
**Geometrical product specifications
(GPS) — Dimensional and geometrical
tolerances for moulded parts —**

**Part 4:
Rules and general tolerances for
castings using profile tolerancing in a
general datum system**

*Spécification géométrique des produits (GPS) — Tolérances
dimensionnelles et géométriques pour les pièces moulées —*

*Partie 4: Tolérances générales pour les pièces moulées par
tolérancement de profil dans un système général de références
spécifiées*



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Published in Switzerland

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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 213, *Dimensional and geometrical product specifications and verification*.

This second edition cancels and replaces the first edition (ISO 8062-4:2017), which has been technically revised.

The main changes are as follows:

- overall clarification regarding better applicability according to the ISO GPS system;
- overall revision of tables and figures for plausibility;
- new symbols for draft angles with symmetrical/unsymmetrical tolerance zones as already included in the model geometry or drawing outlines have been added;
- requirements for the indication in the product definition (new [Clauses 5](#), [6](#) and [7](#)) and types of specifications (new [Clause 8](#)) have been added;
- Rule I concerning the wall thickness has been added;
- [Clause 9](#) and [Annex G](#) have been added, expanding the information previously given in former Annex A;
- new [Annexes A](#), [B](#) and [C](#) have been added;

A list of all parts in the ISO 8062 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 is a geometrical product specification (GPS) standard and is to be regarded as a complementary ISO GPS standard. It influences chain link B of the chain of standards on size, form, orientation and location.

The ISO GPS matrix model given in ISO 14638 gives an overview of the ISO GPS system, of which this document is a part. The fundamental rules of ISO GPS given in ISO 8015 apply to this document and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this document, unless otherwise indicated.

For more detailed information about the relation of this document to other standards and the GPS matrix model, see [Annex I](#).

This document gives terms and definitions and symbols for product definition indications for tolerancing of moulded parts, which are to be used in addition to the usual standards on geometrical product specifications (GPS), such as ISO 1101, ISO 5458 and ISO 5459.

According to this document, $\pm$ tolerances are only used for sizes and the following non-features of size: wall thicknesses, fillets and chamfers. Positional tolerances are also applied for sizes specified with $\pm$ tolerances. For all other tolerancing purposes, geometrical tolerances according to ISO 1101 are used. For all other non-features of size, such as step dimension, $\pm$ tolerances are not recommended. See the ISO 14405 series for background information.

This document defines a system of tolerance grades, draft angle (taper) grades and machining allowance grades for cast metals and their alloys.

ISO/TS 8062-2 states, in relation to the accumulation method where general dimensional tolerances according to ISO 8062-3 are used, that there is not yet a clearly defined way in the context of the future system of ISO GPS standards to apply the rules for calculating the final moulded part nominal dimensions from the final machined moulded part nominal dimensions, taking into account the miscellaneous influences. One of the reasons for this problem is the lack of a proper workpiece datum system.

The general dimensional tolerances apply independently from each other (without a datum system). It is difficult or even impossible to assess what the overall shape of the workpiece can become.

The general dimensional tolerances ($\pm$ tolerances) of ISO 8062-3 apply not only to sizes but also to centre distances and dimensions defining profile contours. This is in contradiction to the ISO GPS rules (e.g. ISO 14405-2).

The general tolerances of ISO 8062-4 are not in compliance with the rules of ISO 22081 with respect to the general geometrical tolerancing.

Furthermore, with 3D CAD the nominal dimensions are not always visible in the model. As the general dimensional tolerances depend on the nominal dimensions, they cannot be used anymore when only the CAD model is available. To avoid these problems this document was developed as a parallel approach fully conforming with the ISO GPS rules given in, for example, ISO 14405-2 by introducing profile tolerancing and a datum system.

If there is no datum system specified or if the datum surfaces are to be machined after moulding then only ISO 8062-3 can be applied.

For the development of a new product, it is strongly recommended that customer and foundry should discuss and agree on the method of tolerancing to be applied to the product. This also includes casting method, calculation methods, cast material and draft angles, which are crucial for the process.

Geometrical product specifications (GPS) — Dimensional and geometrical tolerances for moulded parts —

Part 4: Rules and general tolerances for castings using profile tolerancing in a general datum system

1 Scope

This document specifies the rules for geometrical dimensioning and tolerancing of final moulded parts and parts machined out of moulded parts. It also specifies rules and conventions for the indications of these requirements in technical product documentation and specifies the proportions and dimensions of the graphical symbols to be used.

This document provides symbols for identifying the relative completeness of the moulded features and parts. These graphical symbols differ from the graphical symbols for surface texture according to ISO 1302¹⁾, which are notably larger.

This document specifies general geometrical tolerances using surface profile tolerances related to a general datum system that remains on the final part. It also specifies machining allowances and draft angles (tapers) for castings in all cast metals and their alloys produced by various casting manufacturing processes.

This document establishes the general principles for presentation of general geometrical tolerances that apply to 2D technical drawings in all disciplines and trades but which are also applicable to 3D applications.

NOTE All figures are shown in 2D views only.

When cast datum surfaces are machined, this document is not applicable.

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 129-1, *Technical product documentation (TPD) — Presentation of dimensions and tolerances — Part 1: General principles*

ISO 1101, *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 1302,¹⁾ *Geometrical Product Specifications (GPS) — Indication of surface texture in technical product documentation*

ISO 1660, *Geometrical product specifications (GPS) — Geometrical tolerancing — Profile tolerancing*

ISO 2692, *Geometrical product specifications (GPS) — Geometrical tolerancing — Maximum material requirement (MMR), least material requirement (LMR) and reciprocity requirement (RPR)*

1) Cancelled and replaced by ISO 21920-1.

ISO 5458, *Geometrical product specifications (GPS) — Geometrical tolerancing — Pattern and combined geometrical specification*

ISO 5459, *Geometrical product specifications (GPS) — Geometrical tolerancing — Datums and datum systems*

ISO 7083, *Technical product documentation — Symbols used in technical product documentation — Proportions and dimensions*

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

ISO 8062-1, *Geometrical product specifications (GPS) — Dimensional and geometrical tolerances for moulded parts — Part 1: Vocabulary*

ISO 8785, *Geometrical Product Specification (GPS) — Surface imperfections — Terms, definitions and parameters*

ISO 10135, *Geometrical product specifications (GPS) — Drawing indications for moulded parts in technical product documentation (TPD)*

ISO 10579, *Geometrical product specifications (GPS) — Dimensioning and tolerancing — Non-rigid parts*

ISO 13715, *Technical product documentation — Edges of undefined shape — Indication and dimensioning*

ISO 14405-1, *Geometrical product specifications (GPS) — Dimensional tolerancing — Part 1: Linear sizes*

ISO 14405-2, *Geometrical product specifications (GPS) — Dimensional tolerancing — Part 2: Dimensions other than linear or angular sizes*

ISO 14405-3, *Geometrical product specifications (GPS) — Dimensional tolerancing — Part 3: Angular sizes*

ISO 16792, *Technical product documentation — Digital product definition data practices*

ISO 21204, *Geometrical product specifications (GPS) — Transition specification*

ISO 22081, *Geometrical product specifications (GPS) — Geometrical tolerancing — General geometrical specifications and general size specifications*

ISO 81714-1, *Design of graphical symbols for use in the technical documentation of products — Part 1: Basic rules*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1101, ISO 1660, ISO 2692, ISO 5458, ISO 5459, ISO 8062-1, ISO 10135, ISO 10579 and ISO 16792 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 moulded feature

feature of a moulded part which has not been machined

3.2**intermediate machined feature**

feature of a moulded part which has undergone some machining and which subsequently will be machined to its final condition

Note 1 to entry: An intermediate machined feature is typically a roughly machined *moulded feature* (3.1).

Note 2 to entry: An intermediate machined feature can be used as a datum for subsequent machining of the moulded part.

3.3**final machined feature**

feature of a moulded part which has been machined to its final condition

3.4**final moulded part**

moulded part after fettling (if any)

Note 1 to entry: A final moulded part only consists of features which are moulded and have not been finished except by fettling.

3.5**intermediate machined moulded part**

moulded part which has undergone some machining and which subsequently will be machined to its final condition

Note 1 to entry: An intermediate machined moulded part consists of at least one *moulded feature* (3.1) to be subsequently machined or at least one *intermediate machined feature* (3.2). In addition, it consists of moulded features not to be machined (if any) and *final machined features* (3.3) (if any).

Note 2 to entry: An intermediate machined moulded part can be produced from a *final moulded part* (3.4) or from another intermediate machined moulded part.

3.6**final machined moulded part**

moulded part which has been machined to its final condition

Note 1 to entry: A final machined moulded part consists of *final machined features* (3.3) and can include *moulded features* (3.1) not to be machined. A final machined moulded part cannot include intermediate machined moulded features.

Note 2 to entry: A final machined moulded part can be produced from a *final moulded part* (3.4) or from an *intermediate machined moulded part* (3.5).

3.7**moulded part condition**

manufacturing stage of a moulded part

Note 1 to entry: Listed in chronological order of manufacturing, a moulded part can be in a *final moulded part* (3.4) condition, *intermediate machined moulded part* (3.5) condition or *final machined moulded part* (3.6) condition.

Note 2 to entry: Only one final moulded part condition exists.

Note 3 to entry: Various intermediate machined moulded part conditions can exist.

Note 4 to entry: Only one final machined moulded part condition can exist.

Note 5 to entry: A moulded part does not need to exist in an intermediate machined moulded part condition before the final machined moulded part condition.

Note 6 to entry: Heat treatment or straightening (correction of unintended distortion) can be carried out in any moulded part condition.

3.8 product definition

<of a moulded part> drawing or a 3D model representing the product

3.9 single product definition

product definition (3.8) of a moulded part giving requirements for one *moulded part condition* (3.7) only

3.10 combined product definition

product definition of a moulded part giving requirements for more than one *moulded part condition* (3.7)

3.11 draft angle taper

value of inclination (angle) that is added to a geometrical feature of a pattern or mould to ensure the removal of the pattern or moulded part from the mould

3.12 external draft angle

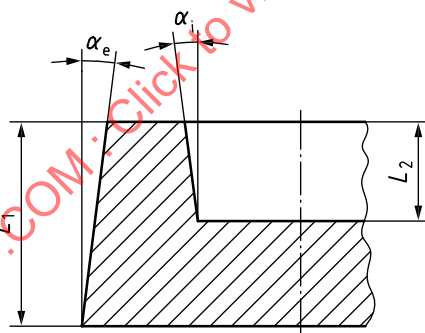
draft angle (3.11) on a surface that has no opposite surface in the direction outward of the part

Note 1 to entry: See [Figure 1](#).

3.13 internal draft angle

draft angle (3.11) on a surface that has an opposite surface in the direction outward of the part

Note 1 to entry: See [Figure 1](#).



Key

L_1	length of the external feature
L_2	length of the internal feature
α_e	external draft angle
α_i	internal draft angle

Figure 1 — External and internal draft angles

3.14 draft angle increasing the tolerance of feature(s)

draft angle (3.11) which is added to the model geometry and included in the tolerance zone

Note 1 to entry: See [Figure 17](#) d).

3.15**general datum system RST**

datum system according to ISO 5459, locking all degrees of freedom and used for the general tolerance

Note 1 to entry: [Annex G](#) provides an example of using general tolerances. For the general datum system RST, see [Figure G.2](#).

Note 2 to entry: It is recommended that the datum feature identifiers R, S, and T are used for the general datum systems for moulded parts.

Note 3 to entry: It is recommended that a datum target system RST is used, see [Figure G.1](#).

Note 4 to entry: The datum letters R, S, T are reserved for the general datum system, see [10.3](#).

3.16**wall thickness**

minimum dimension between two surfaces (external and internal) enclosing solid material

Note 1 to entry: The surface can be planar, cylindrical, complex or any combination thereof.

4 Graphical symbols

[Table 1](#) gives an overview of the graphical symbols used in this document. Their proportions and dimensions shall be as specified in [Annex A](#).

Table 1 — Graphical symbols

Symbol	Description	Source
	moulded surface ^a	ISO 1302
	machined surface ^a	ISO 1302
	moulded or machined surface ^a	ISO 1302
	surface profile tolerance	ISO 1101
	positional tolerance	
	theoretically exact dimension	
	datum of datum target	ISO 5459
	datum target, fixed, movable	
Surfaces without tolerance indication: 	indication of general tolerance	10.1 , 10.2 , 10.3
	parting surface	ISO 10135
	parting surface movable	
	parting surface fixed	
	indication of draft angle with symmetrical tolerance zone as already included in the model geometry or drawing outlines	6.4

^a New symbols for surface roughness in accordance with the ISO 21920 series are being prepared.

