ICS 11.080.01 SLOVENSKÁ TECHNICKÁ NORMA September 2024

STN	**Aseptické spracovanie výrobkov na zdravotnú starostlivosť Časť 1: Všeobecné požiadavky (ISO 13408-1: 2023)**	**STN EN ISO 13408-1** 85 6537

Aseptic processing of health care products - Part 1: General requirements (ISO 13408-1:2023)

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 08/24

Obsahuje: EN ISO 13408-1:2024, ISO 13408-1:2023

Oznámením tejto normy sa ruší
STN EN ISO 13408-1 (85 6537) z novembra 2015

138812

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 13408-1

April 2024

ICS 11.080.01 Supersedes EN ISO 13408-1:2015

English Version

Aseptic processing of health care products - Part 1: General requirements (ISO 13408-1:2023)

Traitement aseptique des produits de santé - Partie 1: Exigences générales (ISO 13408-1:2023)

Aseptische Herstellung von Produkten für die Gesundheitsfürsorge - Teil 1: Allgemeine Anforderungen (ISO 13408-1:2023)

This European Standard was approved by CEN on 2 July 2023.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. EN ISO 13408-1:2024 E

EN ISO 13408-1:2024 (E)

Contents

Page

European foreword

This document (EN ISO 13408-1:2024) has been prepared by Technical Committee ISO/TC 198 "Sterilization of health care products" in collaboration with Technical Committee CEN/TC 204 “Sterilization of medical devices” the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2024, and conflicting national standards shall be withdrawn at the latest by October 2024.

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

This document supersedes EN ISO 13408-1:2015.

This document has been prepared under a standardization request addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

For the relationship with EU Legislation, see informative Annex ZA and ZB, which is an integral part of this document.

Any feedback and questions on this document should be directed to the users’ national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Endorsement notice

The text of ISO 13408-1:2023 has been approved by CEN as EN ISO 13408-1:2024 without any modification.

Annex ZA
(informative)

Relationship between this European Standard and the General Safety and Performance requirements of Regulation (EU) 2017/745 aimed to be covered

This European standard has been prepared under M/575 to provide one voluntary means of conforming to the General Safety and Performance Requirements of Regulation (EU) 2017/745 of 5 April 2017 concerning medical devices [OJ L 117] and to system or process requirements including those relating to quality management systems, risk management, post-market surveillance systems, clinical investigations, clinical evaluation or post-market clinical follow-up.

Once this standard is cited in the Official Journal of the European Union under that Regulation, compliance with the normative clauses of this standard given in Table ZA.1 and application of the edition of the normatively referenced standards as given in Table ZA.2 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding General Safety and Performance Requirements of that Regulation, and associated EFTA Regulations.

Where a definition in this standard differs from a definition of the same term set out in Regulation (EU) 2017/745, the differences shall be indicated in this Annex Z. For the purpose of using this standard in support of the requirements set out in Regulation (EU) 2017/745, the definitions set out in this Regulation prevail.

Where the European standard is an adoption of an International Standard, the scope of this standard can differ from the scope of the European Regulation that it supports. As the scope of the applicable regulatory requirements differ from nation to nation and region to region, the standard can only support European regulatory requirements to the extent of the scope of the European regulation for medical devices (EU) 2017/745).

NOTE 1 Where a reference from a clause of this standard to the risk management process is made, the risk management process needs to be in compliance with Regulation (EU) 2017/745. This means that risks have to be ‘reduced as far as possible’, ‘reduced to the lowest possible level’, ‘reduced as far as possible and appropriate’, ‘removed or reduced as far as possible’, ‘eliminated or reduced as far as possible’, ’removed or minimized as far as possible’, or ‘minimized’, according to the wording of the corresponding General Safety and Performance Requirement.

NOTE 2 The manufacturer’s policy for determining **acceptable risk** must be in compliance with General Safety and Performance Requirements 1, 2, 3, 4, 5, 8, 9, 10, 11, 14, 16, 17, 18, 19, 20, 21 and 22 of the Regulation.

