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Technical product documentation (TPD) — Classification of requirements —

Part 1: Framework

Documentation technique de produits (TPD) — Classification des exigences —

Partie 1: Cadre

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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

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Foreword

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This document was prepared by Technical Committee ISO/TC 10, *Technical product documentation*, Subcommittee SC 6, *Mechanical engineering documentation*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/SS F01, *Technical drawings*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 24096 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

This document addresses the classification of requirements. It provides a framework for building systems to enable the classification of requirements and an indication of the classification in the functional specification, FUN-SPEC, to support communication of the consequences of nonconformity to functional requirements. FUN-SPEC (see ISO/TS 21619) is a part of the technical product documentation (TPD). Other approaches than classification of requirements can be state of the art in achieving the objective of securing the end product.

This document has been developed mainly to be implemented within industry, e.g. the automotive and aerospace industries. However, it can also be used in other engineering fields.

Classification of requirements is a tool by which subsequent parties and stakeholders can be informed of the level of consequences of nonconformity of requirements. This facilitates the guiding of production and quality assurance resources (e.g. purchasing, production planning, control, revision). The classification system relies on established procedures, regulatory framework and contractual agreements for implementation and follow up as present in all modern industry.

There are several examples of industrial stakeholders that deploy their own or partially self-developed system and methodology for classification of requirements. There has previously not been any ISO document that pragmatically describes “what is” and “how to create” a classification system. This series bridges the identified gap and meets the need to describe how to introduce and work with a classification system in an industrial and design context.

Knowledge of the consequences of nonconformity, with requirements and actions taken to resolve the source of the deviation from the given requirements, will have a positive effect on product quality, user safety and economy of the product. Production and inspection resources can then be used where they are most needed.

Annex A gives guidance for class implication and system application.

Annex B gives guidance for indication, definition of requirement classes and the selection of symbols.

Annex C gives guidance for indication in TPD and placing of symbols.

Technical product documentation (TPD) — Classification of requirements —

Part 1: Framework

1 Scope

This document specifies a framework for building systems for the classification of requirements. Such systems can be used to indicate requirements of special importance, and communicate them for production set-up, verification, audit, etc.

This document:

— gives background information why such systems are useful in many areas of manufacturing;

— can be referred to for the concept of classification of requirements;

— functions as a framework for applying such systems in technical product documentation (TPD);

— indicates the needed elements for a classification system;

— supports with aspects in the choice of symbols for a classification system.

As a framework, this document does not give the details of a specific classification system. Instead, it functions as a basis for an organization-specific system which contains details such as notations and symbols, classification levels, assessment procedures, etc., including usage and interpretation in the TPD.

This document does not specify the contractual consequences of a classification (e.g. needed actions such as choice of tools, reliability index or process capability for a classification level) nor other references to standards or documents for handling classifications and nonconformity to requirements.

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 8015:2011, *Geometrical product specifications (GPS) — Fundamentals — Concepts, principles and rules*

ISO 10209, *Technical product documentation — Vocabulary — Terms relating to technical drawings, product definition and related documentation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8015:2011, ISO 10209 and the following apply.

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

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

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

3.1
requirement
statement which translates or expresses a need and its associated constraints and conditions

Note 1 to entry: Requirements exist at different levels in the system structure.

Note 2 to entry: A requirement is an expression of one or more particular needs in a very specific, precise and unambiguous manner.

Note 3 to entry: A requirement always relates to a system, software or service, or other item of interest.

[SOURCE: ISO/IEC/IEEE 29148:2018, 3.1.19]

3.2
requirement class
element in a technical product *requirement* (3.1) which indicates a level of *severity* (3.4)

Note 1 to entry: The lowest requirement class is called “baseline” and usually not marked in the technical product documentation.

3.3
requirement classification system
organization of *requirement classes* (3.2) with described interdependencies and symbols

3.4
severity
gravity of possible consequence of nonconformity

4 Basic rules

4.1 General

The framework in this document describes the needed components in a complete classification system.

With a classification system and through indication of classified requirements, it is possible to give information about the consequences of nonconformity with these requirements. However, classification systems based on this document do not give exemptions to deviate from any requirements.

All requirements in the product documentation shall be fulfilled in accordance with ISO 8015:2011, 4.3 and 4.4.

