HEALTH SCIENCES AUTHORITY

REGULATORY GUIDANCE

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MEDICAL DEVICE GUIDANCE

GN-16: Guidance on Essential Principles for Safety and Performance of Medical Devices

Revision 4

HSA
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**Where applicable, changes and updates made in each document revision are annotated with or within the arrow symbol "►". Deletions may not be shown.*

1. INTRODUCTION

1.1. Purpose

This document provides an overview on meeting the essential principles of safety and performance of medical device.

1.2. Background

For a medical device to be supplied in Singapore, it must conform to the Essential Principles of Safety and Performance for the medical device. Medical device dealers in Singapore are responsible to ensure that the relevant Essential Principles of Safety and Performance are met, making reference to internationally recognised standards, or equivalent. All medical devices supplied in Singapore, regardless of whether the respective medical device requires registration or has an exception from product registration requirements (e.g. Class A medical devices), are required to conform to the Essential Principles of Safety and Performance.

Medical devices that conform to a standard will be considered to have met safety, effectiveness and/or labelling requirements that are addressed by the standard. Further evidence in support of safety and effectiveness requirements not covered by the standard will still be required. Typical standards used to show conformance to having a quality management system in place is the ISO13485 standard. In the case where the medical devices are supplied sterile, the dealers are to ensure that the relevant validations are conducted in conformance to internationally acceptable standards, depending on the state of art method that is deemed appropriate considering the properties and characteristics of the respective medical devices. Some of the commonly used sterilisation standards include:

- ISO 11135 Sterilization of health-care products – Ethylene Oxide
- ISO 11137 Sterilization of health care products – Radiation

NOTE: For Class A medical devices, that have an exception from registration requirements, dealers are required to keep on file, records to demonstrate that

the devices are conforming to the Essential Principles and have been manufactured under appropriate quality management systems (e.g. ISO 13485). For sterile Class A devices, records to demonstrate that sterilisation conform to the requirements in the relevant sterilisation standards should be maintained.

The regulatory framework does not dictate how a product owner should prove that their medical device has met the essential principles, hence providing flexibility to the product owners and catering to technological advances and changes in the development of new medical devices.

For purposes of medical device registration in Singapore, evidence of conformity to Essential Principles of Safety and Performance can be provided in the form of a tabular checklist with supporting documentation to demonstrate conformity. A sample of the Essential Principles conformity checklists is included in Annex 2 for ease of reference.

NOTE: The earlier version of the Singapore Essential Principles conformity checklist (Dec 2017 version) has been included as Annex 3 of this guidance document. This version will continue to be accepted for purposes of registration in Singapore. Registrants may choose to submit either version of the Singapore Essential Principles conformity checklist (i.e. Annex 2 or Annex 3) for device registration. Essential Principles conformity checklists prepared for approvals in our reference regulatory agency jurisdictions (e.g. European Union (EU) or Therapeutic Goods Administration of Australia (TGA)) will continue to be accepted for device registration in Singapore.

1.3. Scope

This document is applicable to all medical devices (including IVD medical devices) that are to be supplied in Singapore.

1.4. Definitions

Definitions that do not indicate they are set out in the Health Products Act (*Act*) or Health Products (Medical Devices) Regulations 2010 (*Regulations*) are intended as guidance in this document. These definitions are not taken verbatim from the above legislation and should not be used in any legal context. These definitions are meant to provide guidance in layman terms.

ACTIVE MEDICAL DEVICE *(as set out in the Regulations)*: means any medical device, the operation of which depends on a source of electrical energy or any source of power other than that directly generated by the human body or gravity and which acts by converting this energy, but does not include any medical device intended to transmit energy, substances or other element between that medical device and a patient without any significant change to that energy, substance or element.

ANALYTICAL PERFORMANCE (OF AN IVD MEDICAL DEVICE): The ability of an IVD medical device to detect or measure a particular analyte.

CLINICAL DATA: Safety and/or performance information that are generated from the clinical use of a medical device.

CLINICAL EVALUATION: The assessment and analysis of clinical data pertaining to a medical device to verify the clinical safety and performance of the device when used as intended by the product owner.

CLINICAL EVIDENCE: The clinical data and the clinical evaluation report pertaining to a medical device.

CLINICAL EVIDENCE (FOR AN IVD MEDICAL DEVICE): All the information that supports the scientific validity and performance for its use as intended by the product owner.

CLINICAL INVESTIGATION: means any designed and planned systematic study undertaken on human subjects to verify the safety or performance of a specific medical device.

CLINICAL PERFORMANCE: The ability of a medical device to achieve its intended purpose as claimed by the product owner.

CLINICAL PERFORMANCE (OF AN IVD MEDICAL DEVICE): The ability of an IVD medical device to yield results that are correlated with a particular clinical condition/physiological state in accordance with target population and intended user.

HAZARD *(as set out in the Regulations)*: means any potential source of harm.

INTENDED PURPOSE/INTENDED USE *(as set out in the Regulations)*: in relation to a medical device or its process or service, means the objective intended use or purpose, as reflected in the specifications, instructions and information provided by the product owner of the medical device.