Table 1 (continued)

Symbol	Description	Source
	indication of a draft angle with unsymmetrical tolerance zone as already included in the model geometry or drawing outlines	6.4
	draft angle with symmetrical tolerance zone	ISO 10135
	draft angle with unsymmetrical tolerance zone	6.4
	moulded condition	5.2
	intermediate (pre)machined	5.3
	final machined	5.4
	machining by supplier	5.5
^a New symbols for surface roughness in accordance with the ISO 21920 series are being prepared.		

5 Product definition type indicator

5.1 Single and combined product definitions

The requirements for the three types of moulded part conditions (final moulded, intermediate machined moulded and final machined moulded) can be specified on a combined product definition or separately on single product definitions, as appropriate.

NOTE Some CAD systems allow the representation of multiple types of moulded part conditions in one CAD model.

If use of the symbols in this document makes a combined product definition difficult to read, use single product definitions instead.

Information as to which part condition or conditions the stated specifications on the product definition apply shall be indicated on the product definition in accordance with [5.2](#), [5.3](#), [5.4](#) and [5.5](#). Therefore, the product definition shall indicate which part condition(s) the stated specification applies to.

On combined product definitions, only the outline of the most advanced part condition for which the product definition is valid shall be illustrated. Requirements for the most advanced condition and for the preceding moulded part condition in question shall be stated.

5.2 Final moulded part product definitions

If the product definition specifies requirements on a final moulded part, the graphical symbol given in [Figure 2](#) shall be indicated in or near the drawing title block or defined in the product definition data set.



Figure 2 — Graphical symbol for a final moulded part product definition

5.3 Intermediate machined moulded part product definitions

If the product definition specifies requirements on an intermediate machined moulded part, the graphical symbol given in [Figure 3](#) shall be indicated in or near the drawing title block or defined in the product definition data set.



Figure 3 — Graphical symbol for an intermediate machined moulded part product definition

If more than one intermediate machined moulded part condition exists on the product definition, they shall be numbered and indicated after the symbol (see [Figure 4](#)).



a)



b)



c)

Figure 4 — Examples of numbered intermediate machined moulded parts

If stating general tolerances on a single product definition of an intermediate machined moulded part, for example by referencing ISO 8062-4 or by stating particular general tolerances, these general tolerances apply to the moulded features in the intermediate machined moulded part condition only.

5.4 Final machined moulded part product definition

If the product definition states requirements on a final machined moulded part, the graphical symbol given in [Figure 5](#) shall be indicated in or near the title block or defined in the product definition data set.



Figure 5 — Graphical symbol for final machined moulded part product definition

If stating general tolerances according to the ISO 8062 series, for example by referencing ISO 8062-4 for castings, on a product definition of a final machined moulded part, these general tolerances apply to the moulded surfaces in the final machined moulded part condition only (see also [Clause 14](#)).

5.5 Identifier for machining by the supplier

If there is, for some special reason, a need to identify which part condition specifications a supplier is expected to meet, this can be indicated by the symbol as shown in [Figure 6](#) after the drawing type indicator (see [Figure 7](#)).



Figure 6 — Symbol for machining by the supplier

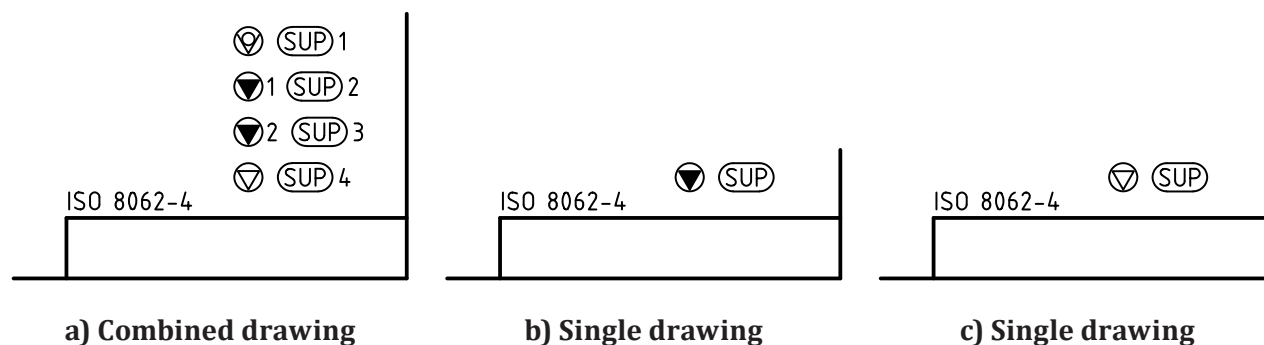


Figure 7 — Example of SUP indication used together with the product definition type indicator near the drawing title block

In any case, the written agreement between customer and foundry shall clearly state which part condition and which specification the supplier is expected to meet, irrespective of other part conditions and specifications appearing on the product definition.

6 Product definition indications

6.1 Surface texture symbols

On combined product definitions, each surface shall be indicated with only one surface texture symbol according to the condition of the surface in question on the most advanced part condition stated on the product definition.

6.2 Part condition identifiers

6.2.1 General

Three-part condition identifiers are used for identifying which part condition a specification applies to (see [Figure 8](#)).



Figure 8 — Part condition identifiers

The part condition identifier may be omitted on single product definitions.

The use of part condition identifiers is necessary on a combined product definition to state requirements to different part conditions (final moulded, intermediate machined moulded, final machined moulded), see [Figure D.4](#). More than one intermediate machined moulded part condition may be specified. This being the case, the intermediate machined moulded part condition is enumerated in consecutive sequence according to the manufacturing processes.

When a specification is given without a part condition identifier, this specification applies to all part conditions stated on the product definition.

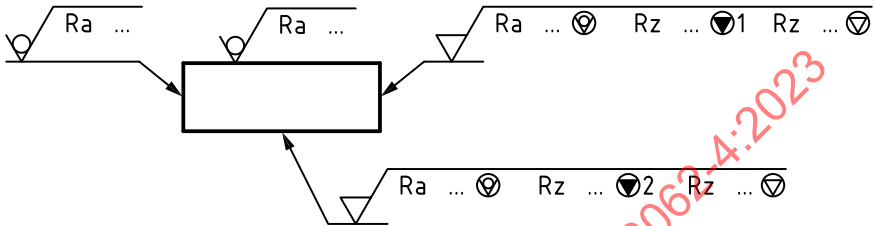
On combined product definitions, requirements on features that remain as moulded in the most advanced part condition according to the product definition may also be given. If not otherwise specified, this type of specification applies to all part conditions according to the product definition, see [Figure 9](#).

When a specification is given with an intermediate part condition, this specification applies for all subsequent part conditions if not otherwise specified.

6.2.2 Surface texture

On combined product definitions, surface texture requirements shall be indicated for each part condition using the symbols as shown in Figure 9.

Product definition indication



Condition

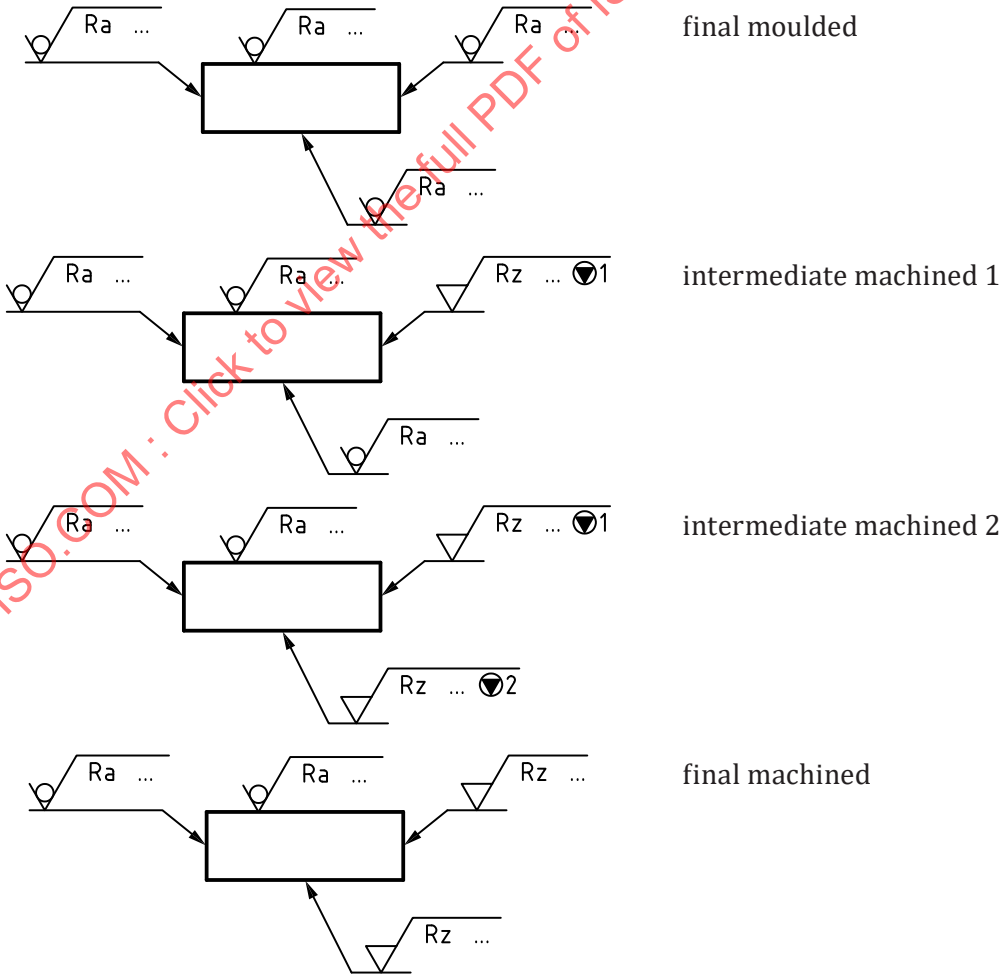


Figure 9 — Example of a surface texture indication on a combined product definition and its interpretation

6.2.3 Linear sizes

The part condition to which the linear dimension applies shall be indicated by a part condition identifier as shown in [Figure 10](#), if necessary.

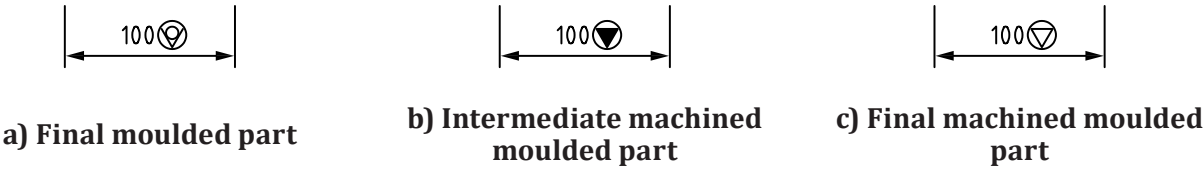


Figure 10 — Examples of nominal dimensions

6.2.4 Linear dimensions and individually indicated dimensional tolerances

The part condition to which the linear dimension with its tolerance applies shall be indicated by a part condition identifier as shown in [Figure 11](#), if necessary.

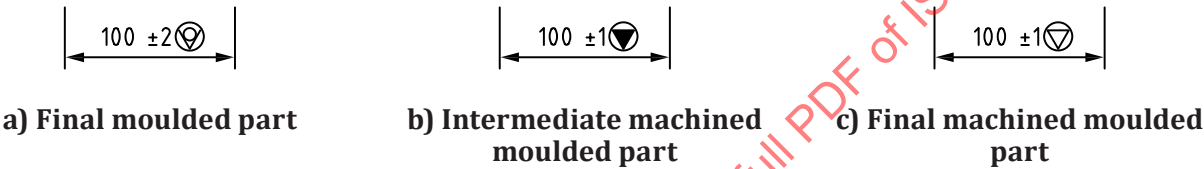


Figure 11 — Examples of nominal dimensions with individual tolerances

6.2.5 Theoretically exact dimensions (TEDs)

The part condition to which the TED applies shall be indicated by a part condition identifier as shown in [Figure 12](#), if necessary.