A classification system is a tool to indicate critical requirements in order to facilitate quality assurance downstream in the design departments.

A classification system shall contain a description of the indications (see Annex A for examples), criteria for classification levels and an explanation on how to document a classification. A classification system can be constructed with levels and/or types of consequences of nonconformity with requirements.

The design goal should always be to have a robust design, in which variations occurring in, for example, production do not cause critical effects, and thereby render this type of marking redundant.

The requirements to be secured are usually customer requirements such as economy, safety and environment. They are usually difficult to measure in production and therefore not suitable for production follow up and quality control. Customer requirements on the product are met through product requirements (including regulatory requirements). They in turn are met through functional requirements, characteristic requirements and ultimately parameter requirements, see Figure 1.

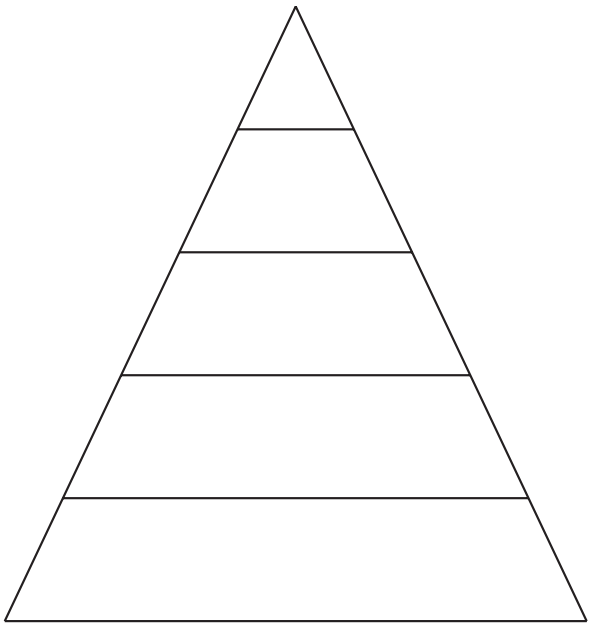


Figure 1 — Requirement pyramid

4.2 Description of requirement class

This type of requirement classification system defines the levels of severity at nonconformity and how to communicate the consequences.

The definition of a requirement class shall indicate a level of consequence at nonconformity in terms of, for example, product non-function, risk for personal injury or that downstream/subsequent production processes can be impaired. The product's function is central, and "function" shall be understood in the widest sense of the word. It means that subfunctions expressed through sub-requirements such as safety, mountability, reliability, interchangeability, appearance, etc. are included.

A requirement class can also indicate the areas that are affected (such as production, safety regulations, legal requirements, certification or other regulations) and whether documentation of requirement fulfilment is mandatory.

Numbers, letters, words or other symbols can be used as class identifiers. Keyboard characters have the advantage of being readily available, while specific symbols stand out to a higher degree. Examples of classification systems are given in Tables A.1 and B.1.

4.3 Use of a classification system

Due to the variety of already existing solutions, this document is a framework which can help individual organizations when deciding on their own classification system and how to use it in the TPD. It is possible to use an already existing system, develop a new one or modify an existing one.

NOTE Severity with a requirement as the sole basis for classification can lead to an excessive number of classified requirements. Additional parameters, such as susceptibility, can therefore be useful, as described in ISO 24096-2.

4.4 Application

This document can only be used as a basis for an organization-specific system which contains the explicit classification and the symbology used in the TPD. Therefore, it cannot be used as a standalone reference.

4.5 Definition of classification levels

The definition of each class should be given independent of the type of product and production process, see examples in Annex B.

Implication of a classification shall be described directly or indirectly in the classification system. The classification system can also describe who is responsible for classifying requirements.

The classification level will define the appropriate production and inspection setup. The production process can also cover the obtaining of materials, semi-manufactures and products supplied by sub-contractors.

Annex A
(informative)

Guidance for class implication and system application

In general, the importance of applying classification increases in the following circumstances:

— the longer the product development time and the larger the investment;

— the greater the number of persons (organizational levels) and sub-contractors involved;

— the more technically optimized and complicated the product or process.

In this way, teamwork between the various departments (design, pre-engineering, production and inspection) will make more cost-efficient work possible.