NOTE 3 When a General Safety and Performance Requirement does not appear in Table ZA.1, it means that it is not addressed by this European Standard.

Table ZA.1 — Correspondence between this European Standard and Annex I of Regulation (EU) 2017/745 [OJ L 117] and to system or process requirements including those relating to quality management systems, risk management, post-market surveillance systems, clinical investigations, clinical evaluation or post-market clinical follow-up

General Safety and Performance Requirements of Regulation (EU) 2017/745	Clause(s)/sub-clause(s) of this EN	Remarks/Notes
11.3	4,5,6,7,8,9	This standard provides general requirements for processes, programs and procedures for development, validation and routine control of aseptic processing. This General Safety and Performance Requirement is addressed only with regard to devices for which use of aseptic processing is appropriate. This General Safety and Performance Requirement is only partly addressed in this European Standard. Design and packaging for maintenance of sterility are not covered. Aspects of manufacture other than those related to maintenance of a specific microbial state by aseptic processing are not covered.
11.4 first sentence only	4,5,6,7,8,9	This standard provides general requirements for processes, programs and procedures for development, validation and routine control of aseptic processing. This General Safety and Performance Requirement is addressed only with regard to devices for which use of aseptic processing is appropriate. This General Safety and Performance Requirement is only partly addressed in this European Standard. Design and packaging for maintenance of sterility are not covered. Evidence that the integrity of the packaging is maintained to the point of use is not covered. Aspects of manufacture other than those related to maintenance of sterility during aseptic processing are not covered. Transport and storage conditions are not covered.
11.5	4,5,6,7,8,9	This standard provides general requirements for processes, programs and procedures for development, validation and routine control of aseptic processing. This General Safety and Performance Requirement is addressed only with regard

General Safety and Performance Requirements of Regulation (EU) 2017/745	Clause(s)/sub-clause(s) of this EN	Remarks/Notes
		to devices for which use of aseptic processing is appropriate. This General Safety and Performance Requirement is only partly addressed in this European Standard. Design and packaging for maintenance of sterility are not covered. Aspects of manufacture other than those related to maintenance of sterility during aseptic processing are not covered.

Table ZA.2 — Applicable Standards to confer presumption of conformity as described in this Annex ZA

Column 1 Reference in Clause 2	Column 2 International Standard Edition	Column 3 Title	Column 4 Corresponding European Standard Edition
ISO 13408-2	ISO 13408-2:2018	Aseptic processing of health care products — Part 2: Sterilizing filtration	EN ISO 13408-2:2018
ISO 13408-6	ISO 13408-6:2021	Aseptic processing of health care products — Part 6: Isolator systems	EN ISO 13408-6:2021
ISO 14644-1:2015	ISO 14644-1:2015	Cleanrooms and associated controlled environments — Part 1: Classification of air cleanliness by particle concentration	EN ISO 14644-1:2015
ISO 14644-2	ISO 14644-2:2015	Cleanrooms and associated controlled environments — Part 2: Monitoring to provide evidence of cleanroom performance related to air cleanliness by particle concentration	EN ISO 14644-2:2015
ISO 14664-4	ISO 14664-4:2001	Cleanrooms and associated controlled environments — Part 4: Design, construction and start-up	EN ISO 14664-4:2001
ISO 14644-7	ISO 14644-7:2004	Cleanrooms and associated controlled environments — Part 7: Separative devices (clean air hoods, gloveboxes, isolators and mini-environments)	EN ISO 14644-7:2004

The documents listed in the Column 1 of Table ZA.2, in whole or in part, are normatively referenced in this document and are indispensable for its application. The achievement of the presumption of conformity is subject to the application of the edition of Standards as listed in Column 4 or, if no European Standard Edition exists, the International Standard Edition given in Column 2 of Table ZA.2.

