performed by the organization, are the responsibility of the organization and are accounted for in the organization’s quality management system (see 4.1a).

In this International Standard the terms “if appropriate” and “where appropriate” are used several times. When a requirement is qualified by either of these phrases, it is deemed to be “appropriate” unless the organization can document a justification otherwise. A requirement is considered “appropriate” if it is necessary for

—the product to meet specified requirements, and/or

—the organization to carry out corrective action.

1.2 Application

Certain regulatory systems provide for some medical devices to be placed on the market without having to demonstrate conformance with clause 7.3 of 13485. For those medical devices, the safety and efficacy resulting from the design and development activities are ensured by other means, such as type testing. Due to this exclusion provision, there is no longer a need for a separate quality management system standard to replace ISO 13488.

Additionally, ISO 13485 provides for the organization to not include in its quality management system certain product realization requirements (limited to those in clause 7 of the standard) which do not affect the organization’s ability, or responsibility, to provide product which meets customer and applicable regulatory requirements (see 4.1 and 7.1).

There are two important distinctions between requirements that are “excluded” and those which are “not included” in an organization’s quality management system. “Exclusion” is limited to the requirements within subclause 7.3;

and such an exclusion will be noted on the organization's quality management system certificate. Requirements "not included" may be any of those found in clause 7; but such non-included requirements will not appear on the organization's quality management system certificate.

It is important to note, however, that any exclusion or non-inclusion(s) must be justified in the organization's quality manual (see 4.2.2),

The organization can exclude from, or not include in, its quality management system, certain product realization requirements which are related to functions not performed by the organization. It is important, however, for the organization to carefully review all the requirements of clause 7, in order to identify those requirements which do apply to functions performed by the organization. Once those requirements are identified, the organization is obliged to comply with clause 7.1, and to perform the planning associated with identified product realization requirements.

For example, an organization intends to place its private label on a medical device designed, produced, and serviced by suppliers outside its quality management system, and to market this medical device. The organization intends to communicate with customers who have purchased the medical device and also have systems in place for receiving customer complaints. In this scenario, the organization is, in fact, a medical device organization and ISO 13485 applies to it. Even though the organization does not perform design and development activities, it still has obligations to meet product realization requirements within clauses 7.2, 7.4, and 7.5 of ISO 13485. Once the organization identifies those requirements, it is obliged under 7.1 of the standard to plan for the quality management system processes needed to meet those requirements.

Organizations whose quality management systems exclude design and development control (7.3 of the standard), must still comply with the product verification and validation requirements as specified in 7.1 of the standard dealing with product realization. In such organizations, the controls included in 7.3 should be considered for all changes made to the product. Such changes will require objective evidence (e.g., product verifications and validations, inspection and test specifications, revised procedures, etc.) of the results of the activities described in 7.3 of the standard.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 9000:2000, Quality management systems — Fundamentals and vocabulary.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this Technical Report. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this Technical Report 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 normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 13485:2003, *Quality systems – Medical Devices – System requirements for regulatory purposes*
ISO 9000:2000, *Quality management systems – Fundamentals and vocabulary*

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 9000 apply, together with the following.

The following terms, used in this edition of ISO 13485 to describe the supply chain, have been changed to reflect the vocabulary currently used:

supplier----------->organization---------->customer

The term "organization" replaces the term “supplier” used in ISO 9001:1994, and refers to the unit to which this International Standard applies. Also, the term "supplier" now replaces the term "subcontractor".

Throughout the text of this International Standard, wherever the term “product” occurs, it can also mean “service”.

Wherever requirements are specified as applying to "medical devices", the requirements apply equally to related services as supplied by the organization.

NOTE The following definitions should be regarded as generic, as definitions provided in national regulations can differ slightly and take precedence.

3.1 active implantable medical device: active medical device which is intended to be totally or partially introduced, surgically or medically, into the human body or by medical intervention into a natural orifice, and which is intended to remain after the procedure

3.2 active medical device: medical device relying for its functioning on a source of electrical energy or any source of power other than that directly generated by the human body or gravity

3.3 advisory notice: notice issued by the organization, subsequent to delivery of the medical device, to provide supplementary information and/or to advise what action should be taken in

— the use of a medical device,

— the modification of a medical device,

— the return to the organization that supplied the medical device, or

— the destruction of a medical device,

for the purpose of corrective or preventive action.

NOTE Issue of an advisory notice can be required to comply with national or regional regulations.

3.4 customer complaint: written, electronic or oral communication that alleges deficiencies related to the identity, quality, durability, reliability, safety or performance of a medical device that has been placed on the market

3.5 implantable medical device: medical device intended

— to be totally or partially introduced into the human body or a natural orifice, or

— to replace an epithelial surface or the surface of the eye,

by surgical intervention, and which is intended to remain after the procedure for at least 30 days,

and which can only be removed by medical or surgical intervention.

NOTE This definition applies to implantable medical devices other than active implantable medical devices.

3.6 labelling: written, printed or graphic matter

— affixed to a medical device or any of its containers or wrappers, or,

— accompanying a medical device,

related to identification, technical description, and use of the medical device, but excluding shipping documents.

NOTE Some regional and national regulations refer to "labelling" as "information supplied by the manufacturer."

3.7 medical device: (GHTF-SG1, N029R11, 2 Feb 2002) any instrument, apparatus, implement, machine, appliance, implant, in vitro reagent or calibrator, software, material or other similar or related article, intended by the manufacturer to be used, alone or in combination, for human beings for one or more of the specific purpose(s) of:

— diagnosis, prevention, monitoring, treatment or alleviation of disease,

— diagnosis, monitoring, treatment, alleviation of or compensation for an injury,

— investigation, replacement, modification, or support of the anatomy or of a physiological process,

— supporting or sustaining life,

— control of conception,

— disinfection of medical devices,

— providing information for medical purposes by means of in vitro examination of specimens derived from the human body,

and which does not achieve its primary intended action in or on the human body by pharmacological, immunological or metabolic means, but which may be assisted in its function by such means.

3.8 sterile medical device: category of medical device intended to meet the requirements for sterility

NOTE The requirements for sterility of a medical device can be subject to national or regional regulations or standards.

3 Terms and definitions

For the purposes of this Technical Report, the terms and definitions given in ISO 9000 and ISO 13485 apply.

NOTE The terms provided in annex A should be regarded as generic, as definitions provided in national regulatory requirements can differ.

4 Quality management system

4.1 General requirements

The organization shall establish, document, implement and maintain a quality management system and maintain its effectiveness in accordance with the requirements of this International Standard.

The organization shall

a) identify the processes needed for the quality management system and their application throughout the organization (see 1.2),

b) determine the sequence and interaction of these processes,

c) determine criteria and methods needed to ensure that both the operation and control of these processes are effective,

d) ensure the availability of resources and information necessary to support the operation and monitoring of these processes,

e) monitor, measure and analyse these processes, and

f) implement actions necessary to achieve planned results and maintain the effectiveness of these processes.

These processes shall be managed by the organization in accordance with the requirements of this International Standard.

Where an organization chooses to outsource any process that affects product conformity with requirements, the organization shall ensure control over such processes. Control of such outsourced processes shall be identified within the quality management system (see 8.5.1).

NOTE Processes needed for the quality management system referred to above should include processes for management activities, provision of resources, product realization and measurement.

4 Quality management system

4.1 General requirements

Achieving regulatory compliance should result from implementing and maintaining a quality management system which is designed to effectively meet customer requirements, and provide safe and effective medical devices. Managing an organization includes quality management, among other management disciplines.

After initial verification that the quality management system is capable of meeting customer and regulatory requirements and providing safe and effective medical devices, the organization can maintain the effectiveness of its established system through a range of activities, such as
— internal audits,
— management review, and
— independent external assessments.

Maintaining the effectiveness of the quality management system includes the organization responding to changes in internal and external requirements, such as
— regulatory expectations,
— customer feedback,
— vigilance reporting/medical device reporting,

— key personnel,
— standards,
— facilities,
— plant,
— machinery,
— product, and
— manufacturing processes.

Examples of activities to maintain a quality management system include
— defining and promoting processes which lead to achieving regulatory compliance,
— acquiring and using process data and information on a continuing basis,
— determining and providing resources, including human and information system resources, required to implement and maintain the quality management system,
— directing progress towards needed improvement, and
— using suitable methods to evaluate process improvement, such as internal audits and management review.

4.2 Documentation requirements

4.2.1 General

The quality management system documentation shall include

— documented statements of a quality policy and quality objectives,

— a quality manual,

— documented procedures required by this International Standard,

— documents needed by the organization to ensure the effective planning, operation and control of its processes,

— records required by this International Standard (see 4.2.4), and

— any other documentation specified by national or regional regulations.

Where this International Standard specifies that a requirement, procedure, activity, or special arrangement be “documented”, it shall, in addition, be implemented and maintained.

For each type or model of medical device, the organization shall establish and maintain a file either containing or identifying documents defining product specifications and quality system requirements (see 4.2.3). These documents shall define the complete manufacturing process and, if applicable, installation and servicing.

NOTE 1 The extent of the quality management system documentation can differ from one organization to another due to

— the size of organization and type of activities,

— the complexity of processes and their interactions, and

— the competence of personnel.

NOTE 2 The documentation can be in any form or type of medium.

4.2 Documentation requirements

4.2.1 General

Documented quality management system procedures are required for applicable requirements of ISO 13485 and should be consistent with the organization's quality policy. It is important to recognize that the structure and level of detail required in these procedures should be tailored to the needs of the organization's personnel, which will depend upon methods used and the training requirements, skills and qualifications of such personnel, as indicated in 6.2.2.

Procedures or instructions can be presented in graphic or audio-visual form. Frequently a simple set of pictures can convey the requirements more accurately than a lengthy detailed description.

Documented procedures, including work instructions and flowcharts, define activities and usually describe
— what is to be done and by whom,
— when, where, and how it is to be done,
— what materials, equipment and documents are to be used, and
— how an activity is to be controlled and recorded

Documentation should be evaluated with respect to the effectiveness of the quality management system against criteria such as
— functionality,
— human interfaces,
— resources required,
— policies and objectives, and
— interfaces used by organization's customers and suppliers.

The "file containing documents defining for each type / model of medical device," referred to in subclause 4.2.1 of the standard, is sometimes referred to by different terms (see annex A). This file can contain, or give reference to the location of, documentation relevant to the manufacture of that product. Examples of such documentation can include
— specifications for raw materials, labelling, packaging materials, intermediate and finished products,
— parts lists,
— engineering drawings,
— work instructions, including equipment operation,
— sterilization process details, if applicable,
— quality plans,
— manufacturing/inspection/test procedures, and
— acceptance criteria.

Such files can also contain quality records (see 4.2.4) such as process validation records.

This documentation forms part of the quality system and should be subject to document control procedures (see 4.2.3).

4.2.2 Quality manual

The organization shall establish and maintain a quality manual that includes

a) the scope of the quality management system, including details of and justification for any exclusion and/or non application (see 1.2)

b) the documented procedures established for the quality management system, or reference to them, and

c) a description of the interaction between the processes of the quality management system.

The quality manual shall outline the structure of the documentation used in the quality

management system.

4.2.2 Quality manual

Guidance on development of quality manuals is given in ISO 10013.

In addition, the organization's quality manual should include justification for any exclusion or non-inclusion(s) of requirements specified in clause 7 (see 1.2).

The organization should also consider including in the quality manual the generic types or categories of medical products or services which are to be covered by the quality management system.

4.2.3 Control of documents

Documents required by the quality management system shall be controlled. Records are a special type of document and shall be controlled according to the requirements given in 4.2.4.

A documented procedure shall be established to define the controls needed

— to review and approve documents for adequacy prior to issue,

— to review and update as necessary and re-approve documents,

— to ensure that changes and the current revision status of documents are identified,

— to ensure that relevant versions of applicable documents are available at points of use,

— to ensure that documents remain legible and readily identifiable,

— to ensure that documents of external origin are identified and their distribution controlled, and

— to prevent the unintended use of obsolete documents, and to apply suitable identification to them if they are retained for any purpose.

The organization shall ensure changes to documents are reviewed and approved either by the original approving function or another designated function which has access to pertinent background information upon which to base its decisions.

The organization shall define the period for which at least one copy of obsolete controlled documents shall be retained. This period shall ensure that documents to which medical devices have been manufactured and tested are available for at least the lifetime of the medical device as defined by the organization, but not less than the retention period of any resulting record (see 4.2.4), or as specified by relevant regulatory requirements.

4.2.3 Control of documents

The system established for the control of internal and external documents will usually
— include periodic review of documents, as required by the quality management system;
— assign responsibilities for preparation, approval and issue of documents,
— identify recipients of controlled copies of documents,
— ensure prompt withdrawal of obsolete copies of controlled documents,
— define a method for recording the implementation date of a document change, and
— allow controlled and non-controlled documents to be distinguished.

— Document control procedures can be assisted by the adoption of a consistent structure for the documents within the quality management system. These procedures should clearly indicate that document control information should be included in each document. Consideration should be given to the inclusion of
— title and scope,
— document reference number,
— date of issue/date effective,
— revision status,
— review date or review frequency, as required by the quality management system,
— revision history,
— the originator or author,
— the person(s) approving it,
— the person(s) issuing it,
— the distribution,
— pagination, and
— computer file reference, if applicable.

Changes to documents, including computer-based documents, are made by authorized personnel (e.g. persons with an access code to the document file to be changed). The approval of authorized changes is identified in the document or in its change history. Prevention of unauthorized changes to computer-based documents and data can be facilitated by making “read only” copies available to persons who have a need to use them but are not authorized to change them.

Retention time takes into consideration
— product life,
— legislative requirements,
— liability,
— the retention time of related records, and
— spare parts availability.

The organization has to retain at least one copy of obsolete controlled documents for at least the minimum period of time required by regulation. Obsolete documents should also be retained for as long as is necessary to understand the content of records which are related to the document (see 4.2.4).

Where the standard requires the organization “to apply suitable identification” to obsolete documents, such identification may be applied physically (as with a stamp) or electronically (as in a computerized database).

Relevant regulations are defined by the respective markets to which the organization supplies product.

To assist in determining the lifetime of the medical device for document retention purposes, an organization can consider
— the need or advisability of keeping the records forever,
— the labelled shelf life of the medical device,
— the labelled “use by” date on the medical device,
— the expiry date for devices or components which are subject to degradation over time,
— the number of cycles of use of the medical device, based on life testing of the device,
— anticipated material degradation,
— stability of packaging material,
— for sterile devices, the ability to maintain sterility,
— the organization’s ability/willingness to support service,
— spare parts availability, and
— legal advice/liability.

4.2.4 Control of records

Records shall be established and maintained to provide evidence of conformity to requirements and of the effective operation of the quality management system. Records shall remain legible,

readily identifiable and retrievable. A documented procedure shall be established to define the controls needed for the identification, storage, protection, retrieval, retention time and disposition of records.

The organization shall retain the records for a period of time at least equivalent to the lifetime of the medical device as defined by the organization, but not less than two years from the date of product release by the organization or as specified by relevant regulatory requirements.

4.2.4 Control of records

Quality records should be prepared, stored safely, protected from unauthorized access, protected from alteration and maintained by the organization. These records should be properly identified, collected, indexed and filed, and readily accessible as and if needed. They can be stored or copied in any suitable form (e.g. hardcopy or electronic media). If records are retained on electronic media, consideration of the retention times and accessibility of the records should take into account, as well as the degradation of the electronic images and the availability of devices and software needed to access the records. Such copies of quality records should contain all the relevant information captured in the original quality records.

Hand-written entries should be made in ink or other indelible medium. Persons making authorized entries on records should do so in clear legible writing, and should confirm the entry by adding their initials, signature or stamp, and the date.

If an error is made or detected on a record, it should be corrected in such a manner that the original entry is not lost and the correction is initialed and dated. If appropriate, the reason for the correction should be recorded.

A system should be in place which assures the integrity of electronic records and protects against unauthorized entries.