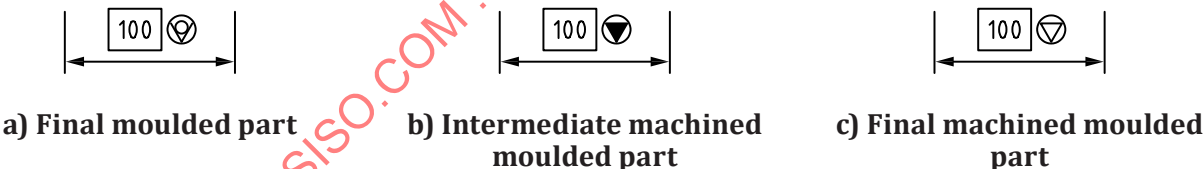
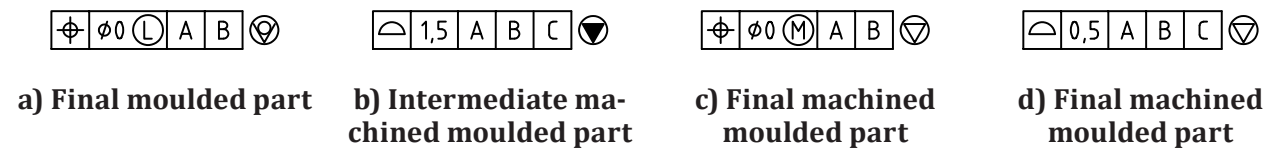


Figure 12 — Examples of TEDs

6.2.6 Geometrical tolerances and datums

The part condition to which the geometrical tolerance applies shall be indicated by a part condition identifier as shown in [Figure 13](#), if necessary.



NOTE The examples a) and c) need a toleranced size in addition (e.g. $\varnothing 10 \pm 1$).

Figure 13 — Examples of geometrical tolerances with datum references

The part condition identifier shall be indicated after the tolerance indicator. If the datum exists in different part conditions than those specified by the surface texture symbol, the datum applies in that part condition stated together with the tolerance value (see [Figures 14](#) and [15](#)).

If the datum is specified to a planar feature in the final moulded part condition and the feature has a taper, the datum applies without the taper, i.e. the actual taper shall be removed mechanically or virtually. If possible, planar surfaces with draft angles used as datums should be avoided.

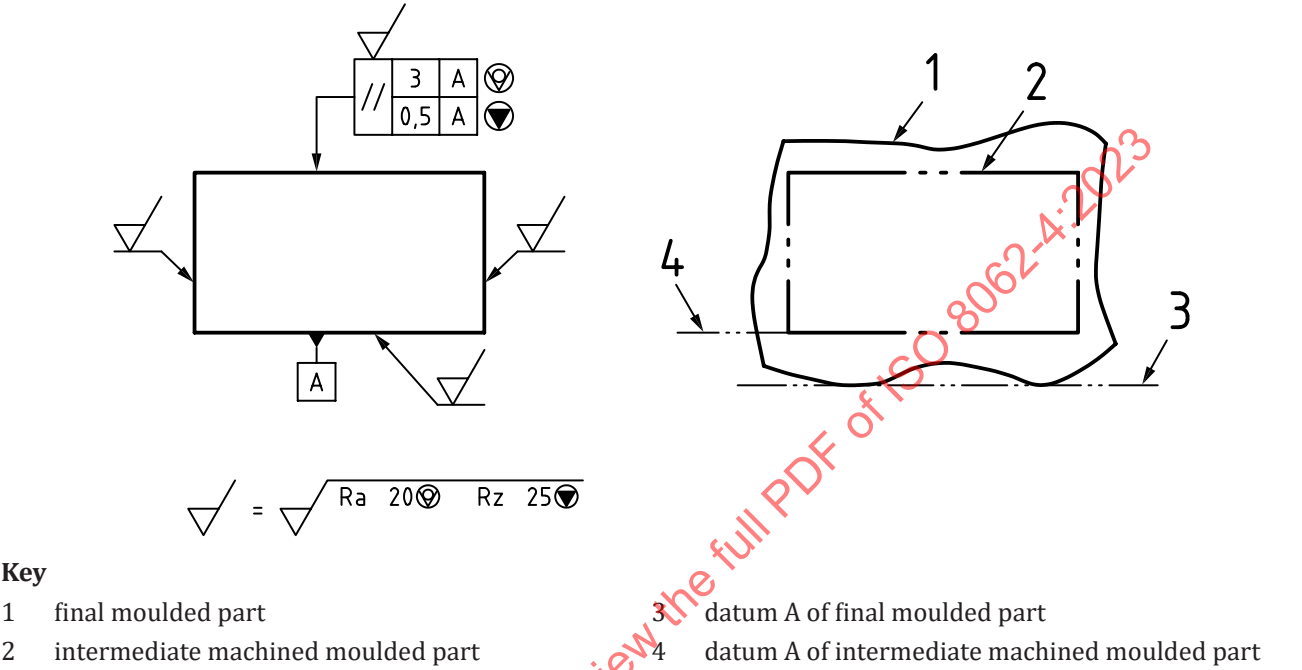


Figure 14 — Example of a datum indication in different part conditions with different datums

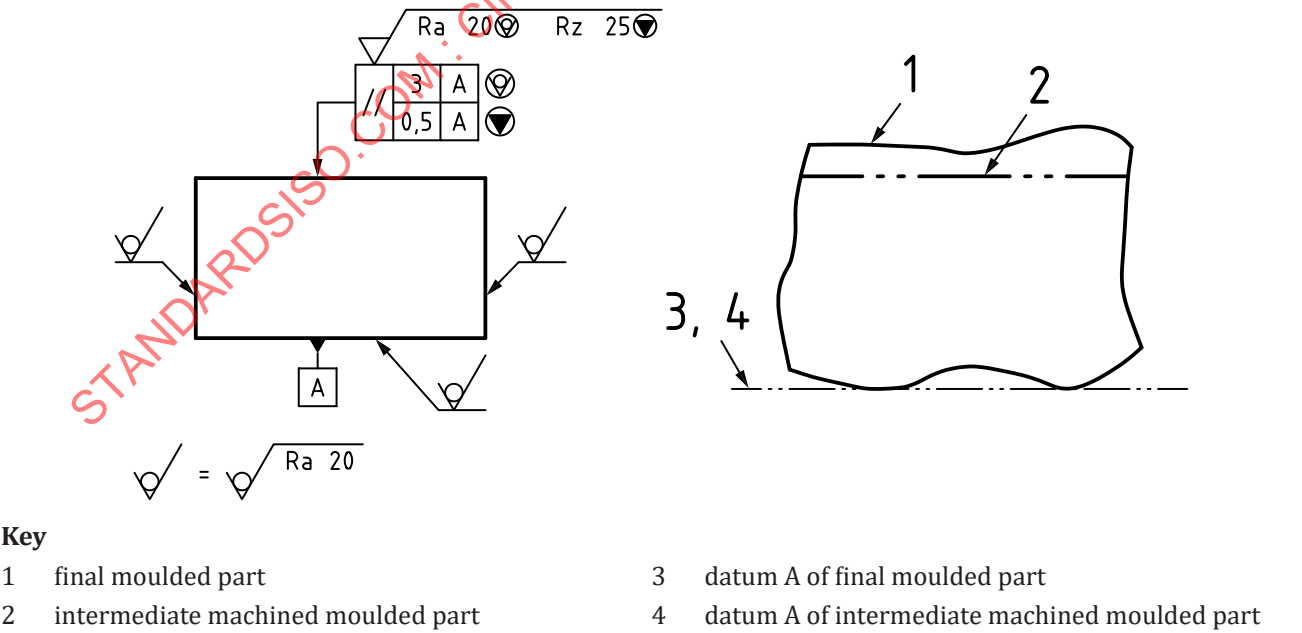


Figure 15 — Example of a datum indication in different part conditions with same datum

When a geometrical tolerance specification is given without a part condition identifier, this specification applies to all part conditions stated on the product definition.

6.3 Required machining allowance (RMA)

6.3.1 General

All RMA values, A_{RMA} , have no tolerance. If applied together with a TED, they shall be used as TED values; if applied together with a size, they shall be used as nominal dimensions. When RMA is used as a TED, the value shall be framed; when used together with a size, it shall not be framed.

6.3.2 General RMA

If a general RMA is to apply to all surfaces to be machined on the final moulded part, it shall be stated in or near the drawing title block or defined in the product definition data set according to this document (ISO 8062-4).

EXAMPLE General tolerances ISO 8062-4 RMA 6

Only one value is specified for all surfaces to be machined, and this value shall be selected from the appropriate dimension range according to the largest overall dimension of the final moulded part. [Table 4](#) contains standardized RMAs.

6.3.3 Individual RMA

If a special RMA is to apply to an individual surface, it shall be indicated individually before the surface texture symbol according to ISO 1302 (see [Figure 16](#)).

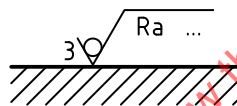


Figure 16 — Example for individual RMA

An individual RMA overrules a general RMA.

In sand casting, top surfaces sometimes need more machining allowance than other features. For these surfaces, coarser required machining allowance grades (RMAGs) can be selected and then indicated individually.

6.4 Draft angles

A draft angle itself has no tolerance. Suggested draft angle values are given in [Tables 5](#) to [9](#). If applied together with a TED, they shall be used as TED-angle values; if applied together with a size, they shall be used as nominal angles.

There are four possible ways to indicate a draft angle:

- as already included in the model geometry or drawing outlines [same result as c)] with the symbol
- as already included in the model geometry or drawing outlines [same result as d)] with the symbol
- by the symbol
- by the symbol

In case a), the general surface profile tolerance zone is located adjacent to the nominal surface that includes the draft angles.

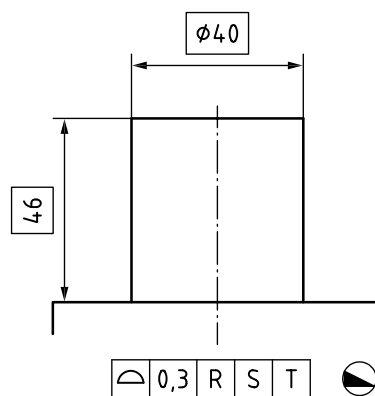
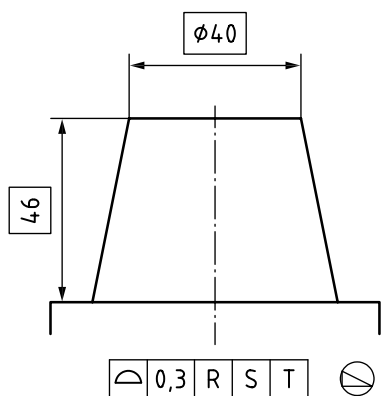
When the draft angles are already included in the nominal model or in the drawing outlines, it shall be indicated in or near the drawing title block or defined in the product definition data set: "Draft angles included with the tolerance zone of $\triangle$ ".

In case b), the general surface profile tolerance zone is located like in case d) for the whole nominal model. When the draft angles are already included in the nominal model or in the drawing outlines, it shall be indicated in or near the drawing title block or defined in the product definition data set: "Draft angles included with the tolerance zone of $\blacktriangle$ ".

In case c), the general surface profile tolerance zone is located adjacent to the surface when the draft angles are added to the nominal model which excludes the draft angles in the tolerance zone, see [Figure 17 c\)](#).

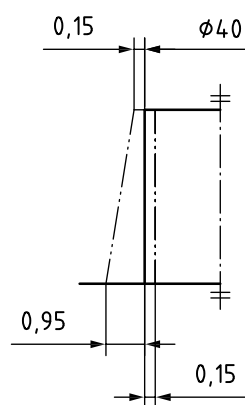
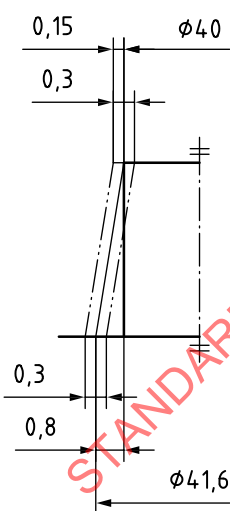
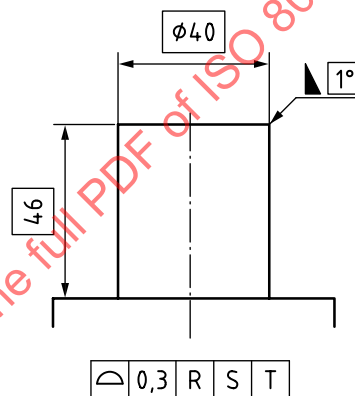
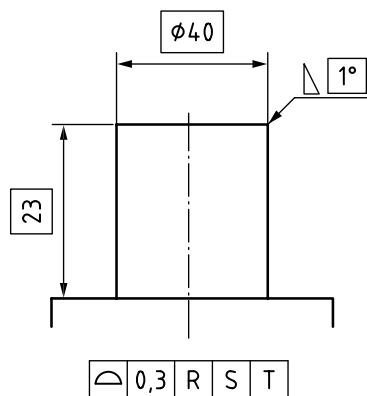
In case d), the general surface profile tolerance zone increases steadily as shown in [Figure 17 d\)](#).