IN VITRO DIAGNOSTIC (IVD) PRODUCT *(as set out in the Regulations)*: means any reagent, reagent product, calibrator, control material, kit, instrument, apparatus, equipment or system, whether used alone or in combination with any other reagent, reagent product, calibrator, control material, kit, instrument, apparatus, equipment or system, that is intended by its product owner to be used in vitro for the examination of any specimen, including any blood or tissue donation, derived from the human body, solely or principally for the purpose of providing information —

(i) concerning a physiological or pathological state or a congenital abnormality;

(ii) to determine the safety and compatibility of any blood or tissue donation with a potential recipient thereof; or

(iii) to monitor therapeutic measures; and

includes a specimen receptacle;

LAY PERSON: An individual who does not have formal training in a relevant field or discipline.

LABEL (*as set out in the Act*): in relation to a health product or an active ingredient, means any written, printed or graphic representation that appears on or is attached to the health product or active ingredient or any part of its packaging, and includes any information sheet or leaflet that accompanies the health product or active ingredient when it is being supplied.

LABELLING the label, instructions for use, and any other information that is related to identification, technical description, intended purpose and proper use of the medical device, but excluding shipping documents.

PACKAGING: Product to be used for the containment, protection, handling, delivery, storage, transport and presentation of goods, from raw materials to processed goods, from the producer to the user or consumer, including processor, assembler or other intermediary.

PATIENT: An individual under the care of a healthcare provider who may benefit from the action of a medical device. A patient may also be a user of a medical device.

PERFORMANCE: The ability of a medical device to achieve its intended purpose as stated by the product owner. Performance may include both clinical and technical aspects.

PERFORMANCE EVALUATION (OF AN IVD MEDICAL DEVICE): Assessment and analysis of data to establish or verify the scientific validity, the analytical and, where applicable, the clinical performance of an IVD medical device.

PERFORMANCE (OF AN IVD MEDICAL DEVICE): The ability of an IVD medical device to achieve its intended use/intended purpose as claimed by the product owner. The performance of an IVD medical device consists of the

analytical and, where applicable, the clinical performance supporting the intended use of the IVD medical device.

PRODUCT OWNER *(as set out in the Regulations)*: in relation to a health product, means a person who —

- supplies the health product under his own name, or under any trade mark, design, trade name or other name or mark owned or controlled by him; and
- is responsible for designing, manufacturing, assembling, processing, labelling, packaging, refurbishing or modifying the health product, or for assigning to it a purpose, whether those tasks are performed by him or on his behalf.

RECOGNISED STANDARDS: Standards deemed to offer the presumption of conformity to specific essential principles of safety and performance.

RISK *(as set out in the Regulations)*: means a combination of the probability of occurrence of harm and the severity of that harm.

RISK ANALYSIS: Systematic use of available information to identify hazards and to estimate the risk.

RISK ASSESSMENT: Overall process comprising a risk analysis and a risk evaluation.

RISK EVALUATION: Procedure based on the risk analysis to determine whether tolerable risk has been exceeded.

SELF-TESTING: Testing performed by lay persons.

SHELF-LIFE: Period of time until the expiry date during which a medical device in its original packaging maintains its stability under the storage conditions specified by the product owner.

SINGLE FAULT CONDITION: Refers to a condition in which a medical device fails, but the backup feature for protection against fault in the medical device does not fail.

STABILITY: Ability of a medical device to maintain its performance characteristics within the product owner's specifications.

NOTE 1: Stability applies to

- Sterile and non-sterile medical devices whose physical, chemical or functional properties may be altered or compromised over a stated time interval;
- IVD reagents, calibrators and controls, when stored, transported and used in the conditions specified by the product owner,
- Reconstituted lyophilized materials, working solutions and material removed from sealed containers, when prepare, used and stored according to the product owner's instructions for use,
- Measuring instruments or measuring systems after calibration.

NOTE 2: Stability of an IVD reagent or measuring system is normally quantified with respect to time

- In terms of the duration of a time interval over which a measured property changes by a stated amount or
- In terms of the change of a property under specified conditions.

STATE OF THE ART: Developed stage of technical capability at a given time as regards products, processes and services, based on the relevant consolidated findings of science, technology and experience.

TRANSMISSIBLE AGENT: Refers to any agent capable of being transmitted to a person as a communicable disease, an infectious disease or a contagious disease.

USER: The person, professional or lay, who uses a medical device. The patient may be that user.

R3 ►

UNIQUE DEVICE IDENTIFIER (UDI): a series of numeric or alphanumeric characters that is created through a globally accepted device identification and coding standard. It allows the unambiguous identification of a specific medical device on the market. The UDI is comprised of the UDI-DI and UDI-PI.

Note: The word "Unique" does not imply serialisation of individual production units. ◄

2. ESSENTIAL PRINCIPLES OF SAFETY AND PERFORMANCE OF MEDICAL DEVICES

A product owner of a medical device must design and manufacture a product that is safe and performs as intended throughout its life cycle. This guidance document describes the fundamental design and manufacturing requirements, referred to as 'Essential Principles of Safety and Performance', to ensure this outcome. There are two categories of essential principles: one that applies to all medical devices, including IVD medical devices and second, there are specific essential principles, for medical devices other than IVD medical devices (general medical devices and combination medical devices) and specific essential principles for IVD medical devices.