Organizations are required by the standard to define the lifetime of each of their products. In making such a definition, the rationale should be given, but need not be “technical’ in nature; e.g., the product lifetime could have a financial or legal basis. If the residual risk for use of the device, whether actually in use or still available for use, is anticipated to increase beyond the defined lifetime of the product, this should be documented in the risk analysis.

5 Management responsibility

5.1 Management commitment

Top management shall provide evidence of its commitment to the development and implementation of the quality management system and maintaining its effectiveness by

— communicating to the organization the importance of meeting customer as well as statutory and regulatory requirements,

— establishing the quality policy,

— ensuring that quality objectives are established,

— conducting management reviews, and

— ensuring the availability of resources.

NOTE: For the purposes of this standard, statutory requirements are limited to the safety and performance of the medical device only.

5 Management responsibility

5.1 Management commitment

It is important to note the emphasis on “top management” throughout this clause. This is intended to ensure that the quality management system is effective as a result of commitment on the part of management at the highest levels of the organization.

Management should ensure that processes operate as an effective network. Management typically analyses and optimizes the interaction of processes, including both realization processes and support processes.

Consideration should be given to
— ensuring that the sequence and interaction of processes are designed to achieve the desired results effectively,
— ensuring that process inputs, activities and outputs are clearly defined and controlled,
— monitoring inputs and outputs to verify that individual processes are linked and operate effectively,
— identifying hazards and managing risks,
— conducting data analysis to facilitate necessary improvement of processes,
— identifying process owners and giving them responsibility and authority, and
— managing each process to achieve the process objectives.

5.2 Customer focus

Top management shall ensure that customer requirements are determined and are met (see 7.2.1 and 8.2.1).

5.2 Customer focus

This clause is intended to emphasize the responsibility of top management to make certain that customer requirements are understood and the necessary resources are available, regardless of who in the organization actually undertakes the interaction with the customer. The references to 7.2.1 and 8.2.1 are pointers to what this process will be expected to cover.

To successfully discharge this responsibility, top management will have to make sure that resources are available to communicate directly with customers and to gain their agreement on product and service requirements. Information gathering to this end could involve
— seeking direct customer input on requirements,
— carrying out market/customer surveys, and
— reviewing industry reports.

It is important to note that customer requirements include any relevant legal and regulatory requirements.

5.3 Quality policy

Top management shall ensure that the quality policy

— is appropriate to the purpose of the organization,

— includes a commitment to comply with requirements and to maintain the effectiveness of the quality management system,

— provides a framework for establishing and reviewing quality objectives,

— is communicated and understood within the organization, and

— is reviewed for continuing suitability.

5.3 Quality policy

The quality policy establishes

— a commitment to quality and the continuing effectiveness of the quality management system to meet customer requirements,
— the context for quality objectives, and
— how the organization's objectives relate to its customers' requirements.

It is important that the organization's quality policy be considered when preparing the overall organization policies related to its business operations (e.g., marketing, sales, finance) in order to ensure that all organization policies are consistent and supportive of each other.

The quality policy should communicate the organization's commitment to quality, and its overall vision of what quality means to the organization's business and customers. Subclause 4.2.1 requires the organization to state this quality policy in writing.

In order to demonstrate that the organization is committed to implementing its quality policy, it will need to identify clear, overall quality goals for the business which are directly relevant to the organization and its customers.

Top management's commitment to the quality policy should be visible, active and effectively communicated. For example, a publicly displayed copy of the quality policy signed by the company's owner is one method which may be used to show that commitment to both employees and customers. Another method is to present and discuss the quality policy at organization meetings throughout the year.

All employees need to understand the quality policy, how it affects them, and their role in the quality management system. Top management has to decide on the active methods which will be used to achieve this understanding.

The quality policy also needs to be reviewed from time to time to determine if it accurately reflects the current quality related goals and objectives of the organization. This review is often carried out during the management review required in 5.6.

5.4 Planning

5.4.1 Quality objectives

Top management shall ensure that quality objectives, including those needed to meet requirements for product [see 7.1 a)], are established at relevant functions and levels within the organization. The quality objectives shall be measurable and consistent with the quality policy.

5.4.2 Quality management system planning

Top management shall ensure that

— the planning of the quality management system is carried out in order to meet the requirements given in 4.1, as well as the quality objectives, and

— the integrity of the quality management system is maintained when changes to the quality management system are planned and implemented.

5.4 Planning

5.4.1 Quality objectives

In order to put the organization's policy into effect, top management needs to establish clearly defined objectives which the organization can aim for. This does not need to be carried out personally by top management, but the responsibility is still theirs.

In setting objectives and any associated targets, timeframes for achieving the targets are usually established.

The standard now calls for objectives not only for the quality management system but also for products and services [see 7.1 a)]

Quality objectives should be realistic and related to achievable and measurable outcomes, such as

— meeting the requirements (customer, regulatory and other) for products and services,
— meeting the planned schedule,
— identifying opportunities for improvement or error reduction, and
— identifying new market opportunities.

Groups within the organization typically establish group objectives which follow from the overall organization objectives and relate to the specific activities of the group.

5.4.2 Quality management system planning

Quality planning is an important and fundamental element of a quality system. It ensures that the organization gives serious, advance thought to the key issues associated with quality system, and product-related activities targeted at providing safe and effective medical devices which meet customer requirements. It also ensures that there is sufficient documentation and effective record keeping for these planning activities. Quality planning is applicable to the design, development, manufacture, distribution, installation, and after-sale support of medical devices.

Because of the diversity of medical devices and suppliers of devices, existing quality systems standards and regulations express quality planning requirements in general terms, allowing for some flexibility in their implementation The terms "quality planning" has been defined variously within ISO quality management standards. The definition contained in ISO 9000 is more general, allowing for some flexibility in its application. The definition in ISO 8402:1994 was more instructive, including a description of the activities and documentation which are normally involved. For convenience these definitions are reproduced below:

quality planning (ISO 8402:1994, clause 3.3):

> activities which establish the objectives and requirements for quality and for the application of quality system elements.
>
> NOTE – Quality planning covers:
>
> product planning; identifying, classifying and weighting the characteristics for quality as well as establishing the objectives, requirements for quality and constraints;
>
> managerial and operational planning; preparing the application of the quality system including organizing and scheduling;
>
> the preparation of quality plans and the making of provisions for quality improvement.

quality planning (ISO 9000:2000 subclause 3.2.9):

> part of quality management . . . focused on setting quality objectives . . . and specifying necessary operational processes . . . and related resources to fulfil the quality objectives.
>
> NOTE Establishing quality plans . . . can be part of quality planning.

There are four types of quality planning carried out by an organization, as follows.

— **Planning related to the quality objectives outlined and agreed to by the organization's leadership and management.** A good example of this kind of planning is manifested in an annual quality plan which may be presented by the Management Representative or the quality systems management at an annual management review. This plan may contain the quality objectives for the next year and the action items and resources required to achieve those objectives. The most effective quality objectives in such a plan are tied to the financial and business objectives of the organization, to the organizations accepted obligations to its customers, and to the organization's regulatory objectives;

— **Planning related to the organization's existing quality system requirements, and to improvements to be made to that quality system.** A good example of this kind of planning would be that associated with the conduct of annual management reviews. Another is the planning associated with implementation of preventive or corrective actions identified during the assessment of the quality system by a regulatory agency or a Notified Body.

— **Planning related to projects for the implementation of new or modified operational processes.** A good example of this kind of planning is a process validation protocol, including predetermined acceptance criteria. Another is the project plan for incorporating a new or acquired operation into an existing facility which is under an existing quality system

— **Planning related to projects for the introduction of new or modified products.** A good example of this kind of planning is manifested in a risk analysis plan of the kind required by ISO 14971. Another example of this kind of planning is a design control plan. Another is the design validation plan, containing acceptance criteria. In each of these cases, the plan normally does not bear the word "quality" in its title.

Documentation of quality plans

In many cases, the organization's quality system requires that quality planning activities be documented (e.g., risk management plan, design validation plan, process validation plan). It is a good idea to document planning for any quality-related activity in advance of that activity being initiated, and to control these documents within the document control system (see 4.2.3).

Recording of quality planning activities

Similarly, the organization's quality system requires the recording of the interim and final results of activities which followed from quality planning (e.g., minutes from design review meetings, field evaluation reports, personnel training records). These records are stored and controlled with the record keeping requirements of the organization's quality system (see 4.2.4).

Auditing of quality planning

In auditing the control and effectiveness of quality planning within the organization, the internal auditor or external assessor typically reviews quality planning documents (e.g., individual quality plans, the Quality Manual, and quality system procedures which describe the planning activities) and the records which result from planning activities. It is important that the Management Representative, or the organization's person administering the work of the auditor or assessor, have a clear understanding of the organization's quality planning activities and the documents and records associated with these activities. The representative has the responsibility to show that effective quality planning is conducted within the quality system, even though it may not be manifested by documents specifically identified as quality plans.

5.5 Responsibility, authority and communication

5.5.1 Responsibility and authority

Top management shall ensure that responsibilities and authorities are defined, documented and communicated within the organization.

Top management shall establish the interrelation of all personnel who manage, perform and verify work affecting quality, and ensure the independence and authority necessary to perform these tasks.

NOTE Particular attention should be paid to the nomination of specific persons responsible for activities related to monitoring experience from the post-production stage and reporting adverse events (see 8.2.1 and 8.5.2).

5.5 Responsibility, authority and communication

5.5.1 Responsibility and authority

This requirement is usually achieved by means of documented position descriptions which include responsibilities and authority, and organization charts which describe the interrelation of personnel. As this documentation forms part of the quality management system it has to be controlled (see 4.2.3). Responsibilities and authority can also be included in documented procedures. Some organizations “map” quality management system processes to show the linkages between processes and the responsibilities associated with activities to be performed.

To ensure effective operation of the quality management system, designees for personnel having the responsibility and authority to make decisions which can affect the quality management system and/or the quality of medical devices are typically defined and documented.

In a number of auditing and review activities, it is important that there be participation by individuals who have the needed knowledge of, as well as organizational independence from, the subject being reviewed. Good examples of this are found in the internal quality audit activities and in design and development review.

As always be knowledgeable of and compliant with the medical device regulations of the nations and regions into which your medical devices are marketed or made available for use.

The note at the end of 5.5.1 has its origins in the harmonized standard EN 46001, section 4.14.2 “Corrective action”, where the following requirement is stated:

“If this European Standard is used for compliance with regulatory requirements which require post marketing surveillance, this surveillance shall form part of the feedback system.

All feedback information, including reported customer complaints and returned product, shall be documented, investigated, interpreted, collated and communicated in accordance with defined procedures by a designated person.”

This “by a designated person” requirement was ultimately not carried forward into the harmonized standard EN ISO 13485, but in the meantime some European countries had promulgated the requirement in their own national regulations (e.g. Germany has such a requirement).

5.5.2 Management representative

Top management shall appoint a member of management who, irrespective of other responsibilities, shall have responsibility and authority that includes

— ensuring that processes needed for the quality management system are established, implemented and maintained,

— reporting to top management on the performance of the quality management system and any need for improvement (see 8.5); and

— ensuring the promotion of awareness of regulatory and customer requirements throughout the organization.

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

5.5.2 Management representative

The functions of the management representative may be totally related to quality management system activities or may be in conjunction with other functions and responsibilities within the organization.

If the management representative has other functions to perform, there should be no conflict of interest between the responsibilities for the other functions and those relating to the quality management system.

The management representative may, in turn, delegate responsibilities for the quality management system to others in the organization; however, only one member of management may be designated by the organization as its management representative.

5.5.3 Internal communication

Top management shall ensure that appropriate communication processes are established within the organization and that communication takes place regarding the effectiveness of the quality management system.

5.5.3 Internal communication

For a quality management system to work effectively, good communication is essential. Top management needs to establish the processes which encourage people within the organization to communicate at all levels, without a 'shoot the messenger carrying bad news' syndrome. To be effective, communication processes should provide the ability to

— transmit and receive information quickly and act on it,
— build mutual trust,
— identify those processes within the quality management system which are working effectively, and
— identify opportunities for improvement.

Quality system related information should be clear and understandable and adapted to the personnel meant to use it. Examples of communication methods include posting information on bulletin boards, holding meetings or circulation of information via e-mail.

5.6 Management review

5.6.1 General

Top management shall review the organization's quality management system, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness. This review shall include assessing opportunities for improvement and the need for changes to the quality management system, including the quality policy and quality objectives.

Records from management reviews shall be maintained (see 4.2.4).

5.6 Management review

5.6.1 General

Top management should review the quality management system on a regular basis; annually could be acceptable for an established and effective quality management system. If changes are planned or being implemented, more frequent review periods are normally needed.

To ensure that the entire quality management system is covered, with particular attention being paid to those items needing management consideration, the management review should be carefully planned, organized, and attended.

People who participate in reviews should be able to contribute and take action on any outcomes.

The method of carrying out the review should suit the organization's business practices and could consist of

— formal face-to-face meetings with an agenda, minutes and formally identified action points,
— a variant of the above by teleconference or Internet links, or
— partial reviews at various levels within an organization, reporting to the executive management who review the reports.

5.6.2 Review input

The input to management review shall include information on

— results of audits,

— customer feedback,

— process performance and product conformity,

— status of preventive and corrective actions,

— follow-up actions from previous management reviews,

— changes that could affect the quality management system,

— recommendations for improvement, and

— new or revised regulatory requirements.

5.6.2 Review input

When determining subjects to be addressed during management reviews, the following should be considered

— the relevance of quality policy and objectives to current needs,
— the effectiveness of the quality management system in meeting quality objectives,
— the effectiveness of process performance,
— quality problems and actions taken,
— customer feedback, including customer complaints,
— supplier problems,
— equipment and facility deficiencies which may be causing product or service problems,
— quality audit reports (both internal and external),
— areas needing improvement/changes recommended,
— corrective and preventive actions taken as the result of risk management activities,
— new or revised regulatory requirements, and
— outstanding actions from previous reviews.

For the purposes of management review and even for the purposes of design input (see 7.3.2 of the standard), the "regulatory requirements" referred to are any laws published or otherwise enacted by any government that establish legal prerequisite conditions for

— placement on the market,
— making available for use, or
— putting into service

any medical device or related service.

Such regulatory requirements are only applicable to an organization if they have entered or plan to enter a particular market or region where such requirements exist. A portion of management review should be devoted to an understanding of the organization's regulatory compliance status as well as action plans to ensure such compliance is established and maintained.

Individual quality-related problems are usually dealt with as they occur, without waiting for the next scheduled management review meeting. Management review consideration of such problems is usually in the context of other similar problems which may indicate a trend which signals the need to improve the quality management system. Such problems may also be the subject of management reviews to determine whether the quality management system is capable of correcting the conditions which caused the problem.

5.6.3 Review output

The output from the management review shall include any decisions and actions related to

— improvements needed to maintain the effectiveness of the quality management system and its processes,

— improvement of product related to customer requirements, and

— resource needs.

5.6.3 Review output

Review output should include a statement regarding the effectiveness of the processes established for the achievement of the quality policy and objectives, and the extent to which those objectives have been achieved based on the established respective metrics.

Records of the review are kept which address all points of the review together with a description of any corrective or preventive action to be taken, the responsibility for such actions, the resources which may be needed to complete such actions, and target dates for completion, if known. The records may be in any form which suits the organization, such as notes in a daybook, formal meeting minutes or notes, which can be produced, distributed and stored on paper or electronically.

The organization should recognize that regulatory requirements are included in the "customer requirements" referred to in this subclause of the standard.

6 Resource management

6.1 Provision of resources

The organization shall determine and provide the resources needed

— to implement the quality management system and to maintain its effectiveness, and

— to meet regulatory and customer requirements.

6 Resource management

6.1 Provision of resources

The provision and maintenance of adequate resources is a prerequisite to the effective initiation, maintenance, and management of quality management system processes. The nature and quantity of such resources will be determined by the processes involved.

Consideration needs to be given by the organization's management to the identification and provision of adequate resources needed to implement its quality policy and to achieve its objectives, as well as to satisfy customer requirements inclusive of applicable regulatory requirements.