NOTE 1 The rules for the indication of the symbols are given in ISO 10135.



a) Indication that draft angles with symmetrical tolerance zone are included in the CAD model

b) Indication that draft angles with unsymmetrical tolerance zone are included in the CAD model



Tolerance constant 0,3
Ideal shape gradually increased $\phi 40 \rightarrow \phi 41,6$

Tolerance gradually increased 0,3 $\rightarrow$ 1,1
Ideal shape constant $\phi 40$

c) Draft angle increasing the model geometry feature(s)

d) Draft angle increasing the tolerance of feature(s)

Figure 17 — Draft angles

If no indication of draft angle is made, the drawing includes the draft angle and the tolerance zone is symmetrically disposed. This corresponds to case c).

NOTE 2 This is how the previous edition of this document (ISO 8062-4:2017) was written.

It is recommended that the draft angle in the drawing is always indicated, either directly on each feature or indirectly as a drawing default in or near the title block.

NOTE 3 Indirect indication could also be a reference to an additional document, e.g. a company standard, giving the default.

7 Indication of general tolerances

7.1 General tolerances according to this document

On drawings, the callout of general tolerances, for example according to this document, applies only to those part conditions stated by the product definition type indicator.

On combined product definitions where the product definition type indicator for final moulded is stated and the general tolerance according to this document is referenced, all non-individually indicated dimensions on the final moulded part condition shall by default be calculated according to the casting calculation method, as specified in Annex H. Other methods may be agreed between the customer and the foundry.

Annex D provides drawing examples. General tolerances for moulded parts shall be indicated in or near the drawing title block or defined in the product definition data set, if applicable. See Figures D.3, D.4 and D.5.

7.2 General surface profile tolerance

The general surface profile tolerance applies to all surfaces without any individual geometrical tolerance or size tolerance indication.

The geometry of all the surfaces to which the general surface profile tolerance applies shall be specified with the TED in its entirety.

To apply a general geometrical specification according to this document, it shall be clearly indicated in or near the title block or in the product definition data set as follows: the wording “General tolerance” followed by a reference to this document (i.e. “ISO 8062-4”), followed by the indication of the general geometrical specification, see Figure 18.

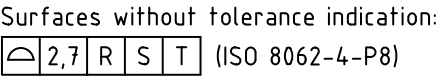


Figure 18 — Example of the indication of general surface profile tolerance

8 Types of specifications

8.1 General

The geometry of the part in its different conditions shall be specified completely. This can be done by using the following specification methods.

8.2 Specification of final moulded part condition

8.2.1 Overview of specification of final moulded part condition

The final moulded part condition can be specified directly on a single final moulded part product definition according to ISO 10135. This method shall be used if the final moulded part is not to be machined.

If the final moulded part is to be machined, the specification of the final moulded part can be given on a combined product definition in one of the following ways:

- indirectly, by using the casting calculation method (see [8.2.2](#));
- directly, by using the multiple tolerancing method (see [8.2.3](#));
- by using the surface profile (see [8.2.4](#)).

8.2.2 Specification of final moulded part condition by the casting calculation method

When using the casting calculation method (see [Annex H](#)), the final moulded part is specified indirectly on the product definition as follows:

- the machined moulded part is specified directly in total;
- appropriate general tolerance according to this document (see [7.1](#)) is specified;
- appropriate RMAG according to this document (see [6.3](#)) is specified;
- product definition type indicator for final moulded part is indicated;
- product definition type indicator for final machined moulded part is indicated.

As a result, the drawing is a combined product definition indirectly giving the specifications on the final moulded part.

8.2.3 Specification of final moulded part condition by the multiple tolerancing method

When using the multiple tolerancing method, the final moulded part is specified directly on the product definition as follows:

- the most advanced machined moulded part, illustrated on the product definition, is specified in total;
- the final moulded part is specified directly in total;
- product definition type indicator for final moulded part is stated.

The specification of the final moulded part and the machined moulded parts should mainly be done by using appropriate geometrical tolerances according to ISO 1101. For sizes (e.g. diameters, widths of slots, tabs), wall thicknesses, fillets and chamfers, dimensional tolerancing ($\pm$ tolerancing) may be used instead.

8.2.4 Specification of final moulded part condition by surface profile

Surface profile (profile of any surface) tolerances may be used either:

- for all surfaces; or
- for all surfaces except those belonging to features of size (diameters and widths), fillets and chamfers.

Features of size may be toleranced by dimensional tolerances together with positional tolerances and, if appropriate, with the maximum material requirement or the least material requirement (see ISO 2692). Fillets and chamfers may be toleranced with linear dimensions.

NOTE If necessary, ISO 21204 can be used for more unambiguous specification of fillets and radii.

8.3 Specification of intermediate machined moulded part conditions

The specification of the intermediate machined moulded part can be given on a single product definition of the intermediate machined moulded part only or on a combined product definition which includes this intermediate machined moulded part and the final moulded part condition or other intermediate moulded parts or the final machined moulded part condition.

The intermediate machined moulded part is specified directly on the product definition as follows:

- the most advanced intermediate machined moulded part, illustrated on the product definition, is specified in total;
- product definition type indicator for intermediate machined moulded part is stated.

The intermediate machined surfaces with their TED and their surface profile tolerances relative to the datum or datum system should be specified either with a general surface profile tolerance or, if more appropriate, with individual tolerances. For sizes (e.g. diameters, widths of slots, tabs), wall thicknesses, fillets and chamfers, dimensional tolerancing ($\pm$ tolerancing) may be used instead.

Surface profile (profile of any surface) tolerances may be used either:

- for all surfaces; or
- for all surfaces except those belonging to features of size (diameters and widths). Features of size may be toleranced by size tolerances together with positional tolerances and, if appropriate, with the maximum material requirement or the least material requirement (see ISO 2692).

All moulded surfaces remaining as moulded shall be specified according to ISO 10135.

8.4 Specification of final machined moulded part condition

The specification of the final machined moulded part can be given on a single product definition of the final machined moulded part only or on a combined product definition which includes either the final machined moulded part and the final moulded part condition, any intermediate machined moulded part condition, or both.

The final machined moulded part is specified directly on the product definition as follows:

- the final machined moulded part, illustrated on the product definition, is specified in total;
- the product definition type indicator for final machined moulded part is stated.

The final machined surfaces with their TEDs and their surface profile tolerances relative to the datum or datum system should be specified either with a general surface profile tolerance or, if more appropriate, with individual tolerances. For sizes (e.g. diameters, widths of slots, tabs), wall thicknesses, fillets and chamfers, dimensional tolerancing ($\pm$ tolerancing) may be used instead.

Surface profile tolerances may be used either:

- for all surfaces; or
- for all surfaces except those belonging to features of size (diameters and widths). Features of size may be toleranced by size tolerances together with positional tolerances and, if appropriate, with the maximum material requirement or the least material requirement (see ISO 2692).

All moulded surfaces remaining as moulded shall be specified according to ISO 10135.

All intermediate machined moulded surfaces shall be specified.

9 Tolerancing

9.1 General

For the tolerance indication, ISO 129-1, ISO 1101, ISO 1302, ISO 1660, ISO 2692, ISO 5458, ISO 5459, ISO 8015, ISO 8785, ISO 10135, ISO 10579, ISO 13715, ISO 14405-1, ISO 14405-2, ISO 14405-3, ISO 21204, ISO 22081 and this document apply.

For the identification of the part condition to which the general tolerances apply, the specification identifier shall be used when necessary.

Tolerancing of moulded parts in various types of conditions (final moulded, intermediate machined moulded, final machined moulded) can be performed as described in [9.2](#), [9.3](#) and [9.4](#).

[Annex B](#) provides an example procedure to tolerance a casting.

9.2 Tolerancing of final moulded parts

9.2.1 Recommendations

Individual tolerances for moulded parts may be specified as:

- dimensional tolerances for features of size (see ISO 14405-1 and ISO 14405-3), and, if appropriate, the envelope requirement (see ISO 14405-1);
- positional tolerances for the location of features of size and, if appropriate, the maximum material requirement or the least material requirement (see ISO 2692);
- dimensional tolerances for wall thicknesses, fillets and chamfers;
- surface profile tolerances for other surfaces, see ISO 1101, ISO 1660 and ISO 5458.

If datums established from surfaces remaining as moulded are necessary, the use of datum targets is recommended, see ISO 5459.

9.2.2 Drafts

Drafts can be indicated according to ISO 10135. Unless otherwise specified, drafts are additional material (taper plus, symbol TP).

However, for a feature of size to which the maximum material requirement or the envelope requirement applies, drafts are subtracted material (taper minus, symbol TM).

9.3 Tolerancing of intermediate machined moulded parts

The product definition, whether single or combined, shall specify the moulded part in the intermediate machined condition.

The intermediate machined surfaces are identified by the machined surface texture symbol and, if necessary, by the part condition identifier. The intermediate machined surfaces are toleranced by surface profile tolerances (according to ISO 1101) related to a datum or datum system.

The datum or datum system may be established from intermediate machined surfaces or from final moulded surfaces by using the surfaces or datum targets.

9.4 Tolerancing of final machined moulded parts

9.4.1 General

There are two calculation methods for deriving the dimensions and the tolerances of the surfaces to be machined on a final moulded part:

- casting calculation method;
- multiple tolerancing method.

For the casting calculation method, see [Annex H](#) for how to calculate the casting nominal dimensions for the final moulded condition from the final machining condition, taking into account the RMA and the tolerances for both conditions.

For calculations using the multiple tolerancing method, the following needs to be taken into account: the boundary of the maximum material condition of the final machined moulded part fits into the boundary of the least material condition of the final moulded part, including the necessary RMA. This method offers the possibility of selecting tolerances which can lead to smaller quantities of material being removed compared with those removed using the accumulation method.

9.4.2 Drafts

If not otherwise specified (see ISO 10135), drafts are additional material (TP), i.e. they are in addition to the dimensional and geometrical tolerances. However, when the maximum material requirement (MMR) is specified, TM applies to the feature of size to which the MMR is allocated.

9.4.3 Multiple tolerancing method

The customer provides a combined product definition or two single product definitions specifying both the tolerances for the final moulded part and the tolerances for the final machined moulded part. Therefore, for surfaces to be machined, both the tolerance of the final machined moulded part and the tolerance of the final moulded part shall be indicated.

The dimensional and geometrical tolerances of the final moulded part shall permit the final machined moulded part dimensions, form, orientation and location to be achieved (supreme requirement for surfaces to be machined while removing certain layers of the surface, at least the RMA). This shall be taken into account when calculating the final moulded part nominal dimensions. See [Figures H.1](#) to [H.3](#).

Tolerances for the final moulded part applied to surfaces to be machined do not include the RMA. (The RMA is an additional material and, contrary to the material in the tolerance zones, this material always exists on the moulded part.)

When the tolerance or the datum refers to the final moulded part condition, the RMA shall be included when calculating the nominal dimension of the final moulded part.

For sizes (diameters, widths):

- the least material virtual size of an external feature of size of the final moulded part shall be larger than the maximum material virtual size of the final machined moulded part by the RMA;
- the least material virtual size of an internal feature of size of the final moulded part shall be smaller than the maximum material virtual size of the final machined moulded part by the RMA.

For features of size to be machined, it is recommended that, according to ISO 2692, the least material requirement is used for the final moulded part and the maximum material requirement is used for the final machined moulded part. When there are no features of size, profile tolerancing according to ISO 1101 shall be used.

For wall thicknesses, fillets and chamfers, dimensional tolerancing ($\pm$ tolerancing) is recommended, and should be indicated generally or individually.

For distances, step dimensions and profiles excluding fillets and chamfers, profile and positional tolerancing according to ISO 1101, ISO 1660 and ISO 5458 is recommended, and is generally or individually to be indicated.

If not otherwise specified (see ISO 10135), drafts are additional material. However, for features of size to which the maximum material requirement applies, the draft is subtracted (TM). In these cases, the considered feature shall not exceed its maximum material virtual condition of perfect form.

10 Rules

10.1 Rule A: Application of general tolerances for castings

The general tolerances for castings according to this document may be used on product definitions showing:

- a) the moulded condition only, see [Figure D.1](#);
- b) the premachined condition and referring to the general tolerances for castings for the features remaining as moulded;
- c) the final machined condition and referring to the general tolerances for the moulded condition (before machining).

Prerequisite is a general datum system RST on surfaces remaining as moulded, see [10.3](#).

10.2 Rule B: General surface profile tolerances

The general tolerances according to this document are surface profile tolerances related to a general datum system RST according to ISO 5459, see [10.3](#). The general tolerance shall be indicated in or near the drawing title block or defined in the product definition data set.

The general surface profile tolerance applies to all surfaces with the exception of [10.4](#).

10.3 Rule C: General datum system RST

A general datum system RST shall be indicated in the product definition and shall lock all degrees of freedom.