WARNING 1 Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

Annex ZB
(informative)

Relationship between this European Standard and the General Safety and Performance Requirements of Regulation (EU) 2017/746 aimed to be covered

This European standard has been prepared under M/575 to provide one voluntary means of conforming to the General Safety and Performance Requirements of Regulation (EU) 2017/746 of 5 April 2017 concerning in vitro diagnostic medical devices [OJ L 117] and to system or process requirements including those relating to quality management systems, risk management, post-market surveillance systems, performance studies, clinical evidence or post-market performance follow-up.

Once this standard is cited in the Official Journal of the European Union under that Regulation, compliance with the normative clauses of this standard given in Table ZB.1 and application of the edition of the normatively referenced standards as given in Table ZA.2 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding General Safety and Performance Requirements of that Regulation, and associated EFTA Regulations.

Where a definition in this standard differs from a definition of the same term set out in Regulation (EU) 2017/746, the differences shall be indicated in the Annex Z. For the purpose of using this standard in support of the requirements set out in Regulation (EU) 2017/746, the definitions set out in this Regulation prevail.

Where the European standard is an adoption of an International Standard, the scope of this standard can differ from the scope of the European Regulation that it supports. As the scope of the applicable regulatory requirements differ from nation to nation and region to region, the standard can only support European regulatory requirements to the extent of the scope of the In vitro Diagnostic Regulation (EU) 2017/746).

NOTE 1 Where a reference from a clause of this standard to the risk management process is made, the risk management process needs to be in compliance with Regulation (EU) 2017/746. This means that risks have to be ‘reduced as far as possible’, ‘reduced to a level as low as reasonably practicable’, ‘reduced to the lowest possible level’, ‘reduced as far as possible and appropriate’, ‘removed or reduced as far as possible’, ‘eliminated or reduced as far as possible’, ‘prevented’ or ‘minimized’, according to the wording of the corresponding General Safety and Performance Requirement.

NOTE 2 The manufacturer’s policy for determining **acceptable risk** must be in compliance with General Safety and Performance Requirements 1, 2, 3, 4, 5, 8, 10, 11, 13, 15, 16, 17, 18 and 19 of the Regulation.

NOTE 3 When a General Safety and Performance Requirement does not appear in Table ZB.1, it means that it is not addressed by this European Standard.

Table ZB.1 — Correspondence between this European standard and Annex I of Regulation (EU) 2017/746 [OJ L 117] and to system or process requirements including those relating to quality management systems, risk management, post-market surveillance systems, performance studies, clinical evidence or post-market performance follow-up

General Safety and Performance Requirements of Regulation (EU) 2017/746	Clause(s)/sub-clause(s) of this EN	Remarks/Notes
11.2	4,5,6,7,8,9	This standard provides general requirements for processes, programs and procedures for development, validation and routine control of aseptic processing. This General Safety and Performance Requirement is addressed only with regard to devices for which use of aseptic processing is appropriate. This General Safety and Performance Requirement is only partly addressed in this European Standard. Design and packaging for maintenance of sterility are not covered. Aspects of manufacture other than those related to maintenance of a specific microbial state by aseptic processing are not covered. Transport and storage conditions are not covered.
11.3	4,5,6,7,8,9	This standard provides general requirements for processes, programs and procedures for development, validation and routine control of aseptic processing. This General Safety and Performance Requirement is addressed only with regard to devices for which use of aseptic processing is appropriate. This General Safety and Performance Requirement is only partly addressed in this European Standard. Design and packaging for maintenance of sterility are not covered. Aspects of manufacture other than those related to maintenance of sterility during aseptic processing are not covered.

WARNING 1 Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

INTERNATIONAL STANDARD

ISO 13408-1

Third edition
2023-08

Aseptic processing of health care products —

Part 1: General requirements

Traitement aseptique des produits de santé —

Partie 1: Exigences générales

Reference number
ISO 13408-1:2023(E)

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

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

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

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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

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

This document was prepared by Technical Committee ISO/TC 198, *Sterilization of health care products,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 204, *Sterilization of medical devices,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 13408-1:2008) which has been technically revised. It also incorporates ISO 13408-1:2008/Amd 1: 2013.