Resources can be people, infrastructure, work environment, information, suppliers and partners, natural resources and financial resources. Responsibility for provision of resources resides with the organization regardless of whether associated processes are performed by the organization itself or outsourced.

6.2 Human resources

6.2.1 General

Personnel performing work affecting product quality shall be competent on the basis of appropriate education, training, skills and experience.

6.2 Human resources

6.2.1 General

There is no specific guidance for this subclause beyond that given in 6.2.2 of this document.

6.2.2 Competence, awareness and training

The organization shall

a) determine the necessary competence for personnel performing work affecting product quality,

b) provide training or take other actions to satisfy these needs,

c) evaluate the effectiveness of the actions taken,

d) ensure that its personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the quality objectives, and

e) maintain appropriate records of education, training, skills and experience (see 4.2.4).

NOTE National or regional regulations can require the organization to establish documented procedures for identifying training needs.

6.2.2 Competence, awareness and training

The organization needs to regularly review the experience, qualifications, capabilities and abilities of personnel, especially in those areas which can affect the safety and effectiveness of the medical devices being manufactured and provided to customers.

Work allocation and assignment of personnel (6.2.1), management review (5.6), corrective action (8.5.2), preventive action (8.5.3) and internal quality audit (8.2.2) are all likely to identify areas which could indicate a need for improving the competence of personnel and the means for such improvement, be it replacement of personnel, further education or

training.

Certain tasks may require a level of competence before they can be performed properly or safely (e.g. internal quality auditing, welding, or non-destructive testing). It may be necessary for people to be qualified or formally certified for some tasks (e.g. forklift or truck driving, or surveying).

Organizations typically provide general education and training for full time, part-time, and contract personnel, tailored to the person's assignment. Such training and education should cover

— the nature of the business,
— the health, safety and environmental regulations,
— the quality policy and other internal policies,
— the role of the employee, and
— the procedures and instructions of relevance to them.

Training may be carried out in stages, and usually includes follow-up or refresher training, as needed and planned. Persons and functions who are assigned responsibility via the documented procedures of the quality management system, should receive training on those procedures.

Organizations should evaluate the effectiveness of training or other actions taken in order to ensure competency. Evaluation can consist of polling the trained employee to assess whether he or she feels they have learned the required information, evaluating the work performance of the trained individual, and reviewing the trainer assessment of training effectiveness.

Organizations should maintain records which show what competencies an employee possesses. Records are also kept of the training an employee has received and any results of that training. The records which show that the training course has been successfully completed and that competence has been achieved can be as simple or complex as necessary. At their simplest, the records may consist of 'sign-off' to confirm that personnel can now use certain equipment, carry out specific processes or follow certain procedures. The records should include a clear statement that a person is now deemed to be competent to do the task for which they were trained. The effectiveness of any further education and training should be re-evaluated, after a period, to confirm that the competence achieved is continuing.

Training should be carried out by personnel with appropriate skills, qualifications and experience. Records are typically kept to document the qualifications of the personnel used as trainers.

The level of documentation required for processes is usually determined by the level of competence required for the personnel intended to perform that process.

6.3 Infrastructure

The organization shall determine, provide and maintain the infrastructure needed to achieve conformity to product requirements. Infrastructure includes, as applicable

— buildings, workspace and associated utilities,

— process equipment (both hardware and software), and

— supporting services (such as transport or communication).

The organization shall establish documented requirements for maintenance activities, including their frequency, when such activities or lack thereof can affect product quality.

Records of such maintenance shall be maintained (see 4.2.4).

6.3 Infrastructure

Manufacturing equipment should be designed, constructed, correctly installed and located to facilitate maintenance, adjustment, cleaning and/or sterilization.

The organization should ensure that, if applicable, any inherent limitations or allowable tolerances of manufacturing equipment are documented on or near the equipment.

Documented procedures should be available for the maintenance and checking of all equipment used in production and for environmental control. The determination of the necessary adjustments and maintenance intervals should be established.

The maintenance schedule is normally posted on or near the equipment, or should be readily available. Maintenance should be carried out on schedule.

The organization should ensure that buildings utilized are of suitable design and contain adequate space to facilitate cleaning, maintenance and other necessary operations. The premises should be laid out in such a way and with sufficient allocation of space to facilitate orderly handling and to prevent mixing between incoming material, in-process batches, material scrapped, re-worked, modified or repaired, any other nonconforming material, finished devices, manufacturing equipment, inspection aids, documents and drawings.

6.4 Work environment

The organization shall determine and manage the work environment needed to achieve conformity to product requirements. The following requirements shall apply:

a) The organization shall establish documented requirements for health, cleanliness and clothing of personnel if contact between such personnel and the product or work environment could adversely affect the quality of the product (see 7.5.1.2.1).

b) If work environment conditions can have an adverse effect on product quality, the organization shall establish documented requirements for the work environment conditions and documented procedures or work instructions to monitor and control these work environment conditions (see 7.5.1.2.1).

c) The organization shall ensure that all personnel who are required to work temporarily under special environmental conditions are appropriately trained or supervised by a trained person [see 6.2.2 b)].

d) If appropriate, special arrangements shall be established and documented for the control of contaminated or potentially contaminated product in order to prevent contamination of other product, the work environment or personnel (see 7.5.3.1).

6.4 Work environment

Product quality may depend, in part, upon the production work environment. Besides the influence of process equipment, the two most significant factors which may affect product quality are
— the environment established by the facilities themselves, and
— the personnel working within that environment.

Environmental control in product realization
The need for control of the environment and the extent to which that control is exercised are dependent upon the type (e.g., active vs non-active, implantable vs non-implantable) and risk level of the product being produced.

Typical examples of device type (if “active” means powered by electricity or another energy) and associated risk level are
a) an active, low risk device,

— an active, high risk device,
— a non-active, low risk device,
— a non-active, high risk device, or
— an active or non-active, implantable device.

Examples of situations in which environmental conditions can have an effect on product quality include medical devices which are
— supplied labelled sterile (this may include product also labelled “pyrogen free”),
— supplied non-sterile and intended for sterilization before use,
— products for which microbiological and/or particulate cleanness or other environmental conditions are of significance in their use,
— products with limited shelf life, or handling or storage requirements, and
— products whose electronic microcircuits or imbedded software may be susceptible to electrostatic discharge (ESD).

During the manufacture of sterile products or products intended to be sterilized before use, or products for which viable or non-viable particulate contamination (including pyrogens) has significance in their manufacture or use, special consideration should be paid to microbial and particulate contamination levels, The organization has to ensure that if environmental conditions at the manufacturing site could have an adverse effect on the fitness of material in use, these environmental conditions are controlled to limit contamination of the material and to provide proper conditions for all operations performed. These products should be produced and packaged in a qualified, controlled environment with established specifications.

An exception to the need for a controlled environment during the entirety of manufacturing processes is if the microbial contamination can be reduced to a known, consistent, controlled level such as by a validated product cleaning and packaging process. However, even when a validated cleaning procedure is relied upon, a controlled environment still has to be established to contain the validated cleaning and packaging process.

There are various parameters, indicators and controls associated with the term environment. Each of the parameters should be evaluated to determine if lack of control could increase the risk posed by the product when put into use; i.e. the need and extent of environmental control should be traceable through the risk/hazard analysis established for the organization’s product. If the environmental conditions are of significance in its manufacturing processes, the organization should establish requirements for the environment to which the product is exposed during production (and use). For some products it may also be necessary to ensure traceability to environmental exposure; e.g. records of continuous monitoring of environmental parameters even during times when products may not be undergoing manufacturing processes, such as evenings or weekends.

Some examples of environmental parameters, indicators and controls are
— temperature,
— humidity,
— airflow,
— air filtration,
— air ionization,
— differential pressure,
— light (both spectral content and lumens),
— sound,
— vibration,
— cleanliness of work surfaces and process equipment (cleanliness, including established acceptability limits, may be based on quantification and qualification of viable and non-viable contaminant on the product and its package), and
— water quality (if product is exposed to an aqueous “environment” during its manufacturing process).

To “control” an environment is to direct, regulate, coordinate and monitor activities and variables which affect the environment such that its quality is known. Qualified and quantified parametric limits for the desired environmental quality should be established and can be used to describe the “extent’ to which control capabilities be implemented.

The “extent’ of control required will influence the type of facility construction, equipment, resources and documentation needed to establish monitor and maintain the work environment. Their synchronized implementation may be referred to as an “environmental control system.” Such a system may require validation (see 7.5.2 and 7.5.2.1). Any environmental control system should be regularly inspected to verify that the system is functioning

properly. Such systems and inspections should be documented.

For information regarding environmentally controlled cleanroom areas, see ISO 14644.

Personnel
Any persons, permanently employed or otherwise, who can come in contact with product or its environment, should be suitably clothed, clean, and in good health, if these factors could adversely affect the product. This is because individuals spread both microorganisms and particles, which constitute contamination risks.

Examples of persons who could be entering the clean room are
— manufacturing personnel, their supervisors and managers,
— material handlers,
— manufacturing engineers,
— design engineers,
— quality control, quality assurance, quality engineering,
— suppliers or subcontractors for any material or service (including cleaning services),
— persons responsible for process equipment maintenance, and
— customers.

It is also important to remember that contact with product or its environment includes those times when product is not actually being produced, such as evenings, weekends and holidays.

Persons who have a medical condition which can adversely affect the product should be excluded from those operations, or prevented from entry into such areas until they have recovered. Personnel should be instructed and encouraged to report such conditions to their supervisor. This is of particular importance in the manufacture of products which are to be supplied
— sterile,
— for sterilization before use, or
— for purposes in which microbiological cleanliness is of significance.

Training and/or supervision should be provided to persons required to perform work under special environmental conditions or within a controlled environment. Any personnel, including temporary personnel such as those involved in manufacturing, maintenance, cleaning, repair, etc., who have not been trained for performing specific tasks in a controlled environment, should not be allowed to enter unless supervised by an appropriately trained person.

Any controlled environment should also be considered a special environmental condition. Examples of a special environmental condition would be
— a room where the temperature or humidity is controlled to such low or high levels that prolonged exposure may be hazardous,
— a room or area where exhaust fans keep hazardous fumes at an acceptable level, or
— a room housing aseptic processing.

Used product
If an organization accepts returned product in any condition for any purpose, special arrangements need to be established and documented for the control of used product in order to prevent contamination of other product, the manufacturing environment or personnel. These special arrangements should also include measures to ensure that, if the returned product is returned to stock for resale, it has not been tampered with, or is equivalent to new product.

Examples of special arrangements are
— special identification as “used product” upon receipt by the organization;
— special handling, cleaning, and decontamination procedures especially for product which may have been used and is invasive, and/or used to channel or store blood or other body fluids or tissues (this also includes devices or accessories which may have come into contact with these types of devices or bodily constituents);
— special re-work, repair or refurbishment procedures inclusive of resultant product specifications and verification means, and
— special traceability means and records.

7 Product realization

7.1 Planning of product realization

The organization shall plan and develop the processes needed for product realization. Planning of product realization shall be consistent with the requirements of the other processes of the quality management system (see 4.1).

In planning product realization, the organization shall determine the following, as appropriate:

a) quality objectives and requirements for the product;

b) the need to establish processes, documents, and provide resources specific to the product;

c) required verification, validation, monitoring, inspection and test activities specific to the product and the criteria for product acceptance;

d) records needed to provide evidence that the realization processes and resulting product meet requirements (see 4.2.4).

The output of this planning shall be in a form suitable for the organization's method of operations.

The organization shall establish documented requirements for risk management throughout product realization. Records arising from risk management shall be maintained (see 4.2.4 and NOTE 3).

NOTE 1 A document specifying the processes of the quality management system (including the product realization processes) and the resources to be applied to a specific product, project or contract, can be referred to as a quality plan.

NOTE 2 The organization may also apply the requirements given in 7.3 to the development of product realization processes.

NOTE 3: See ISO 14971.

7 Product realization

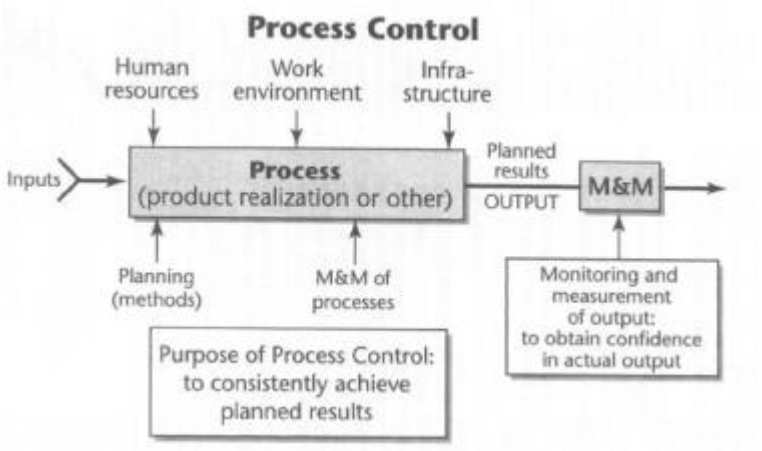
7.1 Planning of product realization

In addition to the guidance given below, the generic guidance given in 5.4.2 of this guidance document regarding quality planning applies. Consistent with subclause 5.4.2, which requires the planning of the quality management system, clause 7.1 requires the planning of the processes related to the realization of product. "Product realization" is the term used in the standard to cover the delivery of a service or the manufacture of a product or combinations of these.

The main purpose of any organization which would elect to comply with ISO 13485 is to produce a product. Since this is the case, the "product realization process" can be considered to be the process which gives purpose to, and is supported by, all other quality management system processes of an organization.

In clause 7.1 the standard indicates that the "processes" needed for product realization need to be planned and developed. The standard requires the organization to establish a consistent, executable routine (i.e., a "process") associated with the full lifecycle of the products which the organization develops. It further requires the organization to integrate the product realization process with the other processes of the quality management system such that it is complemented and supplemented by them. A significant portion of a product realization process occurs during

the design and development stage. NOTE 2 directs attention to subclause 7.3.1 of the standard, the design and development planning stage of design and development. NOTE 1 of ISO 13485 clause 7.1 effectively adds product relevance to the term “quality plan” by necessarily putting it in context with the product realization process.



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In planning for product realization the organization should consider scope of its quality management system (see 1.2). If the organization has used a regulatory approach which allows exclusion of design control from the scope of quality management system product realization activities, the design information related to necessary validations and testing has to be part of, or referenced within, the records of planning product realization. This information can be contained or referenced in a file (see annex A).

Examples of regulatory approaches allowing for exclusion of design control provisions in an organization’s quality management system are

— Canada’s Medical Devices Regulations for class II devices, and
— The European Medical Devices Directive 93/42/EC for class Iia, Iib, & III devices.

Clause 7.1 of the standard lists several needs or requirements relating to product realization which must be considered “as appropriate.” However, the standard also states (see clause 1.2) that when a requirement is qualified by this phrase, it is considered to be appropriate *unless* the organization can document justification otherwise. A requirement should always be considered “appropriate” if it is necessary for the product to meet specified requirements, or for the organization to carry out corrective action.

A requirement need not be stated in the standard in order to be appropriate to an organization. Applicable regulatory requirements determined by the markets an organization’s products are destined for are also considered requirements.

Some examples of such requirements which are typically associated with medical devices, and are always appropriate, include

— the quality objectives and requirements for the product;
— the need to establish processes, documents, and provide resources specific to the product,
— required verification, validation, monitoring, inspection and test activities specific to the product and the criteria for product acceptance (which are appropriate except in cases when process validation, as opposed to design validation, concerns a process which is outside the qualifications given by 7.5.2.1 and 7.5.2.2.1 of the standard); and
— the records needed to provide evidence that the realization processes and resulting product meet requirements (see 4.2.4).

The organization’s procedures should ensure the objectivity of the inspection and test results, inspection and testing if it is carried out by production personnel.

The resultant records referred to in subclauses 4.2.4, 7.1 (d), 7.1 – NOTE 1, and 7.3.3 of ISO 13485 are sometimes referred to by different terms (see annex A).