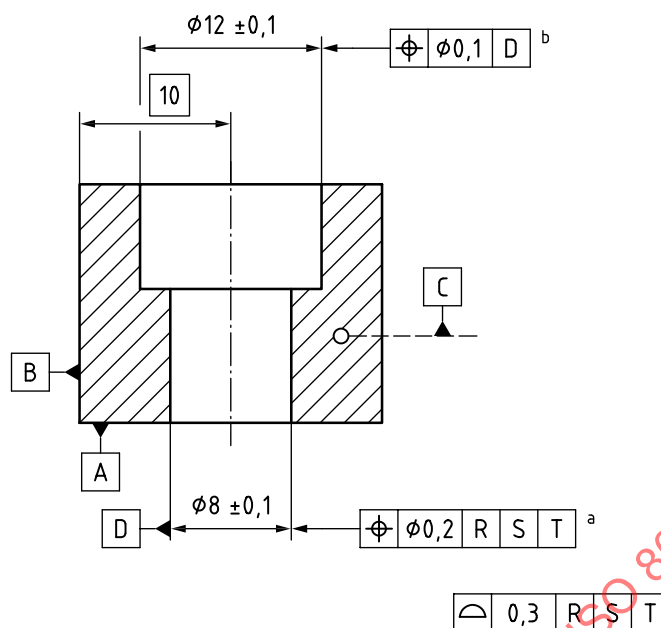
When a general datum system RST is used established by datum targets (preferred method), the general profile tolerances according to [Table 2](#) apply also to the datum features, if not otherwise indicated.

When an integral general datum system RST is used established by integral features, the general profile tolerances according to [Table 2](#) do not apply to the datum features. In such cases, the datum features shall be toleranced separately by:

- an unrelated profile (form) tolerance for the primary datum;
- a profile tolerance related to the primary datum for the secondary datum;
- a profile tolerance related to the primary and the secondary datum for the tertiary datum.

10.4 Rule D: Tolerances overruling the general surface profile tolerances

Individually indicated surface profile tolerances for location according to ISO 1101 and ISO 1660 and individually indicated positional tolerances according to ISO 5458, each related directly or indirectly to the general datum system RST and locking all degrees of freedom, overrule the general surface profile tolerances. See [Figure 19](#).



- a Directly indicated locational tolerances.
b Indirectly indicated locational tolerances.

Figure 19 — Individually directly and indirectly indicated locational tolerances related to the general datum system RST and overruling the general tolerance

When positional tolerances for sizes are used, the (dimensional) size tolerance shall be specified in addition either by individual indication or by reference to general tolerances.

10.5 Rule E: Additional tolerances

Other tolerances than those described in [10.2](#) and [10.4](#), i.e. not related to the general datum system RST, apply in addition to the general tolerances as further constraints.

As the default condition, the general size tolerance for wall thickness in [Table 3](#) shall be one grade coarser than the general tolerance for other dimensions; for example, if there is a general tolerance on a drawing of P10, the tolerance on wall thicknesses shall be S11.

10.6 Rule F: Machined condition

Refer to Figure C.1 c).

The final machined condition shall be possible to achieve.

When the tolerances for the machined surfaces are related to datums or datum systems different from the general datum system RST, additional material is needed for the moulded condition.

Due to the inclination and offset of the general datum system RST of the moulded condition relative to the datum system of the machined condition, the amount of additional material shall be calculated from the geometrical tolerance of the datum surfaces of the machined condition relative to the general datum system RST.

10.7 Rule G: Required machining allowances (RMA)

Surfaces to be machined require a machining allowance RMA. The RMA shall be selected from [Table 4](#) and shall be indicated on the product definition. For information on the selection of RMAs, see [Annex F](#).

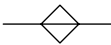
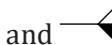
The same RMA applies to all surfaces to be machined, unless a different RMA is individually indicated to a specific surface (according to ISO 1302).

[Annex C](#) gives examples for the calculation of the dimension of the moulded condition (raw dimension).

10.8 Rule H: Draft angle (taper)

The draft angle shall be selected from [Tables 5](#) to [9](#) and shall be indicated on the product definition according to ISO 10135.

In order to identify the draft angled (tapered) surfaces, the parting surface shall be indicated according to ISO 10135.

The parting surface shall be indicated by the symbols  and  (see ISO 10135).

Unless otherwise indicated, draft angle plus (taper plus) (TP) shall apply. The exception to this rule is for features with the maximum material requirement specified according to ISO 2692, where draft angle minus (taper minus) (TM) shall apply. See ISO 10135.

10.9 Rule I: Wall thickness

For wall thicknesses, as a further constraint (see [10.5](#)), the values given in [Table 3](#) shall apply as dimensional tolerances. Unless otherwise specified, symmetrically disposed with $\pm$ half the values.

As the default condition, the general dimension tolerance for wall thickness in [Table 3](#) shall be one grade coarser than the general tolerance for other dimensions; for example, if there is a general tolerance on a drawing of S10, the tolerance on wall thicknesses shall be S11.

For wall thickness with variable dimensions that can lead to different tolerance values, according to [Table 3](#), the smallest tolerance value shall be applied.

EXAMPLE For a casting with an overall dimension of 2 000 mm specified with the tolerance grade 6, the tolerance grade for wall thickness is tolerance grade 7. For a feature with wall thickness that varies between 95 mm and 102 mm, [Table 3](#) gives tolerance values of 1,0 mm for the 95 mm wall thickness and 1,4 mm for the 102 mm wall thickness. The smallest of these values is 1,0 mm and this tolerance is applied to the entire feature.

NOTE The two-point dimension for a wall thickness that is not a feature of size is for the time being not defined.

11 General tolerances

[Table 2](#) gives the general surface profile tolerances for the moulded condition of castings. The tolerances are related to the sizes of the model geometry of the castings (diameter of the smallest enveloping sphere). See [Annex E](#) for more information. The tolerance grades P are related to the material and to the manufacturing method, see [Tables E.1](#) and [E.2](#).

NOTE This general tolerance is constant throughout the casting.

Table 2 — General surface profile tolerances for the moulded condition of castings

Dimensions in millimetres

Moulded space diagonal		General surface profile tolerances for tolerance grades P (profile)														
Above >	Up to, including ≤	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—	10	0,09	0,14	0,19	0,27	0,37	0,53	0,76	1,1	—	—	—	—	—	—	—
10	30	0,12	0,16	0,23	0,31	0,44	0,61	0,86	1,3	—	—	—	—	—	—	—
30	100	0,14	0,19	0,27	0,38	0,53	0,74	1,1	1,5	2,1	3	—	—	—	—	—

Table 2 (continued)

Moulded space diagonal		General surface profile tolerances for tolerance grades P (profile)														
Above >	Up to, including ≤	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
100	300	0,15	0,23	0,35	0,5	0,7	1,0	1,4	2	2,8	4	5,6	8	—	—	—
300	1 000	—	—	0,42	0,64	0,8	1,3	1,9	2,7	3,8	5,5	7,5	11	15	19	23
1 000	3 000	—	—	—	—	—	1,6	2,4	3,8	5,4	8	10	15	21	26	33
3 000	6 300	—	—	—	—	—	—	—	—	7	10	13	19	26	33	41
6 300	10 000	—	—	—	—	—	—	—	—	—	11	16	23	32	40	50

The moulded space diagonal is equal to the diameter of the smallest enveloping sphere.

Unless otherwise indicated according to ISO 10135, surface mismatch is included in the general surface profile tolerance.

For the application of draft angles (tapers) see [10.8](#).

For sizes (diameters) of complete cylinders, as a further restriction (see [10.5](#)), the values given in [Table 3](#) apply as dimensional tolerances. Unless otherwise specified, $\pm$ of half the values of [Table 3](#) apply.

If the values for the general tolerances of [Table 2](#) are not required, the product definition indication for the general tolerance shall only refer to the tolerance grade P.

NOTE 1 The tolerance values for sizes are related to the nominal values of the sizes in the moulded condition.

For wall thicknesses, as a further constraint (see [10.5](#)), the values given in [Table 3](#) apply as dimensional tolerances. Unless otherwise specified, $\pm$ of half the values apply.

If draft angles are involved, see [6.4](#) for indication. The tolerance remains the same over the whole length of the surface, unless otherwise specified. This applies also to wall thicknesses.

NOTE 2 The tolerance values for wall thickness are related to the nominal values of the wall thickness in the moulded condition.

Table 3 — General dimensional tolerances for sizes (diameters) of complete cylinders and for wall thicknesses

Dimensions in millimetres

Casting dimension of the involved surface ^a		General dimensional tolerances for tolerance grades S (size)														
Above >	Up to, including ≤	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—	10	0,1	0,12	0,2	0,24	0,32	0,5	0,7	1,0	1,4	2,0	2,8	4,0	—	—	—
10	30	0,12	0,14	0,24	0,3	0,4	0,6	0,8	1,2	1,6	2,4	3,2	5,0	6,0	8,0	10,0
30	100	0,14	0,2	0,28	0,4	0,5	0,8	1,0	1,6	2,0	3,0	4,0	6,0	8,0	10,0	14,0
100	300	0,16	0,24	0,32	0,5	0,7	1,0	1,4	2,0	2,8	4,0	6,0	8,0	10,0	14,0	18,0

^a Size or wall thickness of the nominal contour in the moulded condition

NOTE The table shows the total tolerances which are used as $\pm$ tolerance of half the values unless otherwise indicated. For example, for size 9 the tolerance grade S1 is $\pm 0,05$.

If, for functional reasons, features of size established by two parallel opposite planes are required, the feature of size tolerances shall be indicated individually.

There are cases where the calculation of the moulded dimension using tolerances according to [Table 2](#) or [Table 3](#) leads to two different results (a larger and a smaller dimension tolerance). In such cases, the smaller dimension tolerance applies.

12 Required machining allowances (RMAs)

The RMAs are given in [Table 4](#). The RMA grades are related to the material and to the manufacturing method, see [Table F.1](#).

Table 4 — Required machining allowance grades (RMAGs)

Dimensions in millimetres

Moulded space diagonal		RMAG									
Above >	Up to, including ≤	A	B	C	D	E	F	G	H	J	K
—	40	0,1	0,1	0,2	0,3	0,4	0,5	0,5	0,7	1	2
40	63	0,1	0,2	0,3	0,3	0,4	0,5	0,7	1	1,4	3
63	100	0,2	0,3	0,4	0,5	0,7	1	1,4	2	2,8	4
100	160	0,3	0,4	0,5	0,8	1,1	1,5	2,2	3	4	6
160	250	0,3	0,5	0,7	1	1,4	2	2,8	4	5,5	8
250	400	0,4	0,7	0,9	1,3	1,8	2,5	3,5	5	7	10
400	630	0,5	0,8	1,1	1,5	2,2	3	4	6	9	12
630	1 000	0,6	0,9	1,2	1,8	2,5	3,5	5	7	10	14
1 000	1 600	0,7	1	1,4	2	2,8	4	5,5	8	11	16
1 600	3 000	0,8	1,1	1,6	2,2	3,2	4,5	6	9	13	18
3 000	6 300	1	1,4	2	2,8	4	5,5	8	11	16	22
6 300	10 000	1,1	1,5	2,2	3	4,5	6	9	12	17	24

NOTE The number of moulded space diagonal graduations is greater than in [Tables 2](#) and [3](#), in order to avoid excess material.

13 Draft angles

If indicated in the general product definition indication, see [Clause 9](#), and if not otherwise individually indicated, the draft angles according to [Tables 5](#) to [9](#) apply.

The rules for the indication of draft angles are given in ISO 10135. The draft angle applies as continuously increasing the tolerance (not increasing the model geometry), see [6.4 c](#)).