The main changes are as follows:

— a complete restructuring of the document;

— inclusion of a diagram to explain the relationship between the ISO 13408 series and ISO 18362;

— revision of the normative references;

— alignment of definitions with ISO 11139:2018;

— positioning of the document to recognize current and future advances in sterile manufacturing technology, acknowledging that new approaches to aseptic processing are transforming classical aseptic processing;

— promotion of aseptic processing principles and the systematic implementation of quality risk management (QRM), including for aseptic process design, and microbiological contamination and particulate contamination control;

— provision of guidance for different types of aseptic processing, for example, manual processing systems to automated robotic processing systems;

— deletion of tables from the previous edition of this document referring to acceptance criteria for process simulation (media fill) qualification and requalification;

— encouraging adoption of advanced aseptic processing technologies and continuous process improvement to improve assurance of sterility;

— recognition that alternative or rapid microbiological methods (RMMs) provide timely microbiological data vital for process monitoring and control, and for product release;

— inclusion of a series of informative annexes providing guidance on defining an aseptic process, including risks to be considered, aseptic processing areas (APAs), classification of cleanrooms, aseptic process flow, closed systems and robotics, and qualification of a cleanroom clothing system.

A list of all parts in the ISO 13408 series can be found on the ISO website.

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

Introduction

Wherever possible, health care products intended to be sterile should be terminally sterilized in their final sealed container by a terminal sterilization process, which has been validated to achieve a specified sterility assurance level (SAL). ISO/TC 198 has developed standards for terminal sterilization of health care products, for example (but not restricted to): the ISO 11137 series (radiation sterilization), ISO 17665-1 (moist heat sterilization), ISO 20857 (dry heat sterilization), ISO 11135 (ethylene oxide sterilization) and ISO 14160 (liquid chemical sterilization).

Where a health care product is intended to be sterile and cannot withstand terminal sterilization in its final container, aseptic processing provides an acceptable alternative for product manufacture.

ISO/TC 198 also developed ISO/TS 19930, which provides guidance on aspects of a risk-based approach to assuring sterility of terminally sterilized, single-use health care product that is unable to withstand processing to achieve maximally a 10^{-6} SAL.

Aseptic processing produces a sterile product in its final container by the assembly of component parts (e.g. product, container and container closure) that have been sterilized separately by validated and controlled processes suitable for each component part. Each of these assembly processes can introduce error that can result in product contamination. Furthermore, contamination can be introduced from the personnel, equipment or environment when the sterilized components are brought together to create the final product. It is important to control all possible sources of contamination so that the aseptic manufacturing process maintains sterility of previously-sterilized components during product filling or assembly, and sealing. Fundamentally, aseptic processing minimises the probability of a chance event of microbial contamination occurring. The rationale to use aseptic processing is product dependent and is not based solely on manufacturing considerations.

Examples of applications in which aseptic processing is used include:

— aseptic handling and filling of solutions, suspensions, semisolids and powders;

— aseptic handling, transfer and packaging of solid products including solid medical devices;

— aseptic handling, transfer and packaging of combination products;

— aseptic handling of tissues or biological production systems (e.g. vaccines).

Sterilization processes for product and components used as a prerequisite for aseptic processing are established and validated separately to aseptic processing activities.

Traditionally, aseptic processing has been carried out in cleanrooms and associated controlled environments to provide an environment in which the air supply, materials, equipment and operators are regulated to maintain sterility of previously-sterilized components. Advances in aseptic processing include systems that prevent the direct intervention of operators with open-product containers or exposed-product contact surfaces in the critical processing zone, for example, the use of fully enclosed barrier systems (e.g. isolators), automation and robotics. This can mean that a traditional cleanroom is not always appropriate for aseptic processing activities.

To provide assurance of sterility for an aseptically processed product, this document identifies three key activities in the development and operation of an aseptic process to reduce and control particulate and microbial contamination risks:

— process design;

— risk assessment;

— contamination control strategy (CCS).