The essential design and manufacturing principles are grouped as:

- General requirements
- Clinical evaluation
- Chemical, physical and biological properties,
- Sterility, packaging and microbial contamination
- Considerations of environment and conditions of use,
- Requirements for active medical devices connected to or equipped with an energy source,
- Medical devices that incorporate software or are standalone software or mobile applications
- Medical devices with a diagnostic or measuring function
- Labelling and Instructions for use
- Protection against electrical, mechanical and thermal risks,
- Protection against radiation
- Protection against the risks posed by medical devices intended by product owner for use by lay persons,
- Medical devices incorporating materials of biological origin

NOTE The product owner selects which of the design and manufacturing requirements are relevant to a particular medical device, documenting the reasons for excluding the others.

R3 ► Medical devices should be labelled with a Unique Device Identifier (UDI) on the device package labels and/or directly marked on the devices, where applicable. The UDI should be presented in both human readable interpretation (HRI) format and Automated Identification for Data Capture (AIDC) technology forms such as linear bar codes, two-dimensional bar codes, QR codes, RFID. UDI-DI and related information should be submitted to the Authority based on the risk class of individual devices and their respective compliance dates as published in GN-36 *Guidance on Medical Device Unique Device Identification (UDI) System*.

Additional information on the UDI format, contents of the label and data fields to be submitted can be found in this GN-36 *Guidance on Medical Device Unique Device Identification (UDI) System*. Medical devices should meet the UDI requirements described above to conform to the Essential Principles of Safety and Performance. ◄

3. ROLES OF STANDARDS IN MEETING ESSENTIAL PRINCIPLES OF SAFETY AND PERFORMANCE

3.1. What is a standard?

A standard is a document, established by consensus and approved by a recognised body that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.

3.2. Types of standards

Basic standard (also known as horizontal standard): Standard indicating fundamental concepts, principles and requirements, with regard to general safety and performance aspects which are applicable to all kinds or a wide range of products and/or processes (e.g., standards concerning risk management, clinical investigation and the quality management system for the manufacture of medical devices).

Group standard (also known as semi-horizontal standard): Standard indicating aspects applicable to families of similar products and/or processes making reference as far as possible to basic standards (e.g., standards concerning sterile medical devices, electrically-powered medical devices, stability of IVD reagents).

Product standard (also known as vertical standard): Standard indicating necessary safety and performance aspects of specific products and/or processes, making reference, as far as possible, to basic standards and group standards (e.g., standards for infusion pumps, for anaesthetic machines or for blood glucose meters for self-testing).

3.3. Source of standards

Standards are drawn up at international, regional and national level. There are 3 major international standardisation bodies:

- International Electrotechnical Commission (IEC) for electricity, electronics and related technologies;
- International Telecommunications Union (ITU) for telecommunications and radiocommunications;
- International Organisation for Standardisation (ISO) for nearly all other technical fields, service sectors, management systems and conformity assessment.

Examples of standard bodies at the regional levels are European Committee for Standardisation (CEN), European Committee for Electrotechnical Standardisation (CENELEC), European Telecommunications Standards Institute (ETSI), the African Regional Organisation for Standardisation (ARSO) and the Pan American Standards Commission (COPANT).

Examples of standards bodies at the national levels are Standards, Productivity and Innovation Board (SPRING Singapore), Association for the Advancement of Medical Instrumentation (AAMI), American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), British Standards Institution (BSI), German Institute for Standardisation (DIN), Japanese Industrial Standards Committee (JISC), etc.

3.4. Applicability of standards

Standards can serve different purposes. They can:

- provide reference criteria that a product, process or service must meet;
- provide information that enhances safety, reliability and performance of products, processes and services;
- assure consumers about reliability or other characteristics of goods or services provided in the marketplace;
- give consumers more choice by allowing one firm's products to be substituted for, or combined with, those of another.

The use of standards is voluntary. Product owners have the option to select alternative solutions to demonstrate their medical device meets the relevant

Essential Principles. Alternative means of demonstrating conformity with the Essential Principles may include, for example:

- industry agreed methods;
- internal product owner standard operating procedures developed by an individual product owner;
- other sources that describe the current state of technology and practice related to performance, material, design, methods, processes or practices.

The acceptability of such other solutions should be justified and may be subject to review by the Authority, as appropriate.

3.5. Technical documentation

The product owner must retain or be able to provide documentation to demonstrate that the device conforms to the selected standard or alternative means of meeting the Essential Principles. This also applies to medical devices that do not require registration for supply in Singapore, such as Class A medical devices.

Documentation may include for example, the standard itself, how it was applied, deviations, test results, relevant pass/fail criteria when these are not specifically stated in the standard and/or other outputs.

When a standard is not applied, or is not applied in full, the product owner should retain, and submit where appropriate, data or information to demonstrate:

- that conformity with the Essential Principles has been achieved by other means, and/or
- that the parts of the standard that were not applied were not pertinent to the particular device in question.

A declaration of conformity to a recognised standard is to be included as part of product registration.