Subclause 7.1 indicates the need to establish documented requirements for risk management activities throughout the product realisation and that records of same shall be maintained. Creating and implementing such risk management requirements can best be achieved via integration of the requirements found in ISO 14971 into the organization's quality management system. Special attention should be paid to the word "throughout." The intent of the standard in using this term is that risk management activities should begin as early as possible during the process, i.e. during the product rationalisation and feasibility stages, and continue throughout the lifecycle of the product. Often the results of risk management activities serve as significant design input, design output, and design change factors. Results of risk management activities should also serve as input to management review. (See 5.6.2) The ISO 14971:2000 standard is referenced in NOTE 3 of 7.1 and, as suggested above, is an excellent basis for implementing risk management activities.

7.2 Customer-related processes

7.2.1 Determination of requirements related to the product

The organization shall determine

— requirements specified by the customer, including the requirements for delivery and post-delivery activities,

— requirements not stated by the customer but necessary for specified or intended use, where known,

— statutory and regulatory requirements related to the product, and

— any additional requirements determined by the organization.

7.2 Customer-related processes

7.2.1 Determination of requirements related to the product

This subclause of the standard deals with customer-related processes associated with
— design input/output for new product development,
— customer expectations for the delivery of existing product, and
— customer feedback and communications relative to orders placed or product delivered.

This subclause focuses mainly on the products and services which the organization is going to provide to its customers. Such requirements can cover additional factors, such as regulatory or legal requirements, intended use, performance expectations, other design related factors, or delivery schedules, conditions of payment or unspecified customer expectations. For medical devices, an understanding of both stated and implied intended use, and indications for use, should be documented. This is of particular importance in the development of new products. The guidance in 7.3 will help the organization to determine if a requirement for design and development apply.

Such information should also be included in risk management activities (see 7.1 above regarding risk management activities).

All parts of a customer's order, contract and expectations need to be understood and reviewed to ensure that they can be met.

If there are any requirements which are not covered by the organization's usual work processes, particularly any requirements which are felt to be unrealistic or unachievable, the organization may need to discuss these with the customer.

The manner in which a customer provides the order may vary in form and could be, for example, a written order, a verbal agreement, a telephone order or via an e-business web address.

One of the most common problems encountered is misunderstanding what was ordered or how it is to be used. Good communication between the organization and the customer is essential to resolve any misunderstandings, and, if possible, the organization should develop communication processes and should appoint someone to liaise with the customers to identify and resolve any such misunderstandings.

Written or electronic orders, such as those received by mail, facsimile, email or the Internet, can provide a permanent record of the order details.

If telephone and direct computer link orders are received, special provisions need to be made to record and confirm the order, the organization will need methods of handling such orders. Two examples follow.

— One approach to telephone orders is to provide a pad (or even pre-printed forms) for the order receiver to record the details of the order and to read it back to the customer, asking for confirmation.

— Another approach is to enter the details directly into a computer system, again seeking confirmation, which could be verbal, by fax or by email, with the information being saved directly to disk or printed out in hard copy form.

At the time the order is received, an appropriate person in the organization should review the order to ensure that the requirements listed in 7.2.2 can be met. In a small business, the appropriate person is frequently the manager.

The organization also needs to determine if there are any design requirements in the order and whether the requirements of 7.3 will apply. The guidance in 7.3 will help the organization to determine if a requirement for design and development apply.

The record of the review can be as simple as a notation on the order that it can be fulfilled, together with the signature of the reviewer and the date. If a more complex review is called for, the organization may determine how the review is recorded, but the record should include at least the main details.

If the organization tenders for a contract or submits a proposal to a potential customer, the same approach should be taken. Any differences between the organization's offer and the requirements of the customer should be resolved. The organization should make sure that the agreed requirements are appropriately recorded.

If changes to an order or tender, or both, arise for whatever reason, the changes should be reviewed and agreed to in the same manner as the original order or tender. If the changes are accepted, it is essential that everyone in the organization who is affected by the changes is informed.

The relevant documents, affected by these changes, must be amended as well.

7.2.2 Review of requirements related to the product

The organization shall review the requirements related to the product. This review shall be conducted prior to the organization's commitment to supply a product to the customer (e.g. submission of tenders, acceptance of contracts or orders, acceptance of changes to contracts or orders) and shall ensure that

— product requirements are defined and documented,

— contract or order requirements differing from those previously expressed are resolved, and

— the organization has the ability to meet the defined requirements.

Records of the results of the review and actions arising from the review shall be maintained (see 4.2.4).

Where the customer provides no documented statement of requirement, the customer requirements shall be confirmed by the organization before acceptance.

Where product requirements are changed, the organization shall ensure that relevant documents are amended and that relevant personnel are made aware of the changed requirements.

NOTE In some situations, such as internet sales, a formal review is impractical for each order. Instead the review can cover relevant product information such as catalogues or advertising material.

7.2.2 Review of requirements related to the product

There is no specific medical device guidance beyond the generic guidance given in 5.2 and 7.2.1.

7.2.3 Customer communication

The organization shall determine and implement effective arrangements for communicating with customers in relation to

a) product information,

b) enquiries, contracts or order handling, including amendments,

c) customer feedback, including customer complaints (see 8.2.1), and

d) advisory notices (see 8.5.1).

7.2.3 Customer communication

In addition to stating the need to implement effective means for customer communication and feedback, subclause 7.2.3 addresses customer complaints and advisory notices. Customer feedback is the topic of 8.2.1 of the standard and additional guidance is provided in that subclause. See also applicable guidance provided in 7.2 above.

Advisory notices and customer complaints are given definition in clauses 3.3 and 3.4 of the standard. Medical device regulatory schemes existing in today's world markets have subtle differences in terms, definitions and reporting requirements with regard to complaints, corrective actions, and preventive actions. These schemes also have differing responsibilities for the organization, regulators, customers and third parties. It is very important that an organization make provisions to understand and comply with the regulatory schemes of each of the markets intended for its product.

The definition for "customer complaint" given in the standard does not include the term "effectiveness." However, if a customer makes the organization aware of a failure of the organization's product based on claims of effectiveness made by the organization, it should be considered to be a "customer complaint."

There is no definition given in the standard for the term “recall”; however, it should be understood by the definition given for “advisory notice” that this action may include product recall activities.

Means for the customer to communicate with the organization can also have an effect on the ability of an organization to provide traceability to an end user. This is particularly important for implantable medical devices or other high risk devices which may have tracking requirements put upon them by regulators.

7.3 Design and development

7.3.1 Design and development planning

The organization shall establish documented procedures for design and development.

The organization shall plan and control the design and development of product.

During the design and development planning, the organization shall determine

— the design and development stages,

— the review, verification, validation and design transfer activities (see NOTE) that are appropriate at each design and development stage, and

— the responsibilities and authorities for design and development.

The organization shall manage the interfaces between different groups involved in design and development to ensure effective communication and clear assignment of responsibility.

Planning output shall be documented, and updated as appropriate, as the design and development progresses (see 4.2.3).

NOTE “Design transfer activities” during the design and development process ensure that design and development outputs are verified as suitable for manufacturing before becoming final production specifications.

7.3 Design and development

7.3.1 Design and development planning

Guidance given in 5.4.2 and 7.1 of this document also applies.

Design and development planning is needed to ensure that the design process is appropriately controlled and that device quality objectives are met. The plans have to be consistent with the organization’s quality management system provisions for quality planning, product realization and the remainder of the design control requirements.

The following elements would typically be addressed in the design and development plan or plans
— a description of the goals and objectives of the design and development program; i.e., what is to be developed;
— the markets intended (at least a broad preliminary assessment) for the product;
— a delineation of quality management system documents, procedures and resulting records applicable to controls for design and development;
— a delineation of organizational responsibilities with respect to assuring quality during the design and development phase, to include interface with any contractors;
— the identification of the major tasks to be undertaken (or stages/phases of the design control, expected outputs (deliverables and records) resulting from each task or stage/phase, and individual or organizational responsibilities (staff and resources) for completing each task or stage/phase;
— the schedule of major tasks or stages/phases to meet overall program time constraints;

— the identification of appropriate existing and anticipated measurement and monitoring devices for the development of product specifications, verification, validation and production related activities (see also guidance given in 7.6 of this document);
— the selection of reviewers, the composition of review teams, and procedures to be followed by reviewers appropriate to each task or stage/phase;
— the risk management activities; and
— additional considerations from ISO 10005.

Planning enables management to exercise greater control over the design and development process while providing for predictable timeframes and records. Planning accomplishes all this by clearly communicating policies, procedures, and goals to members of the design and development team, and by providing a basis for measuring conformance to quality management system objectives.

Design and development activities should be specified at the level of detail necessary to carry out the design process. The extent of design and development planning is dependent on the size of the developing organization and the complexity of the product to be developed. Some organizations have documented policies and procedures which apply to all design and development activities. For each specific development program, such organizations may also prepare a plan which spells out the project-dependent elements in detail, and incorporates the general policies and procedures by reference. Other organizations develop a comprehensive design and development plan which is specifically tailored to each individual project.

The interrelationship of design control and process development may, for some technologies, be very closely related. For others the relationship may be remote. The product should be designed robustly enough to withstand variations in the manufacturing process and the manufacturing process should be capable and stable to assure continued safe products which perform adequately. Often this results in very interactive product development and process development activities.

7.3.2 Design and development inputs

Inputs relating to product requirements shall be determined and records maintained (see 4.2.4). These inputs shall include

a) functional, performance and safety requirements, according to the intended use,

b) applicable statutory and regulatory requirements,

c) where applicable, information derived from previous similar designs,

d) other requirements essential for design and development, and

e) output(s) of risk management (see 7.1).

These inputs shall be reviewed for adequacy and approved. Requirements shall be complete, unambiguous and not in conflict with each other.

7.3.2 Design and development inputs

The guidance given in 7.2.1 of this document also applies.

Design and development inputs are typically in the form of product requirement specifications and/or product description with specifications relating to intended use, configuration, composition, incorporated elements, and other design features. The design and development inputs should be specified to the level necessary to permit the design activities to be carried out effectively and to provide a consistent basis for design decisions, design verifications and design validation.

The design and development inputs should describe all requirements to the greatest possible extent. They lay the

foundation and provide a unified approach to the design. Details agreed upon between customer and organization as to how customer, statutory and regulatory requirements will be met should be included. The record of the design inputs should also include the resolutions of any incomplete, ambiguous or conflicting requirements which have been identified at the contract review and/or design verification stages or related design control activities.

The design and development inputs should identify design criteria, materials, and processes requiring development and analysis, including prototype testing to verify their feasibility and adequacy. Design inputs should be prepared in a way which facilitates periodic updates. They should indicate ‘when’ or ‘what criteria’ did cause, or will cause (since not all criteria are foreseeable), the inputs to be updated, who is responsible for the update, and under what circumstances the customer will get a copy. Design and development inputs prepared in this way serve as the definitive up-to-date reference document as the design progresses to completion.

Examples of design and development inputs which should be defined, reviewed, approved and recorded by the organization, include
— intended use of the device,
— indications for use of the device,
— performance and efficacy claims,
— performance requirements (including normal use, storage, handling and maintenance),
— requirements of the user and patient,
— physical characteristics,
— human factors,
— safety and reliability,
— toxicity and biocompatibility,
— electromagnetic compatibility,
— limits/tolerances,
— measurement and monitoring instruments,
— risk management or risk reduction methods suggested by hazard/risk analysis (including ISO 14971 data if implemented for previous designs),
— MDRs/complaints/failures for previous products
— other historical data,
— previous design history files,
— compatibility with accessories and auxiliary devices,
— compatibility with environment of intended use,
— packaging and labelling (including considerations to deter foreseeable misuse),
— customer/user training,
— potential markets,
— regulatory and statutory requirements,
— voluntary standards (including industry standards, national, regional or international standards, “harmonized” and other consensus standards),
— manufacturing processes,
— sterility requirements,
— reimbursement strategy,
— lifetime of the product, and
— need for servicing.

Labelling
The content of labels can be specified in regulatory requirements, general standards and product standards. If the product is to be supplied to countries with different languages, and the language to be used on the labels has been specified, it is advisable that the label translations be checked by a person with adequate expertise in the specified language and who has technical knowledge of medical devices. The use of internationally agreed upon symbols can reduce translation problems.

The design and development input documents should be regarded as living documentation, and updated and reissued as necessary upon completion of design and development reviews. A record should be kept of all “agreed to” changes to the design and development input as it evolves during the design and development process.

The design transfer process should flow more smoothly if, during the design and development input stage, consideration is given to eventual production (producibility, parts/materials availability, production equipment needs,

operator training etc.) and possible conformity assessment requirements (procedures, methods, equipment). Thus process validation needs consideration at the stages of design and development planning, and of design and development input (and hence output).

7.3.3 Design and development outputs

The outputs of design and development shall be provided in a form that enables verification against the design and development input and shall be approved prior to release.

Design and development outputs shall

— meet the input requirements for design and development,

— provide appropriate information for purchasing, production and for service provision,

— contain or reference product acceptance criteria, and

— specify the characteristics of the product that are essential for its safe and proper use.

Records of the design and development outputs shall be maintained (see 4.2.4).

NOTE Records of design and development output can include specifications, manufacturing procedures, engineering drawings, and engineering or research logbooks.

7.3.3 Design and development outputs

Design and development outputs are the product requirements used for purchasing, production, installation, inspection and testing, and servicing.

Throughout the design and development process, the requirements contained in the design description are translated by the organization into outputs. Design and development outputs should be recorded in terms which can be verified and validated against design and development input requirements and need to contain, or make reference to, acceptance criteria.

Design and development outputs can also include
— specifications for raw materials, component parts, and sub-assemblies,
— drawings and parts list,
— process and materials specifications,
— finished devices,
— product and process software,
— quality assurance procedures (including acceptance criteria),
— manufacturing and inspection procedures,
— manufacturing environment requirements needed for the device
— packaging and labelling,
— identification and traceability requirements (including procedures, if necessary), and
— installation and servicing procedures and materials.

As part of, or in addition to, the design and development output documents, it is common practice to maintain a record/file to demonstrate that each design was developed and verified in accordance with the approved design and development plan (see annex A).

7.3.4 Design and development review

> At suitable stages, systematic reviews of design and development shall be performed in accordance with planned arrangements (see 7.3.1)
>
> — to evaluate the ability of the results of design and development to meet requirements, and
>
> — to identify any problems and propose necessary actions.
>
> Participants in such reviews shall include representatives of functions concerned with the design and development stage(s) being reviewed, as well as other specialist personnel (see 5.5.1 and 6.2.1). Records of the results of the reviews and any necessary actions shall be maintained (see 4.2.4).

7.3.4 Design and development review

The timing of design and development reviews will be influenced by the maturity and complexity of the product being designed and developed. Design and development reviews may consider topics such as the following.

— Do designs satisfy all specified requirements for the product?
— Is the input adequate to perform the design and development tasks?
— What is the life-cycle data on performance of the product?
— Are product design and processing capabilities compatible?
— Are safety considerations considered?
— What is the potential impact of the product on the environment?
— Do designs meet functional and operational requirements, for example, performance and dependability objectives?
— Have appropriate materials and/or facilities been selected?
— Is there adequate compatibility of materials, components and/or service elements?
— Is the design satisfactory for all anticipated environmental and load conditions?
— Are components or service elements standardized and do they provide for reliability, availability and maintainability?
— Is there a provision in tolerances, and/or configuration, for interchangeability and replacement?
— Are plans for implementing the design technically feasible (e.g. purchasing, production, installation, inspection and testing)?
— If computer software has been used in design computations, modelling or analyses, has the software been appropriately validated, authorized, verified and placed under configuration control?
— Have the inputs to such software, and the outputs, been appropriately verified and documented?
— Are the assumptions made during the design and development processes valid?
— Are the results of model or prototype testing considered?
— Has risk analysis been carried out to ensure that safety considerations are covered including evaluation of potential hazards or fault modes in product use?
— Is the labelling adequate?
— Will the design reasonably accomplish the medical use intended?
— Is the packaging adequate, particularly for sterile devices?
— Is the sterilization process adequate?
— Is the device compatible with the sterilization method?
— How are changes and their effects controlled during the design and development process?
— Are problems being identified and corrected?
— Is the product meeting verification and validation goals?
— What is the progress of the planned design and development process?
— Are there opportunities for design and development process improvement?