Table 5 — Draft angles for hand moulding casting

Height range of feature for draft angle mm		Grade A (DA) (fine)		Grade B (DB) (coarse)	
Above >	Up to, including ≤	External	Internal	External	Internal
0	4	6,9° (0,4 mm)	8,3° (0,5 mm)	8,8° (0,6 mm)	10,7° (0,7 mm)
4	6,3	6,5° (0,6 mm)	7,5° (0,7 mm)	5,2° (0,7 mm)	9,3° (0,8 mm)
6,3	10	4,8° (0,7 mm)	5,4° (0,8 mm)	5,7° (0,8 mm)	7,5° (1,0 mm)

Table 5 (continued)

Height range of feature for draft angle mm		Grade A (DA) (fine)		Grade B (DB) (coarse)	
Above >	Up to, in- cluding ≤	External	Internal	External	Internal
10	16	3,2° (0,7 mm)	4,1° (0,9 mm)	4,7° (1,0 mm)	5,7° (1,3 mm)
16	25	2,6° (0,9 mm)	3,0° (1,1 mm)	3,2° (1,1 mm)	4,4° (1,6 mm)
25	40	2,2° (1,1 mm)	2,9° (1,6 mm)	3,0° (1,5 mm)	4,1° (2,2 mm)
40	63	1,9° (1,5 mm)	2,4° (2,1 mm)	2,6° (2,1 mm)	3,3° (2,8 mm)
63	100	1,4° (1,8 mm)	2,0° (2,6 mm)	2,0° (2,4 mm)	2,7° (3,6 mm)
100	160	1,0° (2,2 mm)	1,5° (3,2 mm)	1,4° (3,0 mm)	2,0° (4,3 mm)
160	250	0,8° (2,8 mm)	1,2° (4,0 mm)	1,2° (4,0 mm)	1,6° (5,5 mm)
250	400	0,7° (3,1 mm)	0,9° (5,0 mm)	0,9° (4,5 mm)	1,3° (6,8 mm)
400	630	0,5° (4,7 mm)	0,8° (6,5 mm)	0,7° (6,3 mm)	1,0° (8,7 mm)
630	1 000	0,5° (7,0 mm)	0,7° (9,0 mm)	0,7° (9,5 mm)	0,9° (12,5 mm)
1 000	1 600	0,4° (9,0 mm)	0,5° (11,5 mm)	0,5° (11,5 mm)	0,7° (14,5 mm)

Table 6 — Draft angles for machine moulding casting

Height range of feature for draft angle mm		Grade A (DA) (fine)		Grade B (DB) (coarse)	
Above >	Up to, in- cluding ≤	External draft angle	Internal draft angle	External draft angle	Internal draft angle
0	4	5,8° (0,4 mm)	6,8° (0,5 mm)	7,4° (0,5 mm)	8,6° (0,6 mm)
4	6,3	5,3° (0,5 mm)	6,0° (0,5 mm)	6,7° (0,6 mm)	7,5° (0,7 mm)
6,3	10	4,9° (0,5 mm)	4,4° (0,6 mm)	4,7° (0,7 mm)	6,0° (0,8 mm)
10	16	4,7° (0,6 mm)	3,2° (0,7 mm)	3,9° (0,9 mm)	4,5° (1,0 mm)
16	25	2,2° (0,8 mm)	2,5° (0,9 mm)	2,8° (1,0 mm)	3,5° (1,2 mm)
25	40	2,0° (1,1 mm)	2,4° (1,3 mm)	2,7° (1,5 mm)	3,3° (1,8 mm)
40	63	1,6° (1,4 mm)	1,9° (1,7 mm)	2,0° (1,8 mm)	2,6° (2,2 mm)
63	100	1,2° (1,7 mm)	1,6° (2,1 mm)	1,6° (2,2 mm)	2,2° (3,0 mm)
100	160	1,0° (2,3 mm)	1,3° (2,8 mm)	1,3° (2,9 mm)	1,8° (3,9 mm)
160	250	0,9° (3,0 mm)	1,1° (3,9 mm)	1,2° (4,1 mm)	1,6° (5,4 mm)
250	400	0,8° (4,3 mm)	1,0° (5,4 mm)	1,1° (5,8 mm)	1,4° (7,4 mm)
400	630	0,7° (6,2 mm)	0,9° (7,7 mm)	0,9° (7,9 mm)	1,1° (9,8 mm)
630	1 000	0,5° (7,0 mm)	0,7° (9,0 mm)	0,7° (9,5 mm)	0,9° (12,5 mm)
1 000	1 600	0,4° (9,0 mm)	0,5° (11,5 mm)	0,5° (11,5 mm)	0,7° (14,5 mm)

Table 7 — Draft angles for permanent moulding casting

Height range of feature for draft angle mm		Grade A (DA) (fine)		Grade B (DB) (coarse)	
Above >	Up to, including ≤	External draft angle	Internal draft angle	External draft angle 2	Internal draft angle 2
—	4	3,5° (0,1 mm)	4,3° (0,2 mm)	5,0° (0,2 mm)	5,8° (0,2 mm)
4	6,3	3,0° (0,3 mm)	3,8° (0,3 mm)	4,5° (0,4 mm)	5,3° (0,5 mm)
6,3	10	2,7° (0,4 mm)	3,5° (0,5 mm)	3,8° (0,5 mm)	4,6° (0,7 mm)
10	16	2,2° (0,5 mm)	2,7° (0,6 mm)	3,3° (0,7 mm)	3,8° (0,9 mm)
16	25	2,0° (0,7 mm)	2,2° (0,8 mm)	2,8° (1,0 mm)	3,0° (1,1 mm)
25	40	1,8° (1,0 mm)	2,0° (1,1 mm)	2,3° (1,3 mm)	2,5° (1,4 mm)
40	63	1,5° (1,3 mm)	1,6° (1,4 mm)	1,8° (1,6 mm)	1,9° (1,7 mm)
63	100	1,2° (1,7 mm)	1,3° (1,8 mm)	1,5° (2,1 mm)	1,6° (2,3 mm)
100	160	1,1° (2,5 mm)	1,2° (2,7 mm)	1,4° (3,2 mm)	1,5° (3,4 mm)
160	250	1,0° (3,6 mm)	1,1° (3,9 mm)	1,3° (4,7 mm)	1,4° (5,0 mm)
250	400	0,9° (5,1 mm)	1,0° (5,7 mm)	1,2° (6,8 mm)	1,3° (7,4 mm)
400	630	0,8° (7,2 mm)	0,9° (8,1 mm)	1,1° (9,9 mm)	1,2° (10,8 mm)

Table 8 — Draft angles for pressure die casting

Height range of feature for draft angle mm		Grade A (DA) (fine)		Grade B (DB) (coarse)	
Above >	Up to, including ≤	External draft angle	Internal draft angle	External draft angle 2	Internal draft angle 2
—	4	2,5° (0,1 mm)	3,0° (0,1 mm)	3,5° (0,1 mm)	3,6° (0,1 mm)
4	6,3	2,0° (0,2 mm)	2,5° (0,2 mm)	3,0° (0,3 mm)	3,1° (0,3 mm)
6,3	10	1,5° (0,2 mm)	2,0° (0,3 mm)	2,5° (0,4 mm)	2,6° (0,4 mm)
10	16	1,5° (0,3 mm)	2,0° (0,5 mm)	2,5° (0,6 mm)	2,6° (0,6 mm)
16	25	1,4° (0,5 mm)	1,5° (0,5 mm)	1,8° (0,6 mm)	1,9° (0,7 mm)
25	40	1,3° (0,7 mm)	1,4° (0,8 mm)	1,7° (1,0 mm)	1,8° (1,0 mm)
40	63	1,2° (1,1 mm)	1,3° (1,2 mm)	1,6° (1,4 mm)	1,7° (1,5 mm)
63	100	1,1° (1,6 mm)	1,2° (1,7 mm)	1,5° (2,1 mm)	1,6° (2,3 mm)
100	160	1,0° (2,3 mm)	1,1° (2,5 mm)	1,3° (3,0 mm)	1,4° (3,2 mm)
160	250	0,9° (3,2 mm)	1,0° (3,6 mm)	1,2° (4,3 mm)	1,3° (4,7 mm)
250	400	0,8° (4,5 mm)	0,9° (5,1 mm)	1,1° (6,2 mm)	1,2° (6,8 mm)
400	630	0,7° (6,3 mm)	0,8° (7,2 mm)	1,0° (9,0 mm)	1,1° (9,9 mm)

Table 9 — Draft angles (tapers) for investment casting

Height range of feature for draft angle mm		Grade A (DA) (fine)		Grade B (DB) (coarse)	
Above >	Up to, including ≤	External draft angle	Internal draft angle	External draft angle 2	Internal draft angle 2
—	4	5,7° (0,2 mm)	5,7° (0,2 mm)	5,7° (0,2 mm)	8,5° (0,3 mm)
4	6,3	2,2° (0,2 mm)	2,2° (0,2 mm)	2,2° (0,2 mm)	3,3° (0,3 mm)
6,3	10	1,4° (0,2 mm)	1,4° (0,2 mm)	1,4° (0,2 mm)	2,8° (0,4 mm)
10	16	0,9° (0,2 mm)	1,3° (0,3 mm)	1,3° (0,3 mm)	1,8° (0,4 mm)
16	25	0,8° (0,3 mm)	1,1° (0,4 mm)	1,1° (0,4 mm)	1,4° (0,5 mm)
25	40	0,5° (0,3 mm)	0,7° (0,4 mm)	0,7° (0,4 mm)	1,1° (0,6 mm)
40	63	0,5° (0,4 mm)	0,6° (0,5 mm)	0,6° (0,5 mm)	0,8° (0,7 mm)
63	100	0,3° (0,4 mm)	0,4° (0,6 mm)	0,4° (0,6 mm)	0,6° (0,8 mm)
100	160	0,2° (0,5 mm)	0,3° (0,7 mm)	0,3° (0,7 mm)	0,4° (0,9 mm)
160	250	0,2° (0,6 mm)	0,2° (0,8 mm)	0,2° (0,8 mm)	0,3° (1,0 mm)
250	400	0,1° (0,7 mm)	0,2° (0,9 mm)	0,2° (0,9 mm)	0,2° (1,2 mm)
400	630	0,1° (0,8 mm)	0,1° (1,0 mm)	0,1° (1,0 mm)	0,2° (1,5 mm)

NOTE The overall dimension rating is finer than that in Tables 4 to 8, in order to avoid excess material.

14 General product definition indication

In order to apply the general tolerances according to this document, the following items shall be specified in, or near the drawing title block, or defined in the product definition data set:

- the number of this document, i.e. ISO 8062-4;
- the general profile tolerance and the indication of the datum system;
- the general tolerance grade for sizes of cylinders (if required);
- the general tolerance grade for wall thicknesses;
- the RMA value;
- manufacturing method together with the draft angle grade;
- draft angles included in the model geometry (if draft angles are included in the model geometry);
- the casting size $S\emptyset$ of smallest enveloping sphere;
- the part condition identifier(s), see ISO/TS 8062-2.

EXAMPLE

Surfaces without tolerance indication:

 2,7 R S T (P8)

Cylinder diameters S8

Wall thicknesses S9

RMA -2,5

Machine moulding DB

Draft angles included in the nominal model

Casting size SØ 880

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Annex A

(normative)

Proportions and dimensions of graphical symbols

A.1 General requirements

In order to harmonize the size of the symbols specified in this document with those of other inscriptions on technical drawings (e.g. dimensions, geometrical tolerances), the rules given in ISO 81714-1 shall be applied.

A.2 Application

The graphical symbols given in ISO 1302, ISO 7083 and ISO 13715 shall be used.

A.3 Proportions

The graphical symbols and the additional indications in the area “a” shall be drafted in accordance with [Figure A.1](#).