ANNEX 1

Essential Principles of Safety and Performance of Medical devices

General requirements

1. Medical devices should be designed and manufactured in such a way that, when used under the conditions and for the purposes intended and, where applicable, by virtue of the technical knowledge, experience, education or training of intended users, they will not compromise the clinical condition or the safety of patients, or the safety and health of users or, where applicable, other persons, provided that any risks which may be associated with their use constitute acceptable risks when weighed against the benefits to the patient and are compatible with a high level of protection of health and safety.

2. Product owners should establish, implement, document and maintain a risk management system to ensure the ongoing quality, safety and performance of the medical device. Risk management should be understood as a continuous iterative process throughout the entire lifecycle of a medical device, requiring regular systematic updating. In carrying out risk management, product owners should:

   a) establish and document a risk management plan for covering each medical device;

   b) identify and analyse the known and foreseeable hazards associated with each medical device;

   c) estimate and evaluate the risks associated with, and occurring during, the intended use and during reasonably foreseeable misuse;

   d) eliminate or control the risks referred to in point (c) in accordance with the requirements of points 3 and 4 below;

   e) evaluate the impact of information from the production phase and, in particular, from the post-market surveillance system, on hazardous situations and the frequency of occurrence thereof, on estimates of their associated risks, as well as on the overall risk, benefit-risk determination and risk acceptability; and

f) based on the evaluation of the impact of the information referred to in point (e), if necessary amend control measures in line with the requirements of points 3 and 4 below.

3. Risk control measures adopted by the product owner for the design and manufacture of the devices should conform to safety principles, taking account of the generally acknowledged state of the art. When risk reduction is required, the product owner should control the risk(s) so that the residual risk(s) associated with each hazard is judged acceptable. In selecting the most appropriate solutions, product owners should, in the following order of priority:

a) identify known or foreseeable hazards and estimate the associated risks arising from the intended use and foreseeable misuse,

b) eliminate risks as far as reasonably practicable through inherently safe design and manufacture,

c) reduce as low as is reasonably practicable the remaining risks by taking adequate protection measures, including alarms,

d) inform users of any residual risks.

e) provide information for safety (warnings/precautions/contra-indications) and, where appropriate, training to users.

4. In eliminating or reducing risks related to use, the Product owner should:

a) reduce, as low as is reasonably practicable and appropriate, the risks related to the features of the medical device and the environment in which the medical devices are intended to be used (e.g. ergonomic features, tolerance to dust and humidity) and

b) give consideration to the technical knowledge, experience, education, training and use environment and, where applicable, the medical and physical conditions of intended users.

5. The characteristics and performances of a medical device should not be adversely affected to such a degree that the health or safety of the patient or the user and, where applicable, of other persons are compromised during the expected lifetime of the device, as indicated by the product owner, when the medical device is subjected to the stresses which can occur during intended conditions of use and has been

properly maintained and calibrated (if applicable) in accordance with the product owner's instructions.

6. Medical devices should be designed, manufactured and packaged in such a way that their characteristics and performances, including the integrity and cleanliness of the product and when used in accordance with the intended use, are not adversely affected under transport and storage conditions (for example, through shock, vibrations and fluctuations of temperature and humidity), taking account of the instructions and information provided by the product owner. The performance, safety and sterility of the medical device should be maintained throughout any shelf-life specified by the product owner.

7. Medical devices should have the stability necessary to maintain essential performance conditions in a period of time and conditions previously established during the shelf-life, during the time of use after being opened (for IVDs, including after being installed in the instrument), and during transportation or dispatch when under conditions other than storage conditions.

8. All known and foreseeable risks, and any undesirable side-effects, should be minimized and be acceptable when weighed against the evaluated benefits arising from the achieved performance of the medical device during intended conditions of use taking into account the generally acknowledged state of the art.

9. Clinical evaluation

9.1 Every medical device requires clinical evidence, appropriate for the use and classification of the device, demonstrating that the device complies with the applicable provisions of the essential principles. A clinical evaluation should be conducted.

9.2 A clinical evaluation should assess clinical data to establish that a favourable benefit-risk determination exists for the medical device in the form of one or more of the following:

- clinical investigation reports (for IVDs, clinical performance evaluation reports)

- published scientific literature reviews
- clinical experience

9.3 Clinical investigations should be conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. These principles protect the rights, safety and well-being of human subjects, which are the most important considerations and shall prevail over interests of science and society. These principles shall be understood, observed, and applied at every step in the clinical investigation.

R4 ► Note: Such clinical investigations are generally expected to be designed, conducted and reported in accordance with ISO 14155 - *Clinical Investigation of Medical Devices for Human Subjects*, or to a comparable standard, and in compliance with local regulations. ◄

10. Chemical, physical and biological properties

10.1 The medical devices should be designed and manufactured in such a way as to ensure the characteristics and performance referred to in Clauses 1 to 8 of the 'General Requirements'. Particular attention should be paid to:

a) the choice of materials used, particularly as regards toxicity and, where appropriate, flammability,
b) the impact of processes on material properties;
c) where appropriate, the results of biophysical or modelling research whose validity of which has been demonstrated beforehand;
d) the compatibility between the materials used and biological tissues, cells, body fluids, and specimens, taking account of the intended purpose of the device,
e) the choice of materials used should reflect, where appropriate, matters such as strength, ductility, fracture resistance, wear resistance and fatigue resistance.
f) surface properties; and
g) the confirmation that the device meets any defined chemical and/or physical specifications.