The requirement in the standard for “other specialist personnel”, in addition to those representing organizational functions who have direct concerns regarding the design and development being reviewed, obliges the organization to include person(s) who are both capable of understanding the design and development information being reviewed, and independent from it. The need for such an “independent reviewer” is also a requirement of some national and regional regulatory bodies.

7.3.5 Design and development verification

Verification shall be performed in accordance with planned arrangements (see 7.3.1) to ensure that the design and development outputs have met the design and development input requirements. Records of the results of the verification and any necessary actions shall be maintained (see 4.2.4).

7.3.5 Design and development verification

Design and development verification is necessary to ensure that the design and development outputs conform to specified requirements (design and development inputs). The basis of verification is a three-pronged approach involving tests, inspections and analyses. Any approach which establishes conformance with design and development input requirements is an acceptable means of verifying the design with respect to that requirement. In many cases a variety of approaches is possible.

When alternative calculations or comparison with a proven design are employed as forms of design and development verification, the appropriateness of the alternative calculation method, and/or proven design, should be reviewed in relation to this new application, i.e. that the alternative calculations or comparison with a proven design are actually scientifically valid methods of design verification for the new application.

If tests and demonstrations are employed at any stage of the design and development verification, the safety and performance of the product should be verified under conditions which are representative of the full range of circumstances of actual use.

Verification activities can include, if appropriate
— review of engineering specifications and drawings,
— laboratory testing (bench testing),
— in vivo testing, and
— packaging (see 7.5.5) and labelling review.

7.3.6 Design and development validation

Design and development validation shall be performed in accordance with planned arrangements (see 7.3.1) to ensure that the resulting product is capable of meeting the requirements for the specified application or intended use. Validation shall be completed prior to the delivery or implementation of the product (see Note 1). Records of the results of validation and any necessary actions shall be maintained (see 4.2.4).

As part of design and development validation, the organization shall perform clinical evaluations and/or evaluation of performance of the medical device, as required by national or regional regulations (see Note 2).

NOTE 1 If a medical device can only be validated following assembly and installation at point of use, delivery is not considered to be complete until the product has been formally transferred to the customer.

NOTE 2 Provision of the medical device for purposes of clinical evaluations and/or evaluation of performance, is not considered to be delivery.

7.3.6 Design and development validation

Design and development validation goes beyond the technical issues of verifying that the design and development outputs meet the design and development inputs, and is intended to ensure that the medical device meets user

requirements and the intended use. This involves consideration of the knowledge and capabilities of the intended user, the operating instructions, compatibility with other systems, the environment in which it will be used, and any restriction on the use of the product.

The transfer of a design to production should occur after review and approval of specifications and procedures. Review(s) should take into account the production (producibility, parts/materials availability, production equipment needs, operator training etc.) and possible conformity assessment requirements (procedures, methods, equipment). The review(s) should encompass all of the specifications to ensure that each is correctly incorporated into the specific processes or procedures associated with product realization. Failure to do so can lead to production delays and nonconforming product for reasons such as purchase of incorrect raw material grades or quantities, inappropriate manufacturing methods, unvalidated processes, unclear work instructions, incorrect labelling, etc. The adequacy of specifications, methods and procedures can be demonstrated through process validation. The medical device units employed for validations should be produced under the conditions specified as "final" for the product, e.g. initial production units. The validation should be conducted under actual or simulated use conditions; this can involve clinical investigations. These points are important as many validations can be irrelevant or misleading if not done using products representative of the final product and process conditions, or not done under conditions of actual or simulated use.

Before any packaging of the product is adopted, the appropriateness of the packaging for its intended use should be established. Typically this is done through validation activities which include defining the packaging materials, packaging process conditions, storage and handling conditions to be used during manufacture, warehousing and distribution. The following should be considered if applicable

— microbial barrier properties of packaging materials for sterile devices,
— integrity of the primary container/package to prevent damage and to maintain sterility or cleanliness as required,
— compatibility with the device and packaging process,
— compatibility with the sterilization process, if applicable, and
— transportation hazard trials/shipping tests.

After successful design and development verification, a design and development validation should be performed under defined conditions for the use of the final product. However, validation may need to be performed at earlier stages during product development if there are features which are not possible or practical to validate at the final stage.

Clinical evaluation may include a compilation of relevant scientific literature, historical evidence that similar designs and/or materials are clinically safe, or a clinical investigation, clinical trial or performance evaluation, to ensure that the device performs as intended.

> **7.3.7 Control of design and development changes**
>
> Design and development changes shall be identified and records maintained. The changes shall be reviewed, verified and validated, as appropriate, and approved before implementation. The review of design and development changes shall include evaluation of the effect of the changes on constituent parts and product already delivered.
>
> Records of the results of the review of changes and any necessary actions shall be maintained (see 4.2.4).

7.3.7 Control of design and development changes

Design of a product can be changed or modified for a number of reasons and the change can happen during or after the design and development phase, for example

— omissions or errors (e.g. in calculation, material selection, etc.) during the design phase which have been identified afterwards,
— difficulties in manufacturing, installation and/or servicing found after the design and development phases,
— changes requested by the customer or supplier,

— improvements to the function or performance of a product,
— changes needed to safety, regulatory, or other requirements,
— changes required following design and development review (see 7.3.4), design and development verification (see 7.3.5) or design and development validation (see 7.3.6),
— changes required for corrective or preventive action (see 8.5),
— change requests from engineering, and
— change required in response to risk analysis.

Improving one characteristic may have unforeseen adverse influence on another for example the following should be considered in order to help in avoiding this situation
— Will the product still conform to the agreed-to product requirements?
— Will the product still conform to the agreed-to product specifications?
— Will the intended use be affected?
— Will different components of the product or system be affected by the change?
— Will there be a need for further interface design (e.g., physical contact with other components in a product or system)?
— Will the change create problems in manufacture, installation or use?
— Will the design still be verifiable?
— Will the change affect the regulatory status of the product?

7.4 Purchasing

7.4.1 Purchasing process

The organization shall establish documented procedures to ensure that purchased product conforms to specified purchase requirements. The type and extent of control applied to the supplier and the purchased product shall be dependent upon the effect of the purchased product on subsequent product realization or the final product.

The organization shall evaluate and select suppliers based on their ability to supply product in accordance with the organization's requirements. Criteria for selection, evaluation and re-evaluation shall be established. Records of the results of evaluations and any necessary actions arising from the evaluation shall be maintained (see 4.2.4).

7.4 Purchasing

7.4.1 Purchasing process

The selection of suppliers is a process consisting of establishing criteria for, evaluating, selecting and on-going monitoring of a supplier.

The application of the process should be commensurate with the product or service being purchased. For instance, the process of evaluation and selection, and control may differ when applied to
— an original equipment manufacturer (OEM),
— contract sterilizer,
— supplier of material to the organisation's specifications,
— design service,
— clinical evaluations,
— testing and calibration services, or
— a supplier of off-the-shelf component items.

An evaluation can range from the regular comprehensive auditing of the supplier's quality management system by the organization, to the acceptance of evaluation reports or approval by reference to historical data like records of past performance, certified products, or quality management system registration. Regardless of the method of evaluation, the organisation is required to demonstrate that they have control over the outsourced process by possessing objective evidence that formal consideration was given to the evaluation of the outsourced process, and

that the selection of a supplier was based on appraisals appropriate to the product or service being purchased and the supplier's ability to enable the organization to meet the customer and regulatory requirements of the medical device.

When designing supplier monitoring activities, the organisation may consider results of a supplier's third-party certification status, compliance trends, and nonconformance history. The organization should define the frequency of such performance monitoring. The organization should also include in the supplier monitoring activities the need for their registration body to visit the supplier for the purpose of obtaining objective evidence that the outsourced processes are under control and that the products or services conform to the organizations specified requirements which may include customer and regulatory requirements.

7.4.2 Purchasing information

Purchasing information shall describe the product to be purchased, including where appropriate

— requirements for approval of product, procedures, processes and equipment,

— requirements for qualification of personnel, and

— quality management system requirements.

The organization shall ensure the adequacy of specified purchase requirements prior to their communication to the supplier.

To the extent required for traceability given in 7.5.3.2, the organization shall maintain relevant purchasing information, i.e. documents (see 4.2.3) and records (see 4.2.4).

7.4.2 Purchasing information

The organization's purchasing data should define appropriate specifications to the supplier to ensure the quality of the purchased product, including technical product requirements, calibration services, and inspection and test activities including record keeping requirements.

For example, when cleaning operations in environmentally controlled areas are carried out by a supplier, a written contract specifying the limits of responsibility of the organization and the supplier should be considered in order that product is not contaminated by cleaning agents or personnel or that areas are left uncleaned due to oversight. This contract should include details of the documented cleaning procedure and specify the training to be given to cleaning staff.

Specifications should define any special conditions required for storage or transport of the purchased materials which could significantly affect the safety, effectiveness, or intended use of the medical device.

The organization can make reference to applicable technical information such as national or international standards, test methods, etc. Another approach is for information to be clearly and precisely stated to the supplier on the purchase order. Responsibility for reviewing and approving the purchasing data should be clearly assigned to appropriate personnel to prevent purchasing incorrect materials. The revision status of documents referenced in the purchasing data should be identified to ensure that the correct version of materials are purchased.

To extent required by an organizations traceability requirements (see 7.5.3.2 of this guidance), purchasing documents and records may be need to be identified and retained. This means that when evaluating the traceability requirements, consideration should be given to what purchasing information and records may also need to be retained to facilitate traceability. For example, if it was important to know to what specification revision a purchased part was ordered, then this information should be kept as part of the purchasing documents or records.

7.4.3 Verification of purchased product

The organization shall establish and implement the inspection or other activities necessary for ensuring that purchased product meets specified purchase requirements.

Where the organization or its customer intends to perform verification at the supplier's premises, the organization shall state the intended verification arrangements and method of product release in the purchasing information.

Records of the verification shall be maintained (see 4.2.4).

7.4.3 Verification of purchased product

Receiving inspection is one method for the organization to verify that purchased items delivered to the organization's facilities fulfil specified requirements for quality. If the purchased items are claimed to conform to the supplier's specification, the organization should check that the items meet the agreed specification. This check may be accomplished by various approaches, such as certification of suppliers, certificates of conformance, skip lot testing, 100 % or sampling inspection, as determined by the requirements of the organization's quality system.

The organization's procedures or quality plan usually specify the method of verifying that shipments received are in accordance with specifications, are complete, have proper identity and are undamaged. The procedures should also include provisions for verifying that incoming items, materials, or services are accompanied by the required supporting documentation (e.g. certificates of conformity, acceptance test reports, etc.) as this can cause unnecessary delays later if these are required for incoming inspection or product realization. Appropriate action in the event of nonconformities should be specified (see 8.3) so that the nonconformity can be dealt with in a consistent manner and without undue delay, including identification, segregation and documentation. Analysis of previous receiving inspection data, in-plant rejection history or customer complaints will influence the organization's decisions regarding the amount of inspection required, and the need to reassess a supplier.

This subclause does not imply that incoming items have to be inspected and tested by the organization. Incoming activities may not be required if the necessary confidence in the product can be obtained by other defined processes or procedures, particularly if the information given by a supplier is considered sufficient.

The organization's procedures should define who is authorized to allow incoming product(s) to be used without prior demonstration of conformity to specified requirements for quality. Such a procedure ensures that the decision is being taken at a level in the organization which is aware of the possible impact on product realization if the incoming products do not subsequently meet the requirements. The organization's procedures should also define how such product will be positively identified and controlled in the event that subsequent inspection finds nonconformities, in order to facilitate corrective action.

These requirements apply to all products received from outside the organization's quality management system, whether payment occurs or not (e.g. products shipped from one subsidiary of an organization to another subsidiary).

7.5 Production and service provision

7.5.1 Control of production and service provision

7.5.1.1 General requirements

The organization shall plan and carry out production and service provision under controlled conditions. Controlled conditions shall include, as applicable

— the availability of information that describes the characteristics of the product,

— the availability of documented procedures, work instructions, and reference measurement procedures and reference materials as necessary,

— the use of suitable equipment,

— the availability and use of monitoring and measuring devices,

— the implementation of monitoring and measurement,

— the implementation of release, delivery and post-delivery activities, and

— the implementation of defined operations for labelling and packaging.

The organization shall establish and maintain a record (see 4.2.4) for each batch of medical devices that provides traceability to the extent specified in 7.5.3 and identifies the amount manufactured and amount approved for distribution. The batch record shall be verified and approved.

NOTE A batch can be a single medical device.

7.5 Production and service provision

7.5.1 Control of production and service provision

7.5.1.1 General requirements

The generic guidance with respect to infrastructure given in clause 6.3 of this document applies.

In considering which controlled conditions are applicable for a given process, an organization should consider the impact on quality or regulatory compliance. If, in the absence of the control, there is an adverse or potentially adverse affect on quality or regulatory compliance, then the control is necessary. The amount of control and level of detail can be commensurate with the degree of criticality of the process in achieving the requirements for quality, and the degree of training of product realization personnel.

Process control is generally demonstrated through documented procedures defining the manner of production, installation and servicing, together with records demonstrating that the procedures have been followed. Records and procedures typically cover
— the approval of processes and equipment, as appropriate,
— process validations,
— equipment and materials to be used,
— use of reference standards/codes, quality plans and/or documented procedures,
— the monitoring of process parameters and product characteristics,
— process or material change,
— precautions to be taken,
— step-by-step instructions, and
— in-process quality checks conducted by production personnel.

The amount of documentation and level of detail can be commensurate with the degree of criticality of the process in achieving the requirements for quality and the degree of product realization personnel training. The procedure could be in the form of a simple flowchart, or a processing sequence, combined with a checklist (see 4.2.1).

Ancillary materials are any materials or substances used in, or used to facilitate, a manufacturing process, such as cleaning agents, mould-release agents, lubricating oils, or other substances which are not intended to be included in the finished devices. Ancillary materials (also known as manufacturing materials) should be adequately identified and labelled to avoid confusion and processing errors.

Reference standards can be international, regional or national standards which are referenced as part of the product realization process. For example, if testing of 316 stainless steel to the ASTM standard is required, then that standard should be available. They can also be physical, such as product examples indicating minimum and maximum allowable colour variation, or visual, such as photos of known defects.

Equipment should be designed and selected so that product and process specifications are met. Equipment installation and operational performance qualification should be conducted. New equipment and significantly modified equipment should be verified that it meets purchasing/design specifications and is capable of operating within its defined limits and the process operating limits. This would be achieved through validation of processes. (see 7.5.2)

Some processes require that operators have extra training and/or be specially qualified, or the process itself should have specific approval, as in the following examples.

a) When qualifying an operator in sterile package sealing, if visual or other non-destructive examination for soundness of the seal would give no information on weld strength, the operator is required to be trained and qualified to carry out the sealing process according to a validated process procedure in order to provide assurance of seal strength.
b) When introducing a new or significantly changed manufacturing process, including any new manufacturing and test methods, the process should be evaluated to determine whether validation is necessary.

The risk of labelling and packaging errors can be minimized by the introduction of appropriate controls such as

— segregation of packaging and labelling operations from other manufacturing (or other packaging and labelling) operations,
— avoidance of packaging and labelling product of similar appearance in close proximity,
— line identification,
— application of line clearance procedures,
— destruction of unused batch-coded materials on completion of packaging and labelling,
— use of roll-feed labels,
— use of known number of labels and reconciliation of usage,
— on-line printing, including batch coding,
— use of electronic code encoders/readers and label counters,
— use of labels designed to provide clear product differentiation,
— inspection of label content before use, and
— proper storage of labels in areas of restricted access.

Quality records which facilitate traceability and review of the manufacture of a batch of product, derived during the manufacture of that batch, should be contained in a batch record, and are frequently collated in a single file. Such files can be referred to as a “Device History Record”, “Batch Manufacturing Record”, “Lot History Record” or “Lot Record” (see annex A).