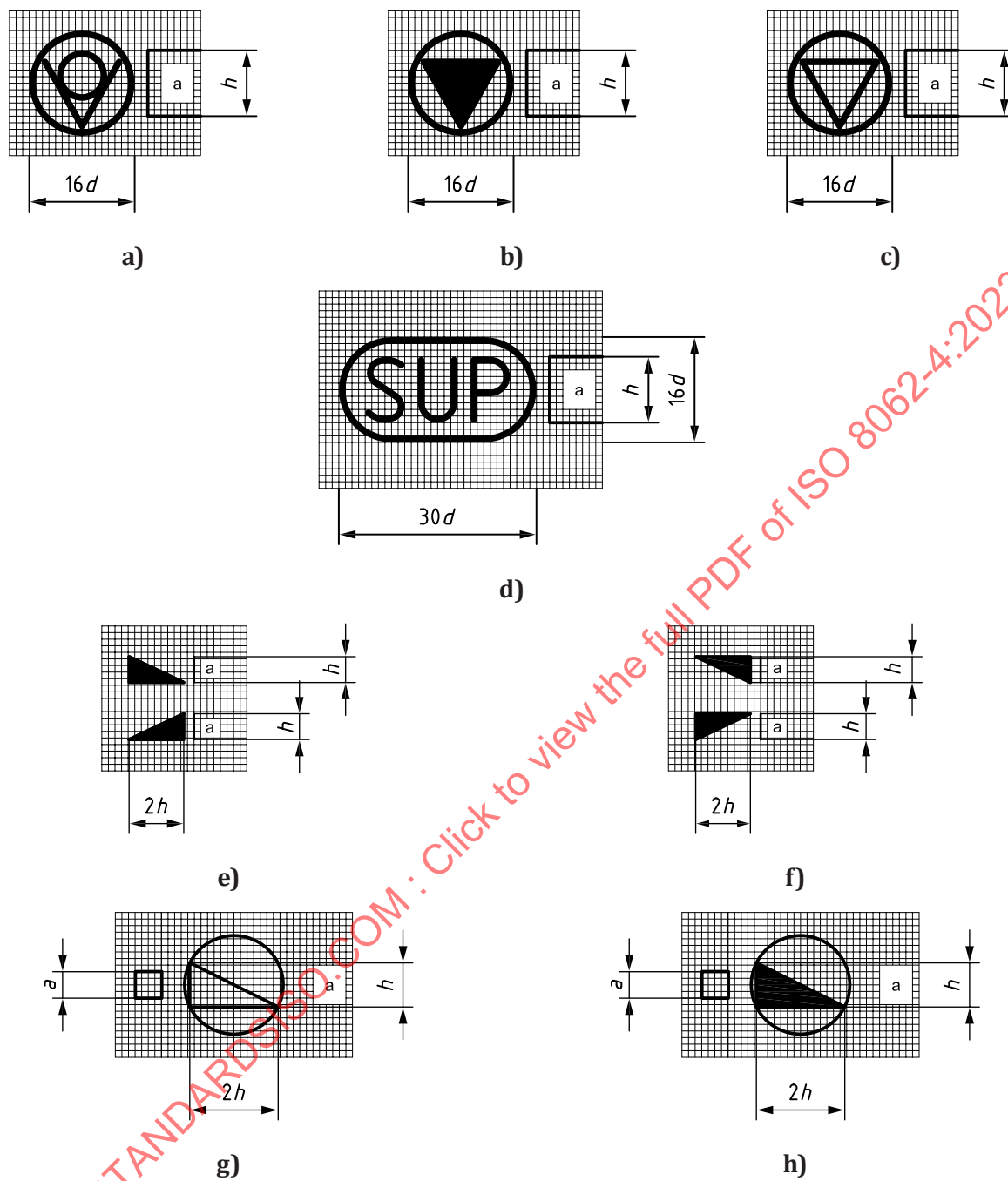


Figure A.1 — Proportions of the graphical symbols

A.4 Dimensions

The dimensional requirements of the graphical symbols and the additional indications are specified in [Table A.1](#).

Table A.1 — Dimensions

Dimensions in millimetres						
Lettering height <i>h</i>	2,5	3,5	5	7	10	14
Line thickness for symbols and lettering <i>d</i>	0,25	0,35	0,5	0,7	1	1,4

Annex B (informative)

Proposed process for general tolerancing castings

Example procedure to tolerance a casting:

- Define the moulded datum system (should remain valid during the whole process chain of the part).
- Select the cast material ([Table E.1](#)).
- Select the series type (long series = [Table E.1](#), short series = [Table E.2](#)).
- Define appropriate general surface profile tolerance: select the tolerance grade P and, if necessary, S ([Tables 2](#) or [Table 3](#)) according to the moulding method ([Tables E.1](#) and [E.2](#)). See [Clause 11](#) (e.g. high-pressure die casting, HPDC, has narrower tolerances than permanent mould casting).
- Define the general wall thickness tolerance as one grade coarser of the defined general S tolerance according to [Table 3](#) if the general surface profile tolerance is not appropriate.
- Define the general size tolerances according to [Table 3](#) if the general surface profile tolerance is not appropriate.
- Define the surface mismatch requirement (see ISO 10135) if the general surface profile tolerance, which includes the mismatch, is not appropriate (see explanation in [Clause 11](#)).
- Define the parting surface and necessary cores, see [10.8](#).
- Define draft angles, see [10.8](#), [Clause 13](#), [Tables 5](#) to [9](#) and ISO 10135.
- Define machining allowance grade according to [Table F.1](#).
- Select values of machining allowances according to [Table 4](#).
- Discuss design proposals with the foundry.

Annex C
(informative)

Examples for the multiple tolerancing method

The examples in [Figures C.1](#), [C.2](#) and [C.3](#) show the relationship between the tolerances in the various part conditions. In practice the tolerances for the final machined moulded part condition may be much smaller than the tolerances for the final moulded part condition. It is up to the designer of the final moulded part condition to decide whether or not these smaller tolerances can be neglected.

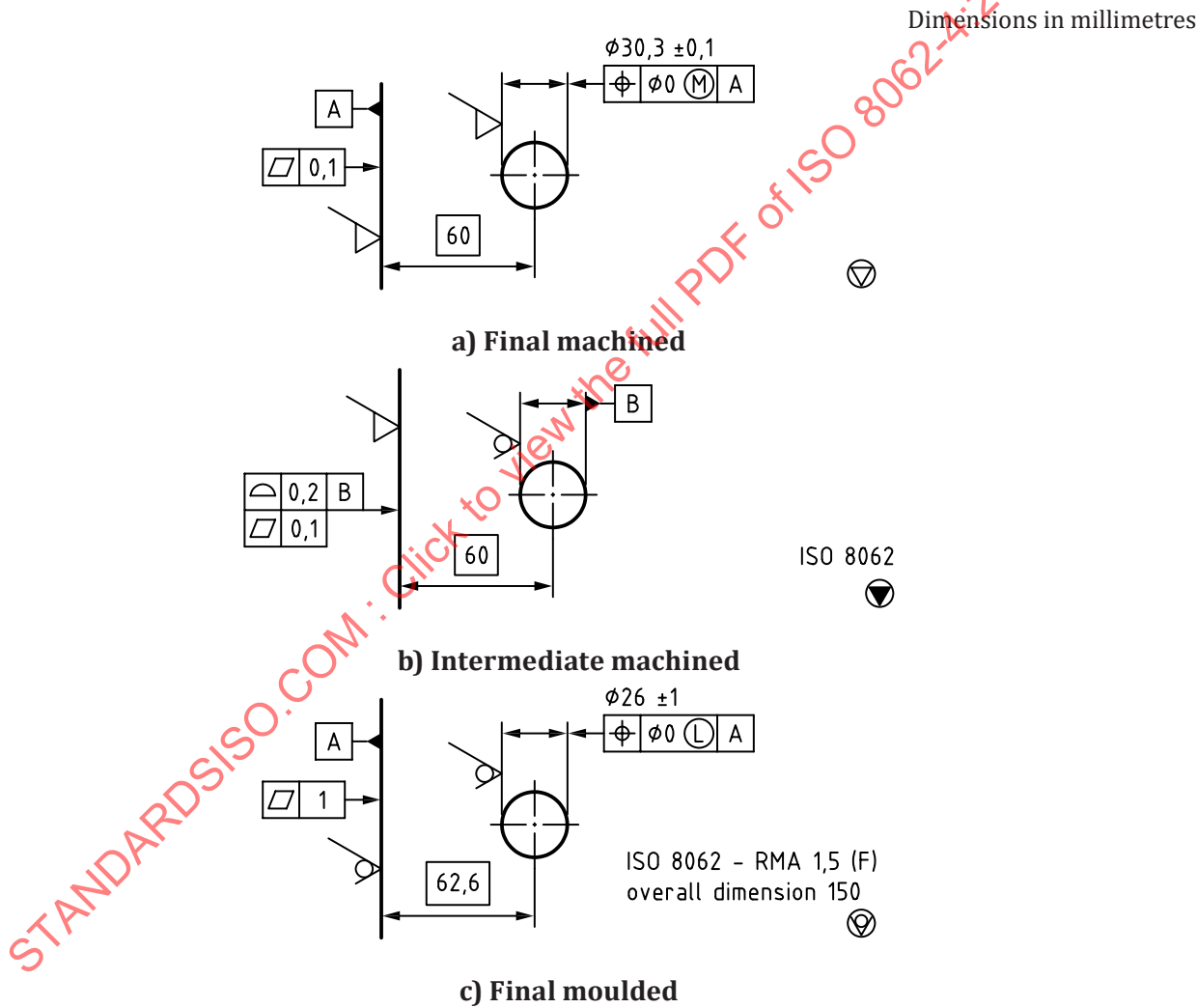


Figure C.1 — Feature of size (hole) relative to a plane datum — requirements



Annex D
(informative)

Drawing examples

This annex provides a number of drawing examples, given in [Figures D.1](#) to [D.6](#).

In [Figure D.1](#), the general surface profile tolerance and the individual tolerances define the geometry. The general surface profile tolerance 3 mm does not apply to $\varnothing 91$ mm because there is a feature of size with a $\pm$ tolerance given.

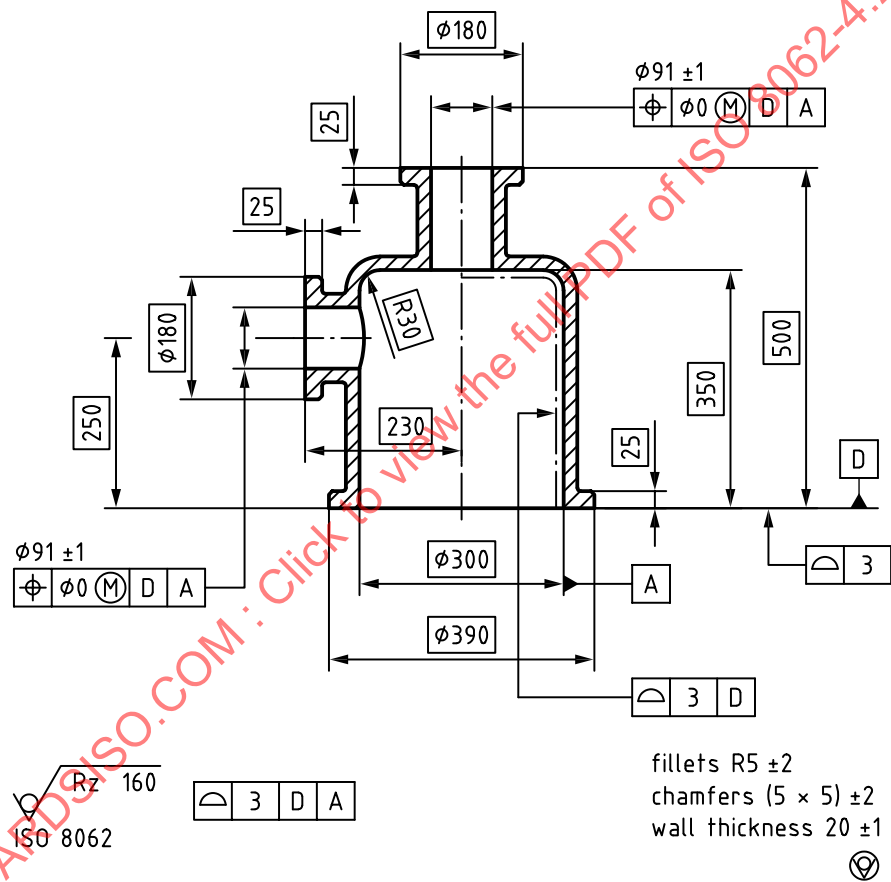


Figure D.1 — Final moulded part, particular general tolerances and individual tolerances

Interpretation of [Figure D.2](#): profile tolerances define tolerance zones and thereby a perfect shape of least material of the following dimensions: 300,2 mm, R 30,2 mm, 350 mm, 90,4 mm, 90,4 mm, 249,8 mm, 229,8 mm, 499,6 mm. [For the calculation, it is assumed that at the datum surfaces 0,2 mm (= profile tolerance) will be finally removed.]