An effective risk management approach is an essential tool for the development, validation and control of aseptic processing. Only when risks of particulate and microbiological contamination have been

identified, and where possible eliminated, or minimized and controlled, can an aseptic process be considered suitable for its intended purpose.

Controls for some infectious agents, e.g. protozoa or parasites, can require a multifaceted approach to assure component or product safety. These types of infectious agents are not considered in the ISO/TC 198 standards for terminal sterilization or aseptic processing. Guidance can be found in ISO 18362 applicable good manufacturing practice (GMP) regulations and the EDQM guide[28].

This document describes the fundamental requirements of aseptic processing regardless of the nature of the aseptic process, e.g. small-scale versus large-scale, open- versus closed-processing, single-use, disposable sterile systems, traditional cleanroom versus isolator systems, manual versus automated or robotic systems, autologous sterile products, processes with post-aseptic lethal treatments and processes using real-time microbiological monitoring. It does not, however, describe the requirements for other manufacturing processes upstream or downstream of aseptic processing activities. This document acknowledges the different geographical regulatory approaches to aseptic processing and recognizes that new approaches to aseptic processing are transforming classical aseptic processing. It recognizes that future improvements in aseptic processing rely on improved use of technology for both existing and new products, for example, sterile advanced therapy medicinal products.

To encourage adoption of suitable, advanced aseptic processing technologies and continuous process monitoring, this document introduces the concept of recognising efforts in risk-based process design, particulate and microbiological contamination control and risk management, to justify consideration of alternative approaches to demonstrating ongoing process effectiveness, for instance reduced frequency of requalification, sampling, or for real-time release of finished product.

Assurance of sterility for an aseptically processed product should not be confused with the term, ‘sterility assurance level (SAL)’. SAL is a mathematical extrapolation applicable only to a validated and controlled terminal sterilization process of known microbial lethality and which is delivered to each individual sealed unit of product subject to that process. Due to the variability and chance nature of occurrence of microbial contamination during aseptic processing, aseptic process simulation (APS) does not result in a mathematical probability of there being a single, viable microorganism in a contaminated unit, but rather results in an indication of what can happen in the routine processing of subsequent product batches (see ISO/TS 19930:2017, Clause 4).

This document specifies the requirements for general aspects of aseptic processing of health care products. Requirements and guidance for other processes often employed during aseptic processing are specified in ISO 13408-2 to ISO 13408-7, i.e. sterilizing filtration (ISO 13408-2), lyophilization (ISO 13408-3), clean-in-place (CIP) technologies (ISO 13408-4), sterilization in place (SIP) (ISO 13408-5), isolator systems (ISO 13408-6) and alternative processes for medical devices and combination products (ISO 13408-7).

ISO 18362 specifies the minimum requirements for, and provides guidance on, a risk-based approach for the processing of cell-based health care products (CBHPs) requiring control of viable and non-viable microbial contamination. It is applicable to CBHPs labelled ‘sterile’, as well as to those that are not labelled ‘sterile’. For aseptic processing of CBHPs to be labelled sterile, ISO 18362 refers normatively to this document and ISO 13408-7. A CBHP that incorporates non-sterile starting material cannot meet the ISO 11139 definition of aseptic processing, which amongst other things, requires the use of sterile product and components. ISO 18362, therefore also includes requirements and guidance for the processing of such products to reduce and control microbial contamination risks.

The relationship between the ISO 13408 series and ISO 18362 is shown in Figure 1.