If it is not practical to include all the relevant documents in the batch record, then the record should list the titles of those documents and their location(s).

The system for record retention should allow retrieval of quality records without undue delay if required for corrective action

Batch records should be prepared from the currently approved versions of the specifications.

The forms which constitute the batch records should be designed and reproduced by an appropriate method to avoid clerical errors. A batch record should have a unique batch identification and relate to an individual manufacturing batch.

During manufacture, relevant information should be entered onto the batch record such as

— the quantity of raw materials, components and intermediate products, and their batch number, if appropriate,
— the date of start and completion of different stages of production including sterilization records, if appropriate,
— the quantity of product manufactured,
— the signed results of all inspections and tests,
— the designation of the product line used, and

— any deviation from the manufacturing specifications.

7.5.1.2 Control of production and service provision – specific requirements

7.5.1.2.1 Cleanliness of product and contamination control

The organization shall establish documented requirements for cleanliness of product if

— product is cleaned by the organization prior to sterilization and/or its use, or

— product is supplied non-sterile to be subjected to a cleaning process prior to sterilization and/or its use, or

— product is supplied to be used non-sterile and its cleanliness is of significance in use, or

— process agents are to be removed from product during manufacture.

If product is cleaned in accordance with a) or b) above, 6.4 a) and 6.4 b) do not apply prior to the cleaning process.

7.5.1.2 Control of production and service provision – specific requirements

7.5.1.2.1 Cleanliness of product and contamination control

Some medical devices may need to be cleaned and/or decontaminated prior to servicing to ensure employees and other product are not exposed to some form of contamination. In such cases they should be decontaminated by appropriate, approved procedures (see ISO 12891-1; see Bibliography).

The organization should establish and maintain documented procedures for the protection of product against contamination by any substance which could reasonably be expected to have an adverse affect. Consideration to the entire supply chain (components, mfg. and distribution) are areas that are typically addressed.

Cleaning processes may be required to remove ancillary materials and/or particulate contamination. Cleaning processes should be validated as to the effectiveness of the process for removing the contamination in accordance with a documented procedure. Records of validation should be retained (see 4.2.4). The cleaning process should be routinely monitored in accordance with documented procedures. Records of this monitoring should be maintained (see 4.2.4).

When a cleaning process is intended to remove microbiological contamination, the validation protocol, the results of the validation and the final operating procedure should be reviewed or approved by a person trained and qualified in microbiology. Where the effectiveness of cleaning is monitored microbiologically, the methods should be approved, and the results reviewed, in the same manner as the validation protocol and results.

7.5.1.2.2 Installation activities

If appropriate, the organization shall establish documented requirements which contain acceptance criteria for installing and verifying the installation of the medical device.

If the agreed customer requirements allows installation to be performed other than by the organization or its authorized agent, the organization shall provide documented requirements for installation and verification.

Records of installation and verification performed by the organization or its authorized agent shall be maintained (see 4.2.4).

7.5.1.2.2 Installation activities

Installation of a medical device is the activity of putting the device into service in the location if it will be used. The activity might involve permanent connection to services, e.g. electrical supply, plumbing, waste disposal. Final testing of installed devices is carried out after it is in its location for use and connected to all relevant services. For medical devices, installation does not mean implantation in, or fitting to, a patient. The responsibility for installation should be clearly defined to ensure proper functioning of the device.

If a medical device has to be assembled or installed at the user's site, instructions should be provided by the organization to guide correct assembly, installation, testing and/or calibrations. Special attention should be paid to ensure correct installation of safety control mechanisms and safety control circuits.

In certain cases (e.g. if required by a regulatory requirement or if performance parameters of a medical device have to be controlled) the organization should provide instructions which allow the installer to confirm correct operation of the device. The results of installation or commissioning tests should be recorded (see 4.2.4).

7.5.1.2.3 Servicing activities

If servicing is a specified requirement, the organization shall establish documented procedures, work instructions and reference materials and reference measurement procedures, as necessary, for performing servicing activities and verifying that they meet the specified requirements.

Records of servicing activities carried out by the organization shall be maintained (see 4.2.4).

NOTE Servicing can include, for example, repair and maintenance.

7.5.1.2.3 Servicing activities

If the functionality of products depends on servicing or maintenance for proper use of the products, and if the organization provides for some or all of the product servicing by either warranty or contract, then the organization's quality management system should include provisions for the type and extent of servicing provided, The following activities should be considered as appropriate

— clarification of servicing responsibilities among organization, distributors and users,
— planning of service activities, whether carried out by the organization or by a separate agent,
— validation of design and function of special-purpose tools or equipment for handling and servicing products after installation,
— control of measuring and test equipment used in field servicing and tests,
— provision and suitability of documentation, including instructions for use in dealing with the spares or parts lists, and in servicing of the product,
— provision for adequate back-up, to include technical advice and support, customer training, and spares or parts supply,
— training of servicing personnel,
— provision of competent servicing personnel,
— feedback of information which would be useful for improving product or servicing design, and
— other customer support activities.

Even when not specified in the contract, the guidance given here can be helpful to the organization.

The organization should establish a system for receiving service requests to determine if there are customer complaints or requirements which are not being met.

7.5.1.3 Particular requirements for sterile medical devices

The organization shall maintain records (see 4.2.4) of the process parameters for the sterilization process which was used for each sterilization batch (see 4.2.4). Sterilization records shall be traceable to each production batch of medical devices (see 7.5.1.1).

7.5.1.3 Particular requirements for sterile medical devices

Sterilization is an example of a process which cannot be verified by inspection and testing of the product. It is important to be aware that exposure to a properly validated and accurately controlled sterilization process is not the only factor associated with ensuring that the product is sterile. It can also be important that attention is given to the microbiological status of incoming raw materials and their subsequent storage, and to the control of the environment in which the product is manufactured, assembled and packaged. Also refer to ISO 11134, ISO 11135, ISO 11137, ISO 11138, ISO 13683, ISO 14937, ISO 14160, ISO 13409 (see Bibliography).

Processes concerning sterile medical devices other than terminal sterilization also need particular requirements (for example, to avoid contamination by prions, and aseptic process).

7.5.2 Validation of processes for production and service provision

7.5.2.1 General requirements

The organization shall validate any processes for production and service provision where the resulting output cannot be verified by subsequent monitoring or measurement. This includes any processes where deficiencies become apparent only after the product is in use or the service has been delivered.

Validation shall demonstrate the ability of these processes to achieve planned results.

The organization shall establish arrangements for these processes including, as applicable

— defined criteria for review and approval of the processes,

— approval of equipment and qualification of personnel,

— use of specific methods and procedures,

— requirements for records (see 4.2.4), and

— revalidation.

The organization shall establish documented procedures for the validation of the application of computer software (and changes to such software and/or its application) for production and service provision that affect the ability of the product to conform to specified requirements. Such software applications shall be validated prior to initial use.

The results of validation shall be recorded (see 4.2.4)

7.5.2 Validation of processes for production and service provision

7.5.2.1 General requirements

The validation of a process is the mechanism or system used by the manufacturer to plan, obtain data, record data, and interpret data associated with a particular process. These activities can be considered to fall into a model

consisting of four phases
— review and approval of equipment specifications – also known as design qualification (DQ);
— an initial qualification of the equipment used and provision of necessary services – also know as installation qualification (IQ);
— a demonstration that the process will produce acceptable results and establishment of limits (worst case) of the process parameters – also known as operational qualification (OQ); and
— and establishment of long term process stability – also known as performance qualification (PQ).

The following table is a list of examples of processes which normally either should be validated, or may be satisfactorily covered by verification, or are processes for which the above model may be useful in determining the need for validation.

Processes which should be validated include
— sterilization processes,
— clean room ambient conditions,
— aseptic filling processes,
— sterile packaging sealing processes,
— lyophilization process, and
— heat-treating processes.

Processes which may be satisfactorily covered by verification include
— manual cutting processes,
— testing for colour, turbidity, total pH for solutions,
— visual inspection of printed circuit boards, and
— manufacturing and testing of wiring harnesses.

Processes for which the above model may be useful in determining the need for validation include
— cleaning processes,
— certain manual assembly processes,
— numerical control cutting processes, and
— filling processes.

To determine the level of risk to the patient in the context of this guidance, it is suggested that the failure modes of the device be analyzed relative to the manufacturing process. If a failure of the process could cause a failure of the device, that process failure should be evaluated for its severity and frequency and subsequent failure rate of the device. Guidance on risk management can be found in other standards and guidances (e.g., see ISO 17941).

The output of a process may be fully verifiable and the overall process may not require validation. However, software used to automate such processes should be validated for its intended use.

Manufacturers should document the rationale used for not validating processes, including risk analysis and the reasons as to why verification and/or process control are sufficient.

When validation is performed either by the organization or supplier, the validation should include the following
— the accuracy and variability of the process parameters, including the settings of the equipment used,
— the skill, capability and knowledge of operators to conform to quality requirements,
— the adequacy of control of any specific environmental parameters,
— the certification records maintained for personnel, processes and equipment, as appropriate, and
— the appropriateness of the process result.

Any change applied to a manufacturing process has to include the consideration for conducting process revalidation.

Statistical methods and tools for process validation
There are many methods and tools which can be used in process validation. Control charts, capability studies, designed experiments, tolerance analysis, robust design methods, failure modes and effects analysis (FMEA), sampling plans, and mistake-proofing are some of the examples.

Computer software used in process control
All software which is purchased, developed, maintained, or modified for automated production or process control purposes should be validated. Software and changes to software can be controlled in the same manner as documents. The software program is formally approved by a documented system prior to issue, a master copy of the original program is retained. Any changes to software programs are validated, approved and documented (see 4.2.3). ISO 9000-3 (see Bibliography) can be used as a reference for software development.

7.5.2.2 Particular requirements for sterile medical devices

The organization shall establish documented procedures for the validation of sterilization processes. Sterilization processes shall be validated prior to initial use.

Records of the results of sterilization process validation(s) shall be maintained (see 4.2.4).

7.5.2.2. Particular requirements for sterile medical devices

Sterilization is an example of a process which cannot be verified by inspection and testing of the product. It is important to be aware that exposure to a properly validated and accurately controlled sterilization process is not the only factor associated with ensuring that the product is sterile. It can also be important that attention is given to the microbiological status of incoming raw materials and their subsequent storage, and to the control of the environment in which the product is manufactured, assembled and packaged. Also refer to ISO 11134, ISO 11135, ISO 11137, ISO 11138, ISO 13683, ISO 14937, ISO 14160, ISO 13409 (see Bibliography).

Processes concerning sterile medical devices other than terminal sterilization also need particular requirements (for example, to avoid contamination by prions, and aseptic process).

7.5.3 Identification and traceability

7.5.3.1 Identification

The organization shall identify the product by suitable means throughout product realization, and shall establish documented procedures for such product identification.

The organization shall establish documented procedures to ensure that medical devices returned to the organization are identified and distinguished from conforming product [see 6.4 d)].

7.5.3 Identification and traceability

7.5.3.1 Identification

Identification of raw materials, components and finished products is important for a number of reasons, including:
— control of material throughout manufacture
— demonstration of product source, status and safety requirements,
— permitting traceability, and
— facilitating fault diagnosis in the event of quality problems.

Identification of the product can be achieved by marking, tagging or the location of the product or its container. For example, on visually identical parts, if the functional characteristics are different, then different colours could be used. For bulk products or product from continuous processes, the identification could be by marking of batches or well-defined lots and accompanying documents.

It is usual for finished products to be identified by a batch/lot/serial number or by electronic means. The extent to which raw materials and components need to be identified and related to the finished product batch/lot or serial

number may depend upon a number of factors such as
— the material involved,
— the type of finished product,
— the effect of failure of finished product or materials used therein,
— specified requirements,
— traceability, if necessary,
— design input, and
— regulatory requirements.

Any marking materials used for product identification, if applied to medical devices or components, should not have a deleterious effect on product performance.

7.5.3.2 Traceability

7.5.3.2.1 General

The organization shall establish documented procedures for traceability. Such procedures shall define the extent of product traceability and the records required (see 4.2.4, 8.3 and 8.5).

Where traceability is a requirement, the organization shall control and record the unique identification of the product (see 4.2.4).

NOTE Configuration management is a means by which identification and traceability can be maintained.

7.5.3.2 Traceability

7.5.3.2.1 General

Identification on products by batch/lot/serial number or electronic means permits traceability in two directions: forward to customers (also known as “device tracking”); and backward to raw materials, components and processes used in manufacturing. The former is important if it is necessary to track products to the user, e.g. patients or hospitals, and the latter enables investigation of quality problems and feedback for the prevention of nonconforming product.

Product traceability involves the ability to trace the history, application or location of an item or activity by means of recorded identification. Traceability is typically required when there is a need to trace a nonconformity back to its source and to determine the location of the remainder of the affected batch.

The organization typically ensures traceability throughout the production and warehousing process, and up to the point when the product leaves the organization’s possession. The organization can choose to limit the traceability activities to particular parts of its operation.

If configuration management is used as a means to maintain identification and traceability, ISO 10007 provides additional guidance.

7.5.3.2.2 Particular requirements for active implantable medical devices and implantable medical devices

In defining the records required for traceability, the organization shall include records of all components, materials and work environment conditions, if these could cause the medical device not to satisfy its specified requirements.

The organization shall require that its agents or distributors maintain records of the distribution of medical devices to allow traceability and that such records are available for inspection.

The organization shall ensure that the name and address of the shipping package consignee is recorded (see 4.2.4).

7.5.3.2.2 **Particular requirements for active implantable medical devices and implantable medical devices**

A traceability system for implantable and active implantable medical devices is essential because it might not be possible to inspect the device while it is in use. Traceability can, therefore, avoid unnecessary explantation of implanted devices by precisely identifying those implants which incorporated a component subsequently identified to be faulty, or for which some process control has subsequently been shown to be inadequate. Regulatory requirements for certain higher risk implants can require additional traceability beyond the organization's possession, and the quality management system should take account of these as appropriate.

The organization can achieve traceability by each individual product having an identifier (e.g. serial number, date code, batch code, lot number) unique to the source of operation. Separate identifiers could be required for changes in operative personnel, changes in raw materials, changes in tooling, new or different machine set-ups, changes in process methods, etc. Traceability identifiers should appear on applicable inspection and stock records (see 4.2.4).

There can be situations where traceability requires identification of the specific personnel involved in each phase of product processing or delivery. A sequence of individuals can perform successive service functions, each of which is to be traceable. The recording of identification evidence through signatures on serially numbered documents in invoicing and banking operations are examples. Here there is no tangible product as such, but each individual's identification evidence should be traceable.

7.5.3.3 Status Identification

The organization shall identify the product status with respect to monitoring and measurement requirements.

The identification of product status shall be maintained throughout production, storage, installation and servicing of the product to ensure that only product that has passed the required inspections and tests (or released under an authorized concession) is dispatched, used or installed.

7.5.3.3 Status Identification

Status can be indicated by marking, location, tagging or signing, either physically or by electronic means. The status should indicate whether or not a product has been inspected and tested and either

— accepted as fully meeting requirements,
— accepted with identified nonconformities under concession,
— put on hold awaiting further analysis/decision, or
— rejected as unsatisfactory.

Separate physical location of these categories of a product is often the most certain method of assuring both the status and accurate disposition. However, in an automated process, accurate disposition can equally as well be achieved by other means, such as by using a computer database.

Any marking materials, used for indication of inspection and test status, applied to medical devices or components should not have a deleterious effect on product performance.

7.5.4 Customer property

The organization shall exercise care with customer property while it is under the organization's control or being used by the organization. The organization shall identify, verify, protect and safeguard customer property provided for use or incorporation into the product. If any customer property is lost, damaged or otherwise found to be unsuitable for use, this shall be reported to the customer and records maintained (see 4.2.4).

NOTE Customer property can include intellectual property or confidential health information.

7.5.4 Customer property

The organization should identify responsibilities in relation to property and other assets owned by customers and under the control of the organization, in order to protect the value of the property.