10.2 The medical device should be designed, manufactured and packed in such a way as to minimise the risk posed by contaminants and residues to the persons involved in the transport, storage and use of the devices and to patients, taking account of the intended purpose of the product. Particular attention should be paid to tissues exposed to those contaminants and residues and to the duration and frequency of exposure.

10.3 The devices should be designed and manufactured in such a way as to reduce as far as reasonably practicable and appropriate the risks posed by substances that may leach or leak from the device.

10.4 The medical device should be designed and manufactured in such a way as to reduce as far as reasonably practicable and appropriate risks posed by the unintentional ingress into the device taking into account the device and the nature of the environment in which it is intended to be used.

11. Sterility, Packaging and Microbial contamination

11.1 Medical devices and their manufacturing processes should be designed in such a way as to eliminate or to reduce as far as reasonably practicable and appropriate the risk of infection to patients, users and, where applicable, all other persons who may come in contact with the medical device.

The design should:

a) allow easy and safe handling,

and, where necessary:

b) reduce as far as reasonably practicable and appropriate any microbial leakage from the medical device and/or microbial exposure during use;

c) prevent microbial contamination of the medical device, or its content (e.g. specimens); and

d) reduce as low as reasonably practicable and appropriate the risks from unintended exposure (e.g. cuts and pricks (such as needle stick injuries), eye splashes, etc.).

11.2 Medical devices labelled as having a special microbiological state should be designed, manufactured and packed to ensure they remain so when placed on the market and remain so under the transport and storage conditions specified by the product owner.

11.3 Medical devices delivered in a sterile state should be designed, manufactured and packed in a non-reusable pack, and/or according to appropriate procedures, to ensure that they are sterile when placed on the market and remain sterile, under the transport and storage conditions indicated by the product owner, until the protective packaging is damaged or opened.

11.4 Medical devices labelled either as sterile or as having a special microbiological state should have been processed, manufactured and, if applicable, sterilised by appropriate, validated methods. The shelf-life of these medical devices should be determined by validated methods.

11.5 Medical devices intended to be sterilised, either by product owner or user, should be manufactured and packaged in appropriate and controlled (e.g. environmental) conditions and facilities.

11.6 Packaging systems for non-sterile medical devices should keep the product without deterioration at the level of cleanliness stipulated and, if the devices are to be sterilised prior to use, minimise the risk of microbial contamination; the packaging system should be suitable taking account of the method of sterilisation indicated by the product owner.

11.7 The packaging and/or label of the medical device should distinguish between identical or similar products placed on the market in both sterile and non-sterile condition.

11.8 Medical devices meant by the product owner to be reusable, must be designed and manufactured in a way to facilitate appropriate processes to allow reuse, including cleaning, disinfection, packaging and where appropriate, the method of re-sterilisation. The instructions for use should provide information to identify when the device should no longer be reused (e.g. when there are signs of material degradation or the maximum number of allowed reuses).

12. Considerations of Environment and Conditions of Use

12.1 Medical devices should be designed and manufactured in such a way as to eliminate or reduce, as low as reasonably practicable and appropriate, the :

a) risks of injury, in connection with their physical features, including the volume/pressure ratio, dimensional and where appropriate ergonomic features;

b) risks of user error due to the design of the medical device user interface, ergonomic features, and the environment in which the medical device is intended to be used;

c) risks connected with reasonably foreseeable external influences or environmental conditions, such as magnetic fields, external electrical and electromagnetic effects, electrostatic discharge, pressure, humidity, temperature or variations in pressure and acceleration;

d) risks connected to their use in conjunction with materials, substances and gases with which they may come into contact during intended conditions of use;

e) risks associated with the possible negative interaction between software and the information technology (IT) environment within which it operates and interacts;

f) environmental risks from unexpected egress of substances from the medical device during use, taking into account the medical device and the nature of the environment in which it is intended to be used;

g) risks of incorrect identification of specimens;

h) risks of reciprocal interference with other medical devices normally used in diagnosis, monitoring or for the treatment given.

12.2 Medical devices should be designed and manufactured in such a way as to eliminate or reduce, as low as reasonably practicable and appropriate, the risks of fire or explosion during normal use and in single fault condition. Particular attention should be paid to devices whose intended use includes exposure to or use in association with flammable substances or substances which could cause combustion.

12.3 Medical devices should be designed and manufactured in such a way that adjustment, calibration, and maintenance can be done safely and effectively. Specifically,

a) when maintenance is not possible (e.g. with implants), the risks from ageing of materials used, will be eliminated or reduced, as low as reasonably practicable and appropriate).

b) when adjustment and calibration are not possible (e.g. with certain kinds of thermometers), the risks from loss of accuracy of any measuring or control mechanism will be eliminated or reduced, as low as reasonably practicable and appropriate.

12.4 If the device is intended for use in combination with other devices or equipment, the whole combination, including the connection system should be safe and should not impair the specified performance of the devices. Any restrictions on use applying to such combinations should be indicated on the label and/or in the instructions for use.