The following should be secured when applying requirement classes:

— the basic technical documentation contains unambiguous requirements;

— the basic technical documentation does not contain any unrealistic requirements;

— the requirements specified in the basic technical documentation serve as a basis for approval or rejection when inspection is carried out;

— documentation requirement can be used to enable efficient product recall, production adjustment, etc.

Table A.1 shows an example of requirement classes in a classification system.

Table A.1 — Example of a classification system with class definition

Class	Definition
1	The production and inspection processes shall be specified in such a manner that the requirements are warranted to be fulfilled. This implies that systematic variations shall be kept within given specification limits. Causes for random errors shall be eliminated. Inspection methods where the result can be influenced by the judgement of the operator shall be avoided. Documentation shall be given that requirements are fulfilled.
2	The production and inspection processes shall be specified in such a manner that the requirements can be fulfilled with a high degree of probability. This implies that systematic variations shall be kept within given specification limits. Process and final inspection should be carried out in accordance with statistical methods. Inspection methods where the result can be influenced by the judgement of the operator should be avoided. If documentation is required, documentation of fulfilled requirements shall be available.
Baseline	The production process shall be specified in such a manner that systematic variations are kept within given specification limits. If the production is considered not with sufficient confidence being within the specification limits, final inspection shall be carried out, preferably according to statistical methods.
NOTE Baseline class is normally not indicated in product documentation. It represents the level for all non-indicated requirements after classification.	

In the course of the development work, and before the TPD is approved for production, it is also important to obtain viewpoints with regard to manufacturing and inspection.

The application of requirement classes is intended to contribute to solutions that balance requirements, design, process, resources and economy. Requirement classes can have an impact on the inspection to be carried out.

Effective technical and economical control presumes TPD, which unambiguously and realistically describes the product requirements, is needed to ensure a proper implementation of planned processes, production and inspection.

It is recommended that assessment of the potential consequences of nonconformity and resulting classification is done in a cross-functional team. This makes control possible with a view to implement:

— a more rational product design and process planning;

— a situation where a large portion of the resources are devoted to meet the requirements judged to have serious consequences if not fulfilled.

It is recommended that for products manufactured in complex and/or complicated processes, requirements that ensure reliability and economic considerations in the process are also classified in the TPD.

Application of a requirement classification system within a company does not necessarily mean that all classes should be used. For some companies or for certain products, a specific requirement class will not be applicable.

The requirement classification system can also be used when analysing the design. A large number of properties in the TPD with requirement class indications can be a sign of an unsuitable design solution.

Annex B
(informative)

Guidance for indication, definition of requirement classes and the selection of symbols

B.1 General

Classification of requirements in a product, manufacturing and/or verification specification references a classification system describing the definitions and implications of the applied requirement classes.

Examples of definition of requirement classes are given in Table B.1.

Table B.1 — Example of requirement class definitions

Class	Potential effect of a nonconformity from a requirement
1	Personal injury Loss of product function causing unpredictable stop Environmental impact
2	Loss of product function Large disturbance of production Immediate repair
Baseline	None of the above
NOTE Baseline class is normally not indicated in product documentation. It represents the level for all non-indicated requirements after classification.	

B.2 Basic symbols

Examples of basic symbols with requirement classes are given in Tables B.2 and B.3.

Table B.2 — Examples of basic symbols

Requirement class	Graphical symbol[a]	Alternative symbol	Symbol also indicating documentation requirement
1		[1]	[1Doc]
2		[2]	[2Doc]
3		[3]	[3Doc]
[a] Requirement affecting safety is represented with an S in the class designation.			

Table B.3 — Example of a classification system definitions with affected area marking

Class and symbol	Potential effect of nonconformity to requirements
1	Damage to life or limb Costly damage to business at loss of function Costly unpredictable stop at loss of function Environmental damage
1L	Breach of legal requirement
2	Imminent repair needed
2P	Loss of product function Large disturbance of production
2L	Infringement on legal requirement or nonconformity with certification
NOTE In this example, the following codes have been used: L: legal requirement P: product function, production process	

Annex C
(informative)

Guidance for indication in technical product documentation and placing of symbols

C.1 General

The classification is indicated by basic symbols which can be supplemented by additional symbols.