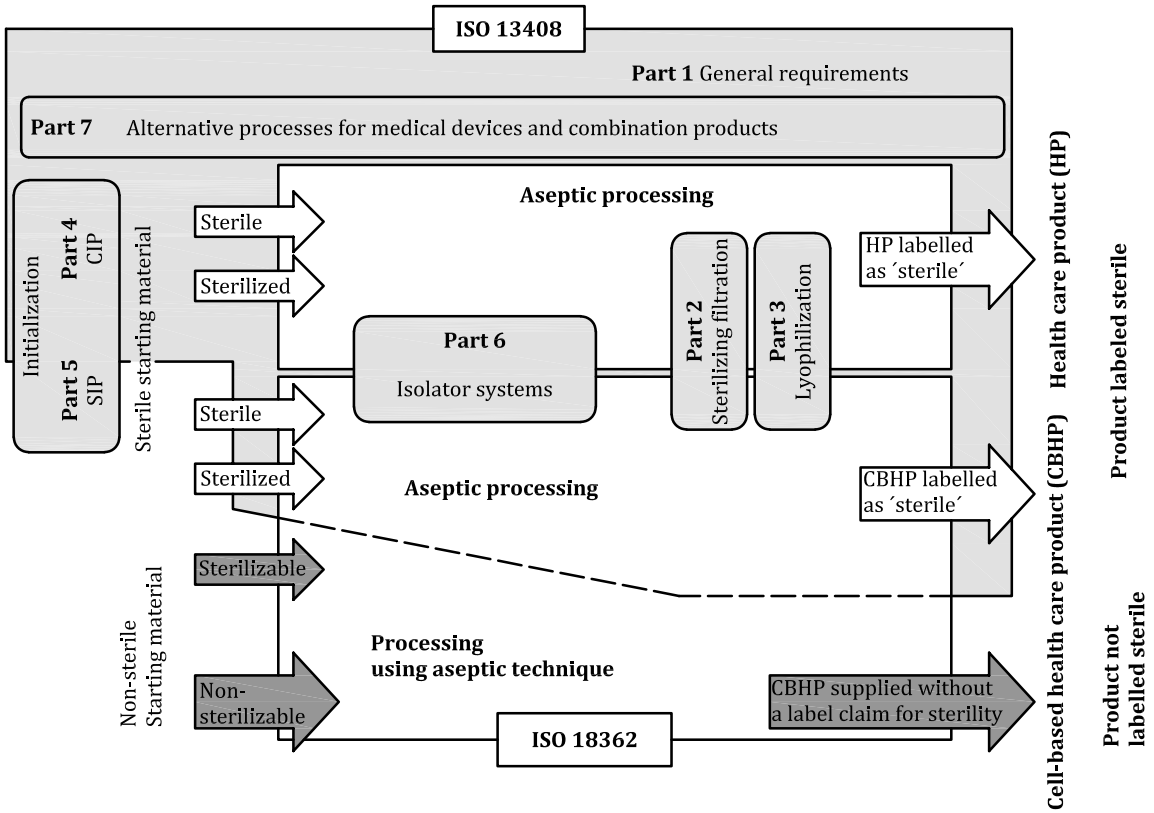

Figure 1 — Relationship between the ISO 13408 series and ISO 18362

INTERNATIONAL STANDARD **ISO 13408-1:2023(E)**

Aseptic processing of health care products —

Part 1:
General requirements

1 Scope

This document specifies the general requirements for, and offers guidance on, processes, programs and procedures for development, validation and routine control of aseptic processing of health care products.

This document includes requirements and guidance relative to the overall topic of aseptic processing.

Specific requirements and guidance on various specialized processes and methods related to sterilizing filtration, lyophilization, clean-in place (CIP) technologies, sterilization in place (SIP) and isolator systems are given in the other parts of the ISO 13408 series.

2 Normative references

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

ISO 13408-2, *Aseptic processing of health care products — Part 2: Sterilizing filtration*

ISO 13408-6, *Aseptic processing of health care products — Part 6: Isolator systems*

ISO 14644-1:2015, *Cleanrooms and associated controlled environments — Part 1: Classification of air cleanliness by particle concentration*

ISO 14644-2, *Cleanrooms and associated controlled environments — Part 2: Monitoring to provide evidence of cleanroom performance related to air cleanliness by particle concentration*

ISO 14644-4, *Cleanrooms and associated controlled environments — Part 4: Design, construction and start-up*

ISO 14644-7, *Cleanrooms and associated controlled environments — Part 7: Separative devices (clean air hoods, gloveboxes, isolators and mini-environments)*