Examples of such property are
— ingredients or components supplied for inclusion in a product,
— product supplied for repair, maintenance or upgrading,
— product supplied for further processing (for example, packaging, sterilization or testing packaging materials supplied directly by the customer),
— services provided on behalf of the customer (such as transport of customer property to a third party), and
— customer intellectual property (including specifications, drawings and proprietary information).

The organization retains the responsibility for the protection of customer property awaiting further processing when it provides these to external organizations for services such as storage and contract sterilization.

7.5.5 Preservation of product

The organization shall establish documented procedures or documented work instructions for preserving the conformity of product during internal processing and delivery to the intended destination. This preservation shall include identification, handling, packaging, storage and protection. Preservation shall also apply to the constituent parts of a product.

The organization shall establish documented procedures or documented work instructions for the control of product with a limited shelf- life or requiring special storage conditions. Such special storage conditions shall be controlled and recorded (see 4.2.4).

7.5.5 Preservation of product

Consideration should be given to the various types of delivery and variations in environmental conditions which can be encountered.

The organization's method for handling product may need to consider providing equipment such as anti-static wrist straps, gloves and protective clothing, and transportation units such as pallets, containers, conveyors, vessels, tanks, rigging, pipelines and vehicles. This is necessary so that damage, deterioration or contamination due to vibration, shock, abrasion, corrosion, temperature variation, electrostatic discharge, radiation or any other conditions occurring during handling and storage, can be prevented. Maintenance of handling equipment is another factor to be considered.

The product's packaging materials and packing should provide adequate protection against damage to the product. During storage and transportation up to the point of use, the packaging of medical devices is intended to provide appropriate protection against damage, deterioration or contamination of the product.

The organization has to provide suitable storage facilities, considering not only physical security but also environmental conditions (e.g. temperature and humidity). It may be appropriate to periodically check items in storage to detect possible deterioration. Consideration may need to be given to administrative procedures for product expiration dates, stock rotation and lot segregation.

Examples of preservation measures include the maintaining of
— sterile conditions for medical equipment,
— dust and static free conditions for semiconductors,
— control of temperature/humidity and hygienic conditions, and
— protection for fragile products.

The identification of items with a limited shelf life, or which require special protection during storage and transportation, is important to ensure that such items are not used if their shelf live has expired. The organization therefore should define the product shelf life applicable under specified storage conditions. Such special storage conditions shall be controlled and recorded (see 4.2.4).

7.6 Control of monitoring and measuring devices

The organization shall determine the monitoring and measurement to be undertaken and the monitoring and measuring devices needed to provide evidence of conformity of product to determined requirements (see 7.2.1).

The organization shall establish documented procedures to ensure that monitoring and measurement can be carried out and are carried out in a manner that is consistent with the monitoring and measurement requirements.

Where necessary to ensure valid results, measuring equipment shall

— be calibrated or verified at specified intervals, or prior to use, against measurement standards traceable to international or national measurement standards; where no such standards exist, the basis used for calibration or verification shall be recorded;

— be adjusted or re-adjusted as necessary;

— be identified to enable the calibration status to be determined;

— be safeguarded from adjustments that would invalidate the measurement result;

— be protected from damage and deterioration during handling, maintenance and storage.

In addition, the organization shall assess and record the validity of the previous measuring results when the equipment is found not to conform to requirements. The organization shall take appropriate action on the equipment and any product affected. Records of the results of calibration and verification shall be maintained (see 4.2.4).

When used in the monitoring and measurement of specified requirements, the ability of computer software to satisfy the intended application shall be confirmed. This shall be undertaken prior to initial use and reconfirmed as necessary.

NOTE See ISO 10012-1 and ISO 10012-2 for guidance.

7.6 Control of monitoring and measuring devices

Although the requirements pertain explicitly to monitoring and measuring devices, including test software, it is helpful to approach the subject from the perspective that measuring is itself a process involving materials,

equipment and procedures. The intent of the requirements is to give the organization confidence in the monitoring and measuring devices which it uses to ensure that what is being produced meets customer and regulatory requirements.

Statistical methods are important in showing which monitoring and measuring devices are used in a manner which ensures measurement uncertainty is known and is consistent with the required measurement capability.

The requirements of this subclause also should be applied by the organization when demonstrating the conformity of the product to the specified requirements. This can involve measurements subsequent to production and inspection of a product, for example, during handling, storage, packaging, preservation, delivery or servicing.

Documented procedures should include details of equipment type, unique identification, location, frequency of checks, check method, and acceptance criteria.

Some monitoring and measuring devices are not used for purposes which affect the quality of the product or service provided by the organization. As a result, the following examples are not necessarily part of the organization's control programme

— instruments which are used to provide an indication only, e.g. a pressure gauge used only to determine the existence of line pressure, but not used to control the actual manufacturing process, or a pressure gauge on a fire extinguisher or on a sprinkler system;
— instruments which are associated with business administration, e.g. clocks to control working times, thermostats to control operator comfort;
— instruments which can be attached to process equipment, but are not used for process control.

Some monitoring and measuring devices which require initial calibration or certification need not be included in the control programme. Examples of such equipment are

— mercury-in-glass thermometers, and
— laboratory volumetric measurement glassware which is not exposed to processes or environments which might affect its calibration.

Monitoring and measuring materials intended to provide a qualitative reference should be stored and maintained in a location which does not compromise the integrity of the material.

Software applications related to the control and/or calibration of monitoring and measuring devices should be validated (see also 7.5.2.2.1). Examples include software used for

— controlling the instrument calibration process,
— determining the control or calibration status of instruments based on the data generated during the process, and
— scheduling the calibration of equipment, if the scheduling is not backed up by a manual, e.g. calibration label or other system.

For general background and guidance on the management of monitoring and measuring equipment, it is recommended that ISO 10012-1 be consulted. It should be recognized that the requirements and guidance in ISO 10012-1 are not mandatory and do not add to, or otherwise change, the requirements of ISO 13485.

8 Measurement, analysis and improvement

8.1 General

The organization shall plan and implement the monitoring, measurement, analysis and improvement processes needed

— to demonstrate conformity of the product,

— to ensure conformity of the quality management system, and

— to maintain the effectiveness of the quality management system.

This shall include determination of applicable methods, including statistical techniques, and the extent of their use.

NOTE National or regional regulations can require documented procedures for implementation and control of the application of statistical techniques.

8 Measurement, analysis and improvement

8.1 General

If documented procedures for inspection and testing activities are required, they usually include details of test methods, acceptance and rejection criteria, and equipment to be used.

The organization‘s procedures should ensure that the integrity of the inspection and test results are not compromised, particularly if testing is done by persons with potential conflicts of interest, such as suppliers or production personnel.

The use of statistical methods can be beneficial to the organization in a wide range of circumstances, including data collection, analysis and application. These techniques are useful for demonstrating process capability, as well as product conformity to specified requirements. They assist in deciding what data to obtain, and in making the best use of the data to gain a better understanding of customer requirements and expectations. Statistical methods may also find uses in

— designing product and processes,
— controlling processes,
— avoiding nonconformity,
— analyzing problems,
— determining risk,
— investigating root causes,
— establishing product and process limits,
— forecasting,
— verifying and validating products or processes, and
— measuring or assessing quality characteristics.

— Among the statistical methods which can be beneficial for these purposes are the following
— graphical methods (histograms, sequence charts, scatter plots, Pareto diagrams, cause and effect diagrams, etc.) which help diagnose problems and suggest appropriate computational approaches for further statistical diagnosis;
— statistical control charts for monitoring and controlling production and measurement processes for all types of product (hardware, software, processed materials and services);
— design of experiments for determining which candidate variables have significant influence on process and product performance, and for quantifying the effects;
— regression analysis which provides a quantitative model for the behaviour of a process or a product when the conditions of process operation or product design are changed;
— analysis of variance (separating the total observed variability), leading to variance component estimates useful for designing sample structures for control charts, for product characterization and release, and for prioritizing quality improvement efforts based on the magnitudes for the variance components;
— methods of sampling and acceptance;
— sampling at all stages of production; and
— statistical methods for inspections and testing.

Once the appropriate statistical techniques are chosen, it is important to implement those techniques in such a manner that appropriate data are collected and evaluated, and the results are reported to the relevant departmental functions, so that necessary actions can be taken. The data resulting from the application of statistical techniques can be an effective means of demonstrating conformity to requirements for quality and can be used as quality

records. The documentation of such techniques and the records resulting from them may be subject to regulatory requirements.

For additional guidance on statistical techniques see ISO /TR 10017 – Guidance on statistical techniques for ISO 9001:1994

Measurement, and analysis include the following considerations
— measurement data should be converted to information and knowledge to be of benefit to the organization,
— measurement, and analysis of products and processes should be used to establish appropriate priorities for the organization, and
— measurement methods employed by the organization should be reviewed as necessary.

8.2 Monitoring and measurement

8.2.1 Feedback

As one of the measurements of the performance of the quality management system, the organization shall monitor information relating to whether the organization has met customer requirements. The methods for obtaining and using this information shall be determined.

The organization shall establish a documented procedure for a feedback system [see 7.2.3 c)] to provide early warning of quality problems and for input into the corrective and preventive action processes (see 8.5.2 and 8.5.3).

If national or regional regulations require the organization to gain experience from the post-production phase, the review of this experience shall form part of the feedback system (see 8.5.1).

8.2 Monitoring and measurement

8.2.1 Feedback

Management should recognise that many sources exist for obtaining customer-related information. This information is useful for providing feedback related to the quality of medical devices and related services. The organization should identify relevant sources of such information and establish an effective process to collect, analyse and use the information for monitoring quality problems. The process established must be documented, so that regulatory requirements are met.

Examples of customer-related information which demonstrates whether or not the requirements of customers and other interested parties have been met, include
— customer and user surveys,
— feedback on aspects of product,
— customer requirements and contract information,
— market needs,
— regulatory agency compliance-related communications,
— peer-reviewed journals,
— service delivery data, and
— information relating to competition.

As part of its requirement to provide early warning of quality problems, vigilance or post-market surveillance systems are typically implemented by regulated organizations. Additional guidance on such systems is found in the GHTF and EU MEDDEV 2.12/1-rev. 4 Guidance for medical devices vigilance systems

8.2.2 Internal audit

The organization shall conduct internal audits at planned intervals to determine whether the quality management system

— conforms to the planned arrangements (see 7.1), to the requirements of this International Standard and to the quality management system requirements established by the organization, and

— is effectively implemented and maintained.

An audit programme shall be planned, taking into consideration the status and importance of the processes and areas to be audited, as well as the results of previous audits. The audit criteria, scope, frequency and methods shall be defined. Selection of auditors and conduct of audits shall ensure objectivity and impartiality of the audit process. Auditors shall not audit their own work.

The responsibilities and requirements for planning and conducting audits, and for reporting results and maintaining records (see 4.2.4) shall be defined in a documented procedure.

The management responsible for the area being audited shall ensure that actions are taken without undue delay to eliminate detected nonconformities and their causes. Follow-up activities shall include the verification of the actions taken and the reporting of verification results (see 8.5.2).

NOTE See ISO 19011.

8.2.2 Internal audit

In addition to the periodic internal audits, an special internal audit may be initiated for the following purposes
— when evaluating the quality management system initially, if there is a desire to establish a contractual relationship;
— when verifying that the quality management system continues to meet specified requirements and is being implemented, if required within the framework of a contractual relationship;
— when undergoing significant changes in functional areas, for example, reorganizations or revising procedures;
— when investigating safety, performance or dependability of the products which are, or which are suspected to be, in jeopardy due to nonconformities; and
— when verifying which required corrective actions have been taken and have been effective.

Planning for internal audits should be flexible in order to permit changes in emphasis based on findings and objective evidence obtained during the audit. Relevant input from the area to be audited, as well as from other interested parties such as customers, corporate audit plans, or third-party assessment organizations, should be considered in the development of internal audit plans.

The results of audits are usually stated in a written report (see 4.2.4) which indicates the deficiencies found and the corrective action(s) required. Avoiding undue delay is usually accomplished by including appropriate target dates for responding to audit findings. The audit results have to be communicated, and should be used as an input to management reviews (see 5.6.2).

A series of limited, well-defined audits can be as effective as one single comprehensive audit. Such an audit system can be operated flexibly to give special, or repeat, attention to any areas of weakness or of other concern.

Internal audits can be partially or fully subcontracted.

8.2.3 Monitoring and measurement of processes

The organization shall apply suitable methods for monitoring and, where applicable, measurement of the quality management system processes. These methods shall demonstrate the ability of the processes to achieve planned results. When planned results are not achieved,

correction and corrective action shall be taken, as appropriate, to ensure conformity of the product.

8.2.3 Monitoring and measurement of processes

No additional guidance is provide for this subclause.

> **8.2.4 Monitoring and measurement of product**
>
> **8.2.4.1 General requirements**
>
> The organization shall monitor and measure the characteristics of the product to verify that product requirements have been met. This shall be carried out at appropriate stages of the product realization process in accordance with the planned arrangements (see 7.1) and documented procedures (see 7.5.1.1).
>
> Evidence of conformity with the acceptance criteria shall be maintained. Records shall indicate the person(s) authorizing release of product (see 4.2.4).
>
> Product release and service delivery shall not proceed until the planned arrangements (see 7.1) have been satisfactorily completed.

8.2.4 Monitoring and measurement of product

8.2.4.1 General requirements

In-process inspection and testing includes all such activities between the acceptance of incoming materials and submission of the medical device for final inspection. The results of in-process inspection and testing can be used both for process control and for the early identification of nonconforming product.

Final inspection involves activities (examination, inspection, measurement or test) upon which the final release of product is based. Records of previously performed inspection and testing results can also be reviewed.

The specified requirements forming the basis of final inspection and test should include all designated release criteria. These should be directly related to the type of medical device involved and its intended use. Final inspection and testing should provide objective evidence of conformance with all designated release criteria which have not been confirmed through previous inspection and testing. Final testing can include, if practical, testing under simulated or actual conditions of use, and using products selected from a lot or batch.

In the case of equipment which is assembled and/or installed at the user's premises, any additional inspection and testing should be carried out after completion of assembly/installation. In such cases, these inspection and testing activities are not necessarily carried out by the organization, but the device manufacturer should ensure the availability of all necessary information about the inspection and test procedure and the results expected (see also 6.3, 6.4, 7.5.1, 7.5.1.2, 7.5.2).

When selecting measurement methods for ensuring that products conform to requirements and when considering customer requirements, the organization should consider the following

— the types of product characteristics, that then determine the types of measurement, suitable measurement means, the accuracy required and skills needed;
— the equipment, software and tools required;
— the location of suitable measurement points in the realization process sequence;
— the characteristics to be measured at each point, and the documentation and acceptance criteria to be used;
— the customer-established points for witness or verification of selected characteristics of a product;

- the inspections or testing required to be witnessed or performed by statutory and regulatory authorities;
- the timing and manner in which the organization intends, or is required by the customer or statutory and regulatory authorities, to engage qualified third parties to perform
  - type testing,
  - in-process inspections or testing,
  - product verification,
  - product validation, and
  - product qualification;
- the qualification of people, materials, products, processes, and the quality management system;
- the final inspection to confirm that verification activities have been completed and accepted; and,
- the recording the results of product measurements.

The organization's inspection and test records (see 4.2.4) should facilitate assessment of in-process and finished products having fulfilled the requirements for quality. Purchased products are monitored under the provisions of subclause 7.4.3.

As applicable, records of monitoring and measurements may
- identify the inspection/test procedure(s) and revision level used (see also 4.2.3),
- identify the test equipment used,
- include test data,
- be signed and dated by the person responsible for the inspection or test,
- clearly identify the number of items examined and the number accepted, and
- record the disposition of any items failing inspection or test, and the reasons for failure.

8.2.4.2 Particular requirement for active implantable medical devices and implantable medical devices

The organization shall record (see 4.2.4) the identity of personnel performing any inspection or testing.

8.2.4.2 Particular requirements for active implantable and implantable devices

In addition to inspection and test records (see 4.2.4), the organization may record the identity of personnel performing any inspection or testing of active implantable or implantable devices to provide traceability, and to increase its confidence that in-process and finished products meet specified requirements.