12.5 Any measurement, monitoring or display scale should be designed and manufactured in line with ergonomic principles, taking account of the intended purpose, users and the environmental conditions in which the medical devices are intended to be used.

12.6 Medical devices must be designed and manufactured in such a way as to facilitate their safe disposal and the safe disposal of any waste substances by the user, patient or other person. The instructions for use should identify safe disposal procedures and measures.

13. Active medical devices connected to or equipped with an energy source

13.1 Medical devices where the safety of the patients depends on an internal power supply should be equipped with a means of determining the state of the power supply and an appropriate warning or indication for when the capacity of the power supply becomes critical.

13.2 Medical devices where the safety of the patients depends on an external power supply should include an alarm system to signal any power failure.

13.3 Medical devices intended to monitor one or more clinical parameters of a patient should be equipped with appropriate alarm systems to alert the user of situations which could lead to death or severe deterioration of the patient's state of health.

13.4 Medical devices should be designed and manufactured in such a way as to eliminate or reduce, as low as reasonably practicable and appropriate, the risks of creating electromagnetic interference which could impair the operation of this or other devices or equipment in the intended environment.

13.5 Medical devices should be designed and manufactured in such a way as to provide an adequate level of intrinsic immunity to electromagnetic disturbance to enable them to operate as intended.

14. Medical devices that incorporate software or are standalone software or mobile applications

14.1 Medical devices that incorporate electronic programmable systems, including software, or are standalone software or mobile applications, should be designed to ensure accuracy, reliability, precision, safety, and performance in line with their intended use. In the event of a single fault condition, appropriate means should be adopted to eliminate or reduce, as far as possible and appropriate, consequent risks or impairment of performance.

14.2 For medical devices that incorporate software or are standalone software or mobile applications, the software should be developed, manufactured and maintained in accordance with the state of the art taking into account the principles of development life cycle (e.g. rapid development cycles, frequent changes, the cumulative effect of changes), risk management (e.g. changes to system, environment, and data), including information security (e.g. safely implement updates), verification and validation (e.g. change management process).

14.3 Software that is intended to be used in combination with generic computing platforms should be designed and developed taking into account the platform itself (e.g. size and contrast ratio of the screen,

connectivity, memory, etc.) and the external factors related to their use (varying environment as regards level of light or noise).

14.4 Product owner should set out minimum requirements concerning hardware, IT networks characteristics and IT security measures, including protection against unauthorised access, necessary to run the software as intended.

15. Medical devices with a diagnostic or measuring function

15.1 Medical devices with a diagnostic or measuring (including monitoring) function, where inaccuracy could have a significant adverse effect on the patient, should be designed and manufactured in such a way as to provide sufficient accuracy, precision and stability for their intended purpose of the device.

a) Where applicable, the limits of accuracy should be indicated by the product owner.

b) Whenever possible, values expressed numerically should be in commonly accepted, standardised units, and understood by users of the medical device.

c) The function of the controls and indicators should be clearly specified on the medical device. Where a medical device bears instructions required for its operation or indicates operating or adjustment parameters by means of a visual system, such information should be understandable to the user and, as appropriate, the patient.

16. Labelling and Instructions for Use

The following principles are the general requirements for labelling and instructions for use. For additional guidance on the contents of the label and instructions for use, please refer to GN-23 *Guidance on Labelling for Medical Devices.*

16.1 Each medical device should be accompanied by the information needed to identify the medical device and its product owner. Each medical devices should also be accompanied by, or direct the user to any safety

and performance information relevant to the user, or any other person, as appropriate. Such information may appear on the medical device itself, on the packaging or in the instructions for use, and should be easily understood.

16.2 The medium, format, content, legibility, and location of the label and instructions for use should be appropriate to the particular medical device, its intended purpose and the technical knowledge, experience, education or training of the intended users. Instructions for use should be written in terms readily understood by the intended user and, where appropriate, supplemented with drawings and diagrams. If instructions for use are insufficient, appropriate training should be provided. Some medical devices should include separate information for the professional user and the lay person.

17. Protection against electrical risks, mechanical and thermal risks

17.1 Medical devices should be designed and manufactured in such a way as to eliminate or reduce, as low as reasonably practicable and appropriate, the risks of accidental electric shocks to the user or any other person, during normal use and in single fault condition, provided the medical device is installed and maintained as indicated by the product owner.

17.2 Medical devices should be designed, manufactured and maintained in such a way as to provide an adequate level of cybersecurity against attempts to gain unauthorised access.

17.3 Medical devices should be designed and manufactured in such a way as to protect, as far as possible and appropriate, against unauthorized access that could hamper the device from functioning as intended or impose a safety concern.

17.4 Medical devices should be designed and manufactured in such a way as to protect the patient and user against mechanical risks connected with, for example, resistance to movement, instability and moving parts.

17.5 Medical devices should be designed and manufactured in such a way as to eliminate or reduce, as low as reasonably practicable and appropriate, the risks arising from vibration generated by the medical device, taking account of technical progress and of the means available for limiting

vibrations, particularly at source, unless the vibrations are part of the specified performance.

17.6 Medical devices should be designed and manufactured in such a way as to eliminate or reduce, as low as reasonably practicable and appropriate, the risks, arising from the noise emitted, taking account of technical progress and of the means available to reduce noise, particularly at source, unless the noise emitted is part of the specified performance.