The classification can include the function of an element in the finished product as well as it's function during the production process. When it is necessary to distinguish between these functions, this can be indicated by alternative symbols.

Mandatory documentation can be included in the definition of a requirement class. It can be shown with or without an alternative symbol, depending on how the classification system is defined. See an example in Table B.2.

Symbols should preferably be placed on the right side of the requirements. For geometrical tolerances, however, the symbol can be placed above the tolerance indicator. See examples shown in Table C.1.

C.2 Indication in TPD

Examples of presentation and indications on 2D drawings, in computer-aided design (CAD) models (e.g. in 3D models) and/or in other product, manufacturing and inspection documentation are shown in Table C.1.

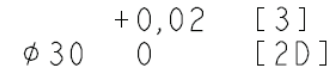
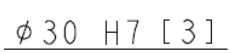
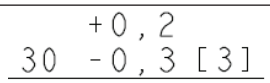
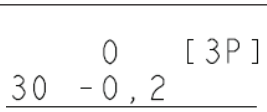
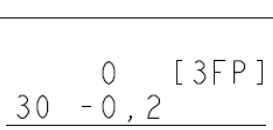
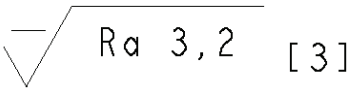
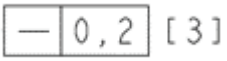
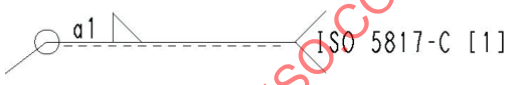
Clarity on what shall be documented (result, capability, etc.), in relation to what (individual item, production date, batch, etc.) and how it shall be available (duration, directly reported, retrieval time, etc.) is vital for the recipient to be able to fulfil the requirement.

Documentation requirement related to a technical requirement, having an indicated classification, can be indicated directly in a classification system with regular or special symbols, or, alternatively, can be directly linked to a specific annotation level and regulated in local standards and contracts. This will further guide and govern downstream stakeholders such as production and its equipment.

Any documentation requirement should be based on the purpose and its legal context. What is documented can depend on the need to follow up a requirement and aid in a potential recall campaign; it can also be to enable better process management. The relation (item level, batch, etc.) can depend on production volume, item cost or level of disturbance at nonconformity to requirements including the cost of a recall campaign. The availability generates cost in terms of systems, storage and handling.

NOTE There is an abundance of documentation requirements from legal regulations, etc. that do not always directly influence product requirements. Those are not covered in this document. They can influence other areas such as work routines, workplace environment revisions, etc. which are also not covered in this document.

Table C.1 — Examples for the indication of requirements in TPD

Example	Explanation
	Upper tolerance limit: Requirement class 3. Lower tolerance limit: Requirement class 2 documentation is mandatory.
	Upper and lower tolerance limit: Requirement class 3.
	Upper tolerance limit: Baseline. Lower tolerance limit: Requirement class 3.
	Upper tolerance limit: Requirement class 3 is of importance for the production process. Lower tolerance limit: Baseline.
	Upper tolerance limit: Requirement class 3 is of importance for both the function of the part and the production process. Lower tolerance limit: Baseline.
	Requirement class 3 applies to the surface finish.
	Requirement class 3 applies to the straightness requirement.
Static torsional strength: Min 200 Nm during 30 s without permanent deformation [1]	Material requirement: Requirement class 1.
EN-GJS-450-10 in accordance with EN 1563:2018 Yield strength: Min 310 MPa [SC] Tensile strength: Min 450 MPa [SC] Elongation: Min 10 % [SC]	Requirement class SC for the material properties.
	Weld joint: Requirement class 1.
NOTE In this example, the following codes have been used and can be combined: D: documentation requirement P: production process F: function of the part SC: significant characteristics	

Documentation requirement on a classified requirement should have the same classification as the requirement the documentation relates to, see Examples 1 and 2.

EXAMPLE 1 Extract from a product requirement document:

Testing of chemical composition according to ISO 19272:2015. <C>1 The analysis certificate or analysis result shall be kept on file at least 12 years. The system of documentation shall show the correspondence between steel batch and batch of beams. This documentation shall be available to Mechanical Products Inc. to ensure traceability. <C>2

NOTE 1 The number after the classification <C> represents a running number for the classifications in the document.