8.3 Control of nonconforming product

The organization shall ensure that product which does not conform to product requirements is identified and controlled to prevent its unintended use or delivery. The controls and related responsibilities and authorities for dealing with nonconforming product shall be defined in a documented procedure.

The organization shall deal with nonconforming product by one or more of the following ways:

— by taking action to eliminate the detected nonconformity;

— by authorizing its use, release or acceptance under concession. The organization shall ensure that nonconforming product is accepted by concession only if regulatory requirements are met. Records of the identity of the person(s) authorizing the concession shall be maintained (see 4.2.4);

— by taking action to preclude its original intended use or application.

Records of the nature of nonconformities and any subsequent actions taken, including concessions obtained, shall be maintained (see 4.2.4).

When nonconforming product is corrected it shall be subject to re-verification to demonstrate conformity to the requirements.

When nonconforming product is detected after delivery or use has started, the organization shall take action appropriate to the effects, or potential effects, of the nonconformity.

If product needs to be reworked (one or more times), the organization shall document the rework process in a work instruction that has undergone the same authorization and approval procedure as the original work instruction. Prior to authorization and approval of the work instruction, a determination of any adverse effect of the rework upon product shall be made and documented (see 4.2.3 and 7.5.1).

8.3 Control of nonconforming product

People in the organization should be empowered with the authority and responsibility to report nonconformities at any stage of a process in order to ensure timely detection and disposition of nonconformities.

The management of the organization should ensure the establishment of an effective process to provide for review and disposition of identified nonconformities.

Nonconforming product includes nonconforming product occurring in the organization's own facilities as well as to nonconforming product received by the organization. Procedures established and maintained by the organization should have the following purposes

— to determine which product is involved in the nonconformity, for example, what production time interval, production machines or products are involved;
— to identify the nonconforming product to make sure that it can be distinguished from the conforming product (see 7.5.3);
— to document the existence and source of the nonconformity;
— to evaluate the nature of the nonconformity;
— to consider the alternatives for the disposition of the nonconforming product;
— to decide upon and record what disposition should be made;
— to control (e.g. by physical segregation) the subsequent processing of the nonconforming product consistent with the disposition decision;
— to notify others who may be affected by the nonconformity including, if appropriate, the customer.

When a nonconformity is determined, the organization should take steps to investigate and eliminate the reason for the occurrence of the nonconformity (Corrective Action) as well as determine what do to with (disposition of) the nonconforming product. If the nonconforming product is to be used, accepted or released, the organization should decide to do so either by correcting the nonconforming product and then reevaluating it, or by using the product as is.

If the organization chooses to use, accept or release nonconforming product when a nonconformity exists, the organization has made a "concession." Concessions are a tool used to minimize the financial impact to the organization as it relates to the disposition of nonconforming products. In such instances of concessions being made, the organization may not relinquish regulatory responsibilities for medical devices and related services. Each concession should be reviewed to ensure that the nonconformity does not conflict with any regulatory requirement. The identity of the person(s) within the organization who authorizes each concession should be maintained in a record, and this record should include information documenting that regulatory requirements have been fully met.

"Correction" refers to repair, rework, or adjustment and relates to the disposition of an existing nonconformity, whereas the "Corrective Action" relates to the elimination of the causes of nonconformity (see 8.5.2).

Actions taken when nonconforming product is detected after delivery or use has started is sometimes referred to as

"product recall." Because the term "recall" has different definitions in different national or regional jurisdictions, its use in ISO 13485 has been avoided when describing such activities.

The procedures for dealing with nonconformities discovered in product which has already been shipped can include taking such actions as

— withdrawing products from sale,
— withdrawing products from distribution,
— giving advice to customers (this can take the form of checks to be carried out before use, providing additional guidance on the use of the product or the replacement of certain products), or
— in extreme cases, requesting the physical return or destruction of products.

Information concerning nonconforming items should be provided to all appropriate personnel, so that action is taken, if necessary, to identify and correct the cause of the nonconformity and prevent recurrence (see 8.5).

Any product returned to the organization should be treated as potentially nonconforming product until it has satisfied a documented acceptance procedure. For any returned product for which there is a risk of biological contamination, consideration should be given to hazardous materials regulatory requirements (see, for example, ISO 12891-1).

Control should be established over the disposal of nonconforming material designated as scrap to ensure that

— its status is clearly identified,
— it cannot be confused with conforming product,
— it cannot re-enter the production system, and
— it is disposed of safely.

8.4 Analysis of data

The organization shall establish documented procedures to determine, collect and analyse appropriate data to demonstrate the suitability and effectiveness of the quality management system and to evaluate if improvement of the effectiveness of the quality management system can be made. This shall include data generated as a result of monitoring and measurement and from other relevant sources.

The analysis of data shall provide information relating to

— feedback (see 8.2.1),

— conformity to product requirements (see 7.2.1),

— characteristics and trends of processes and products including opportunities for preventive action, and

— suppliers.

Records of the results of the analysis of data shall be maintained (see 4.2.4).

8.4 Analysis of data

Data should be collected and analyzed in order to verify the ongoing suitability and effectiveness of the quality management system and to determine if there are any trends or patterns which require attention. Negative trends should be considered for improvement. The results of the analysis of data should be an input to management review.

Analysis of data can help to determine the root cause of existing or potential problems, and thereby to guide decisions about the corrective and preventive actions needed for improvement.

For an evaluation of the effectiveness of the quality management system, data and information from all parts of the organization should be integrated and analyzed. The results of this analysis can be used by the organization to determine

— trends in product conformance,
— extent to which customer requirements are being met,
— process effectiveness,
— supplier performance, and
— success of performance improvement objectives.

> **8.5 Improvement**
>
> **8.5.1 General**
>
> The organization shall identify and implement any changes necessary to ensure and maintain the continued suitability and effectiveness of the quality management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and management review.
>
> The organization shall establish documented procedures for the issue and implementation of advisory notices. These procedures shall be capable of being implemented at any time.
>
> Records of all customer complaint investigations shall be maintained (see 4.2.4). If investigation determines that the activities outside the organization contributed to the customer complaint, relevant information shall be exchanged between the organizations involved (see 4.1).
>
> If any customer complaint is not followed by corrective and/or preventive action, the reason shall be authorised (see 5.5.1) and recorded (see 4.2.4).
>
> If national or regional regulations require, the organization shall establish documented procedures to notify the regulatory authorities of those adverse events which meet the reporting criteria.

8.5 Improvement

8.5.1 General

For the purposes of this standard, “improvement” activities are those which identify and implement any changes necessary to ensure and maintain the continued suitability and effectiveness of the quality management system to meet the requirements of the customer. If the need for corrective or preventative action is identified, this is an indication that the quality management system has unexpectedly not been suitable or fully effective in a particular area. Correcting the problem or potential problem by implementing corrective or preventative action to bring the quality management system back to a fully suitable and effective state is considered to be improvement. While most organisations will consider “improvement” in a broader sense than this for business reasons, for the purposes of this standard improvement is limited to corrective and preventative action.

Customer complaints
Any customer complaint received by the organization on a product should be evaluated. Customer complaints and warranty claims are the most common external indications of product deficiency which may be subject to correction and corrective or preventative action to prevent recurrence of the problem.. Some organisations may consider other sections within the same organisations to be customers. In this case internal complaints can be treated as customer complaints and processed accordingly. If non-conforming product is involved, this should also be handled according to the requirements of Section 8.3 of the standard.

In evaluating the complaint, it should be considered whether the product fails to conform to its specification, or conforms with its specifications but nevertheless causes problems in use. For instance, a complaint with a product conforming to its specifications may be caused by a design fault. Complaints related to handling may indicate inadequate instructions for use.

Regulatory requirements can place requirements on organizations to monitor the use of their products and to inform regulatory authorities of certain defined experience in use.

The organization should formally designate a person(s) (by role or position) to collect and coordinate all written and oral customer complaints about devices. This person(s) should have the authority to ensure immediate review of any complaint, particularly those relating to injury, death or any hazard.

The investigation of a complaint may determine that activities outside the organisation may be involved. The other organisation site may be unrelated (e.g. a subcontractor or authorised representative), but may also be within the same organisation (e.g. another division or the Head Office). Whoever the other party is, arrangements must be such that there is two-way communication of whatever information is needed to properly investigate and resolve the complaint. This will normally be provided for in the contract with the other party.

The documented complaints system should cover the following
— establishing responsibility for operating the system,
— evaluating the complaint,
— creating records and statistical summaries to enable the major causes of complaints to be determined,
— taking any corrective action,
— segregating and disposing of customer returns and faulty stock (special attention may need to be given to decontamination), and
— filing of customer correspondence and other relevant records (the retention time for these should be defined).

The records of complaint investigations should contain enough information to show that the complaint was properly reviewed, for example a determination of whether or not
— there was an actual product failure to perform per specifications,
— the product was being used to treat or diagnose a patient,
— a death, injury or serious illness was involved; or
— there was any relationship of the product to the reported incident or adverse event.

An investigation record typically includes
— the name of the product,
— the date the complaint was received,
— the control number used,
— the name and address of the complainant,
— the nature of the complaint,
— the results of the investigation,
— the corrective action taken,
— the justification if no action is taken,
— the dates of the investigation,
— the name of the investigator, and
— the reply (if any) to the complainant.

Advisory notices
National or regional regulatory requirements may require that advisory notices be reported to designated regulatory authorities.

In some countries “advisory notices” are considered to include notices of medical devices that need to be corrected in order to be safe and perform as intended, as well as nonconforming devices that cannot be corrected and must be removed from the market. In other countries an advisory notice is a notice of correction needed to a medical device in order to maintain it’s safety and effectiveness and a notice of nonconforming devices that must be removed from the market is defined as a “recall”. Many countries have specific regulatory procedures for processing advisory notices and recall. These must be included in the quality management system.

The nature and seriousness of the hazard or nonconformity, the intended use of the product, and the potential for patient injury or failure to meet regulatory requirements, will determine whether it will be necessary to issue an advisory notice and to report to local or national authorities. These factors will also determine the urgency and extent of the action.

The procedures for generating, authorizing and issuing an advisory notice should specify:
— the management arrangements which enable the procedure to be activated, even in the absence of key personnel;
— the level of management authorized to initiate corrective action, and the method of determining the affected products;
— the system for determining the disposition of returned product, for example, rework, re-package, scrap; and
— the communication system (which includes the necessity to report to local or national authorities), the points of contact and the methods of communication between the organization and national authorities.

An advisory notice should provide
— a description of the medical device and model designation,
— the serial numbers or other identification (for instance batch or lot numbers) of the medical devices concerned,
— the reason for the issue of the notice,
— any advice regarding possible hazards, and
— any consequent actions to be taken.

If a product is returned to the organization, the progress of agreed corrective actions should be monitored and, if appropriate, the quantities of product physically returned to the medical device manufacturer or scrapped locally or corrected locally should be reconciled.

8.5.2 Corrective action

The organization shall take action to eliminate the cause of nonconformities in order to prevent recurrence. Corrective actions shall be appropriate to the effects of the nonconformities encountered.

A documented procedure shall be established to define requirements for

— reviewing nonconformities (including customer complaints),

— determining the causes of nonconformities,

— evaluating the need for action to ensure that nonconformities do not recur,

— determining and implementing action needed, including, if appropriate, updating documentation (see 4.2),

— records of the results of any investigation and of action taken (see 4.2.4), and

— reviewing corrective action taken and its effectiveness.

8.5.2 Corrective action

Corrective action is the action taken to prevent recurrence of a nonconformance which has already occurred. If nonconforming product is involved, this is handled according to clause 8.3 and the action taken to prevent recurrence of the nonconforming product is handled under this subclause (8.5.2).

The organization's corrective action procedures should clearly establish responsibility for taking corrective action, when and how this action will be carried out, and verification of the effectiveness of the corrective action. An important element in the program is the dissemination of quality problem information to those directly responsible for ensuring quality.

Causes of detected nonconformities should promptly be identified so that corrective action can be taken and recurrence prevented. These causes can include the following

— failures, malfunctions or nonconformities in incoming materials, processes, tools, equipment or facilities in which products are processed, stored or handled, including the equipment and systems therein,
— inadequate or non-existent procedures and documentation,
— non-compliance with procedures,
— inadequate process control,
— poor scheduling,
— lack of training,
— inadequate working conditions,
— inadequate resources (human or material), and
— inherent process variability.

— Input to corrective action can come from many sources, including the following
— inspection and test records,
— validation study results,
— nonconformity records,
— observations during process monitoring,
— audit observations,
— field, service or customer complaints,
— regulatory authority or customer observations,
— observations and reports by personnel,
— supplier problems,
— management review results,
— solicited information on new or modified products,
— published literature, and
— published reports of failures of similar products.

Key features of the documented procedure(s) necessary to effectively implement corrective action typically include
— clear and accurate identification of the nonconformity,
— details of the investigation conducted including consideration of what other product(s), process(e) or procedure(s) might have been affected,
— identification of the root cause of the nonconformity,
— identification of the action required to prevent recurrence of the problem,
— any necessary approvals required before any action is taken,
— a record that the identified corrective action was taken,
— a check that the corrective action taken was effective (in other words verification that the nonconformance is unlikely to recur).

The degree of corrective action taken should be dependent upon and related to the risk, size and nature of the problem and its effect(s) on product quality. For example, the level of investigation to determine the cause of the nonconformity, the work done to determine and verify the appropriateness of corrective action, and the level of documentation kept, would be far more extensive for a nonconformity relating to the failure of a medical device compared to a less serious nonconformity such as the failure to conduct an internal audit when scheduled.

Corrective action should be implemented without undue delay.

8.5.3 Preventive action

The organization shall determine action to eliminate the causes of potential nonconformities in order to prevent their occurrence. Preventive actions shall be appropriate to the effects of the potential problems.

A documented procedure shall be established to define requirements for

— determining potential nonconformities and their causes,

— evaluating the need for action to prevent occurrence of nonconformities,

— determining and implementing action needed,

— records of the results of any investigations and of action taken (see 4.2.4), and

— reviewing preventive action taken and its effectiveness.

8.5.3 Preventive action

Preventive action is taken when a potential nonconformity is identified as the result of an analysis of records and other relevant sources of information

The degree of preventive action taken should be dependent upon and related to the risk, size and nature of the problem and its effect(s) on product quality.

Sources for information for initiating preventive actions include
— purchased items rejected on receipt,
— products requiring rework,
— in-process problems, wastage levels,
— final inspection failures,
— customer feedback,
— warranty claims,
— process measurements,
— statistical process control documents,
— difficulties with suppliers (see 7.4.1),
— service reports, and,
— the need for concessions.

Annex A

(informative)

Terms used in certain regulatory administrations to describe documents referenced in this Technical Report

	Document	USA	EU	Japan
A	A compilation of records which describes and records the history of the design activity (see 7.3 and 4.2.4 of ISO 13485). Examples include (but are not limited to): calculations, design inputs, requirements and specifications, design testing reports, risk analyses, design reviews, design verification and validation reports (including clinical investigation results), product labelling, and design changes and related records, etc.	DHF Design History File	Referred to as Technical Documentation and Design Dossier	Part of Seihin Hyojunsho
B	A compilation of documents based on the device design activity which specify how the device is to be produced (see 4.2.1, 7.1 of ISO 13485). Examples include (but are not limited to): specifications for raw materials, packaging, and labelling, process/product specifications, engineering drawings, parts lists, work instructions (including equipment operation), sterilization procedures (if applicable), quality plan, and manufacturing/testing/inspection procedures and acceptance criteria, etc.	DMR Device Master Record	Referred to as Technical Documentation and Design Dossier	Seihin Hyojunsho
C	A compilation of records containing the production/ manufacturing history to demonstrate conformity with (approved) pre-production documents (see 4.2.4 of ISO 13485). Example include (but are not limited to): manufacturing test reports, lot or batch records, travellers, functional test reports, actual labelling, etc.	DHR Device History Record	Manufacturing records	Quality Records

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