17.7 Medical devices should be designed and manufactured in such a way as to eliminate or reduce, as low as reasonably practicable and appropriate, the risks of error when certain parts within the device are intended to be connected or reconnected before or during use.

17.8 Terminals and connectors to the electricity, gas or hydraulic and pneumatic energy supplies which the user has to handle should be designed and constructed in such a way as to minimise all possible risks.

17.9 Medical devices (excluding the parts or areas intended to supply heat or reach given temperatures) and their surroundings should not attain potentially dangerous temperatures under intended conditions of use.

18. Protection against radiation

18.1 Medical devices should be designed and manufactured and packaged in such a way that exposure of patients, users and other persons to any emitted radiation should be eliminated or reduced, as low as reasonably practicable and appropriate, compatible with the intended purpose, whilst not restricting the application of appropriate specified levels for therapeutic and diagnostic purposes.

18.2 The operating instructions for medical devices emitting hazardous or potentially hazardous radiation should give detailed information as to the nature of the emitted radiation, means of protecting the patient, user and others, and on ways of avoiding misuse and of eliminating the risks inherent to transport, storage and installation, as far as possible.

18.3 Where medical devices are intended to emit potentially hazardous, visible and/or invisible radiation, they should be fitted, where practicable, with visual displays and/or audible warnings of such emissions.

18.4 Medical devices should be designed and manufactured in such a way that the exposure of patients, users and other persons to the emission of unintended, stray or scattered radiation is reduced as low as practicable and appropriate.

18.5 Medical devices emitting ionising radiation intended for diagnostic radiology should be designed and manufactured in such a way as to achieve appropriate image and/or output quality for the intended medical purpose whilst minimising radiation exposure of the patient and user.

18.6 For medical devices emitting hazardous or potentially hazardous radiation and that require installation, information regarding the acceptance and performance testing, the acceptance criteria, and the maintenance procedure should be specified in the operating instructions.

18.7 Medical devices intended to emit hazardous or potentially hazardous ionising and/or non-ionising radiation should be designed and manufactured in such a way as to ensure that, where practicable, the quantity, geometry and energy distribution (or quality), and other key characteristics of the radiation emitted can be varied and controlled, and where appropriate, monitored during use, taking into account the intended use. Such medical devices should be designed and manufactured to ensure reproducibility of relevant variable parameters within an acceptable tolerance.

19. Protection against the risks posed by medical devices intended for use by lay persons

19.1 Medical devices for use by lay persons (such as self-testing or near-patient testing) should be designed and manufactured in such a way that they perform appropriately for their intended purpose taking into account the skills and the means available to lay persons and the influence resulting from variation that can reasonably be anticipated in lay person's technique and environment. The information and instructions provided by the product owner should be easy for the lay person to understand and apply when using the medical device and interpreting the results.

19.2 Medical devices for use by lay persons (such as self-testing or near-patient testing) should be designed and manufactured in such a way as to:

a) ensure that the medical device can be used safely and accurately by the intended user per instructions for use. If instructions for use are insufficient, appropriate training should be provided.

b) reduce, as low as reasonably practicable and appropriate, the risks of error by the intended user in the handling of the medical device and, if applicable, in the interpretation of the results.

19.3 Medical devices for use by lay persons (such as self-testing or near-patient testing) should, where appropriate, include means by which the lay person:

a) can verify that, at the time of use, the medical device will perform as intended by the product owner, and

b) is warned if the medical device has failed to operate as intended or to provide a valid result.

20. Medical devices incorporating materials of biological origin

20.1 For medical devices that incorporate tissues, cells, or substances of animal origin, or their derivatives, which are non-viable or rendered non-viable the following should apply:

a) where feasible, taking into account the animal species, tissues and cells of animal origin, or their derivatives, should originate from animals that have been subjected to veterinary controls that are adapted to the intended use of the tissues. The product owner is required to retain information on the geographical origin of the animals.

b) sourcing, processing, preservation, testing and handling of tissues, cells and substances of animal origin, or their derivatives, should be carried out so as to provide safety for patients, users and, where applicable, other persons. In particular, safety with regards to viruses and other transmissible agents should be addressed by implementation of validated state of the art methods of elimination or

inactivation in the course of the manufacturing process, except when the use of such methods would lead to unacceptable degradation compromising the medical device.

20.2 For products that incorporate tissues, cells, or substances of human origin or their derivatives as medical devices, the following should apply:

a) donation, procurement and testing of the tissues and cells should be done in accordance with jurisdictional requirements; and

b) processing, preservation and any other handling of those tissues and cells or their derivatives should be carried out so as to provide safety for patients, users and, where applicable, other persons. In particular, safety with regard to viruses and other transmissible agents should be addressed by appropriate methods of sourcing and by implementation of validated state of the art methods of elimination or inactivation in the course of the manufacturing process.

20.3 For medical devices manufactured utilising non-viable biological substances other than those referred to in Clauses 20.1 and 20.2, the processing, preservation, testing and handling of those substances should be carried out so as to provide safety for patients, users and, where applicable, other persons, including in the waste disposal chain. In particular, safety with regards to viruses and other transmissible agents should be addressed by appropriate methods of sourcing and by implementation of validated state of the art methods of elimination or inactivation in the course of the manufacturing process.

21. Essential principles applicable to medical devices other than IVD medical devices

The essential design and manufacturing principles listed in this Section of the document are additional to the essential principles listed in Clauses 1 to 21. These essential principles are applicable to medical devices other than IVD medical devices.

21.1 Chemical, physical and biological properties

21.1.1 With regards to chemical, physical, and biological properties of a medical device, particular attention should be paid to the compatibility between the materials and substances used and biological tissues, cells and body fluids, taking account of the intended purpose of the device and, where relevant, absorption, distribution, metabolism and excretion.

21.1.2 Medical devices should be designed and manufactured in such a way that they can be used safely with the materials, substances, and gases, with which they enter into contact during their intended use; if the devices are intended to administer medicinal products they should be designed and manufactured in such a way as to be compatible with the medicinal products concerned in accordance with the provisions and restrictions governing those medicinal products and that the performance of both the medicinal products and of the devices is maintained in accordance with their respective indications and intended use.

21.1.3 Medical devices should be designed and manufactured in such a way as to eliminate or reduce, as low as reasonably practicable and appropriate, the risks, linked to the size and the properties of particles which are or can be released into the patient's or user's body, unless they come into contact with intact skin only.

21.2 Particular Requirements for Implantable Medical Devices

21.2.1 Implantable medical devices should be designed and manufactured in such a way as to eliminate or reduce, as low as reasonably practicable and appropriate, the risks connected with medical treatment (e.g. the use of defibrillators, high-frequency surgical equipment).

21.2.2 Active programmable implantable medical devices should be designed and manufactured in a manner that allows the unequivocal identification of the device without the need for a surgical operation.

21.3 Protection against the risks posed to the patient or user by medical devices supplying energy or substances

21.3.1 Medical devices for supplying the patient with energy or substances should be designed and manufactured in such a way that the amount to be delivered can be set and maintained accurately enough to ensure the safety of the patient, user, and others.

21.3.2 Medical devices should be fitted with the means of preventing and/or indicating any inadequacies in the amount of energy delivered or substances delivered which could pose a danger. Devices should incorporate suitable means to prevent, as far as possible, the accidental release of dangerous levels of energy or substances from an energy and/or substance source.

21.4 Medical devices incorporating a substance considered to be a medicinal product/drug

21.4.1 Where a medical device incorporates, a substance which, if used separately may be considered to be a medicinal product/drug and which is liable to act upon the body with action ancillary to that of the medical device, the safety and performance of the medical device as a whole should be verified, as well as the identify, safety, quality and efficacy of the substance in the specific combination product if dose, mechanism of action and intended use of the substance is similar to that of medicinal product when used separately.

Note: Medicinal product includes any stable derivative of human blood or human plasma

22. Essential principles applicable to IVD medical devices

The essential design and manufacturing principles listed in this Section of the document are additional to the essential principles of safety and performance listed in Clauses 1-21. These essential principles are applicable to only IVD medical devices.

22.1 Performance characteristics

22.1.1 IVD medical devices should achieve the analytical and clinical performances, as stated by the product owner that are applicable to the intended use/purpose, taking into account the intended patient population, the intended user, and the setting of intended use. These performance characteristics should be established using suitable, validated, state of the art methods. For example:

a) The analytical performance can include, but is not limited to,

i. Traceability of calibrators and controls;

ii. Accuracy of measurement (trueness and precision);

iii. Analytical Sensitivity/Limit of detection;

iv. Analytical specificity;

v. Measuring interval/range;

vi. Specimen stability.

22.1.2 The clinical performance, such as diagnostic/clinical sensitivity, diagnostic/clinical specificity, positive predictive value, negative predictive value, likelihood ratios, and expected values in normal and affected populations.

22.1.3 Where the performance of an IVD medical device depends on the use of calibrators or control materials, the traceability of values assigned to such calibrators or control materials should be ensured through available reference measurement procedures or available reference materials of a higher order.

22.1.4 Wherever possible, values expressed numerically should be in commonly accepted, standardised units and understood by the users of the IVD medical device.

22.1.5 The performance characteristics of the IVD medical device should be evaluated according to the intended use statement which may include the following:

a) intended user, for example, lay person, laboratory professional;

b) intended use environment, for example, patient home, emergency units, ambulances, healthcare centres, laboratory;

c) relevant populations (e.g. paediatric, adult, pregnant women, individuals with signs and symptoms of a specific disease, patients undergoing differential diagnosis, blood supply screening, etc.). Populations evaluated should represent, where appropriate, ethnically and genetically diverse populations so as to be representative of the population(s) where the device is intended to be marketed. For infectious diseases, the populations selected should also have similar prevalence rates.

22.2 Chemical, physical and biological properties

22.2.1 With regards to chemical, physical, and biological properties for IVD medical devices, attention should be paid to the possibility of impairment of analytical performance due to physical and/or chemical incompatibility between the materials used and the specimens, analyte or marker to be detected (such as biological tissues, cells, body fluids and micro-organisms), taking account of the intended purpose of the device.

HEALTH SCIENCES AUTHORITY

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