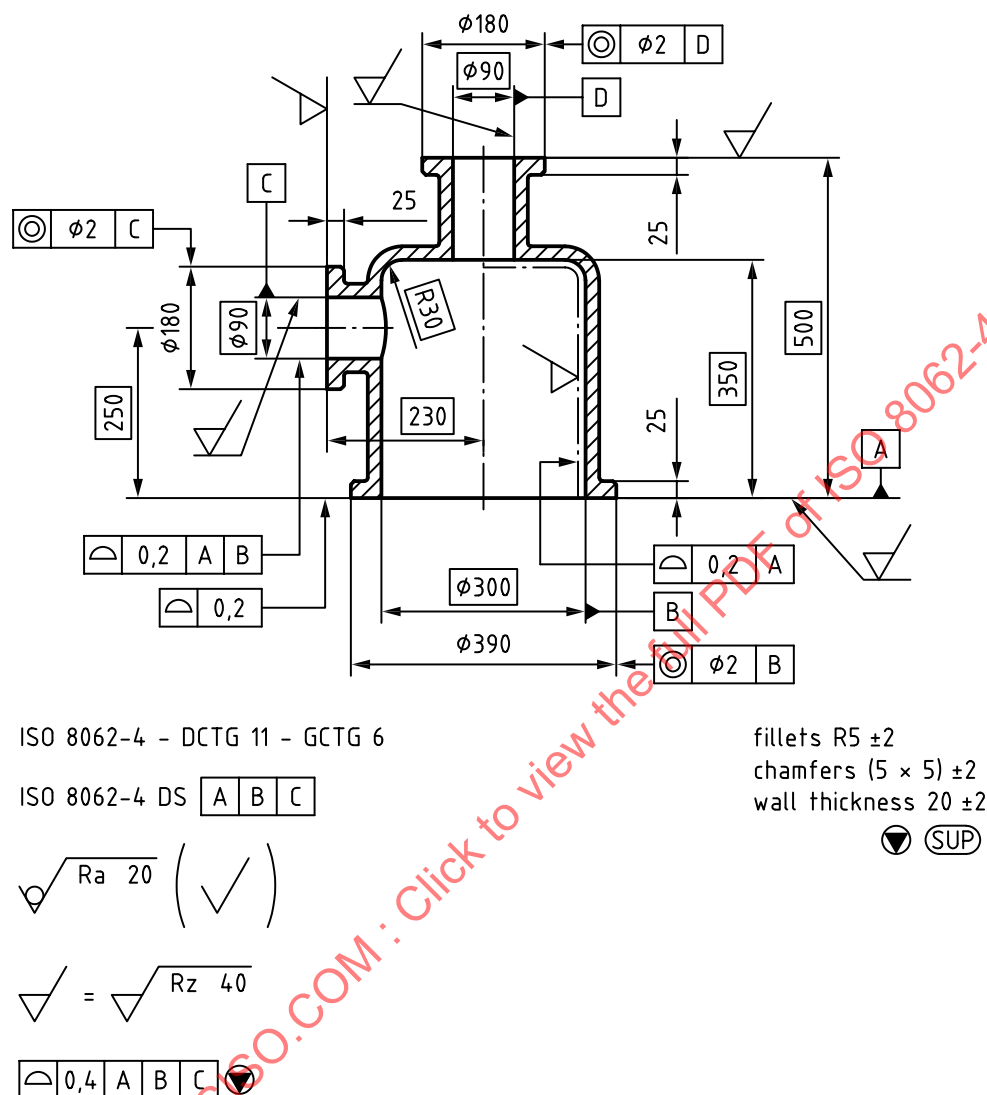


Figure D.2 — Intermediate machined moulded part SUP, general tolerances ISO 8062-3 for moulded surfaces

The final machined moulded part with all deviations and with an additional material layer of the final machining allowance shall fit into the material of this shape, see [Figure D.3](#).

Wall thicknesses (20 ± 2) mm.

Dimensions 390 mm, 180 mm and thickness 25 mm within ISO 8062-3 — DCTG 11.

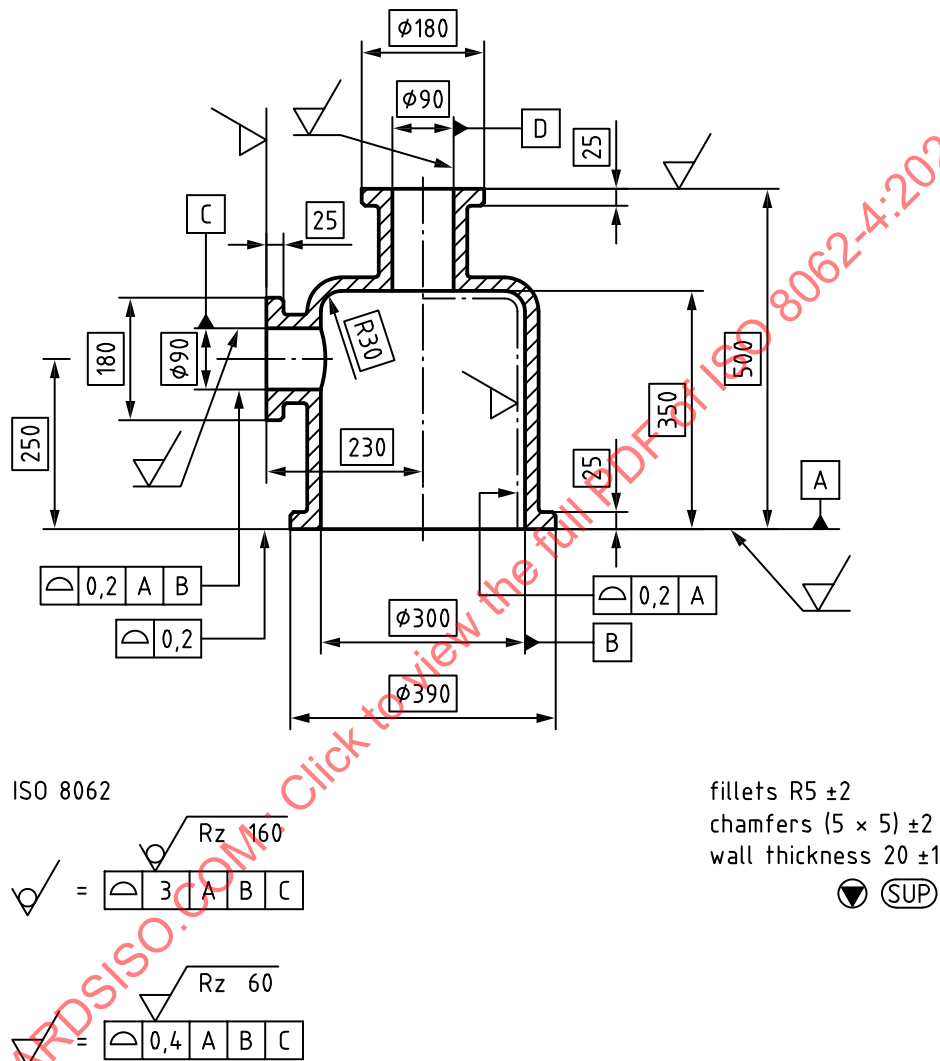


Figure D.3 — Intermediate machined moulded part SUP, particular general tolerances for moulded surfaces

Interpretation of [Figure D.4](#): The indicated tolerances apply (general tolerances and individually indicated tolerances). The positional tolerances have the same datum system as the general surface profile tolerances and overrule the general surface profile tolerances. The general surface profile tolerance does not apply to the 84 mm as there is no TED.

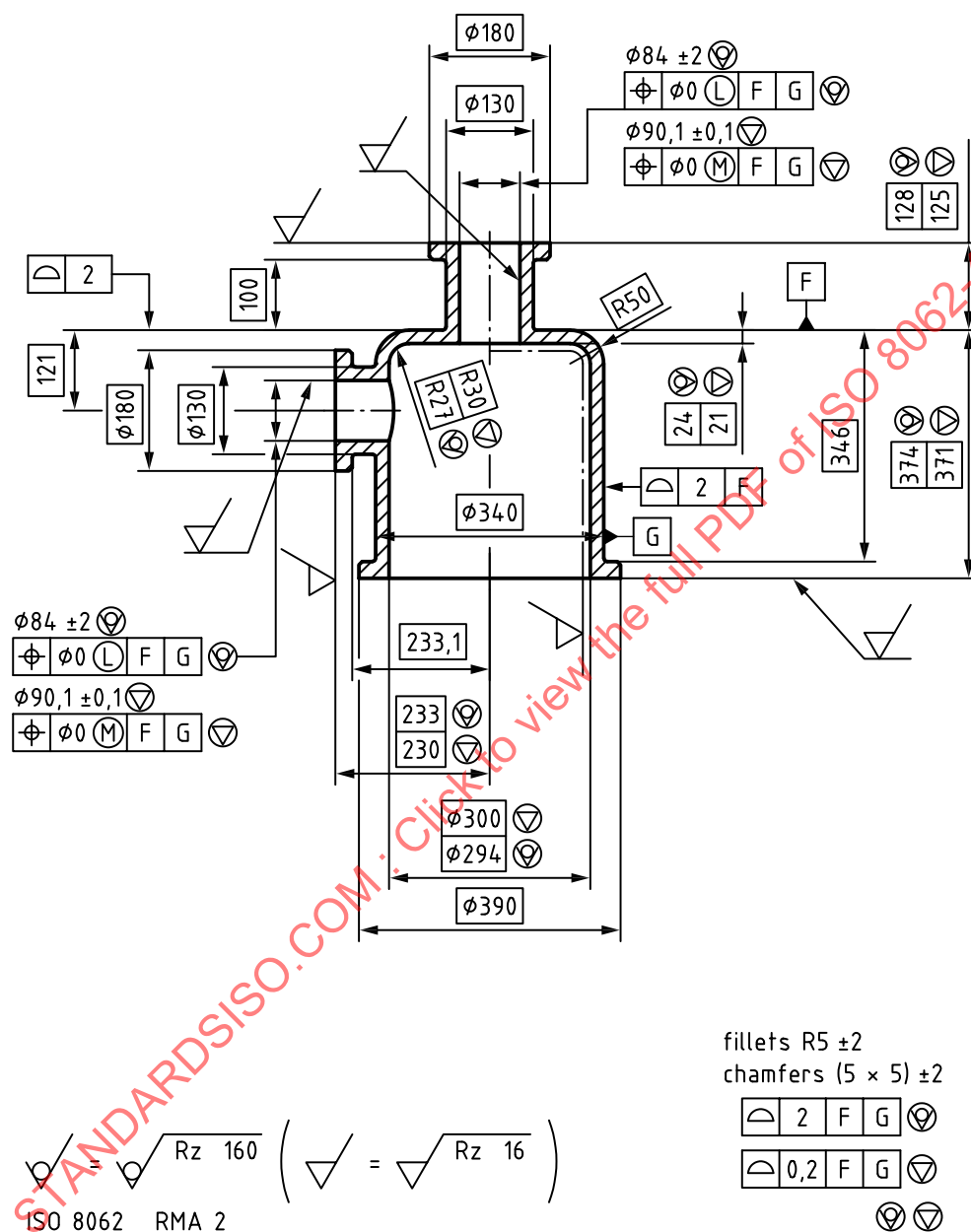


Figure D.4 — Final moulded part and final machined moulded part, multiple tolerancing method

In [Figure D.5](#), the general tolerance applies to all surfaces, including the datum surfaces.

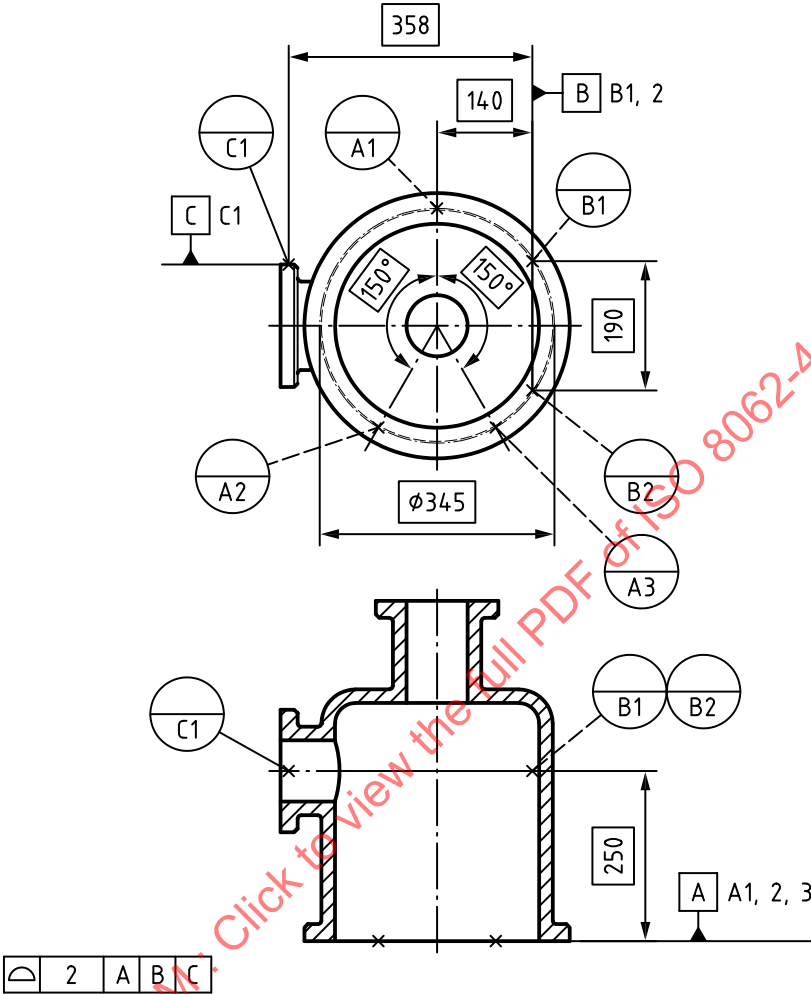


Figure D.5 — Datum system established by datum targets according to ISO 5459, location of datum targets defined by TEDs

In [Figure D.6](#), the general tolerance applies to all surfaces, including the datum surfaces. The zero coordinates may be changed in order to fit the particular part into the overall tolerance zone (specified as a particular general tolerance).

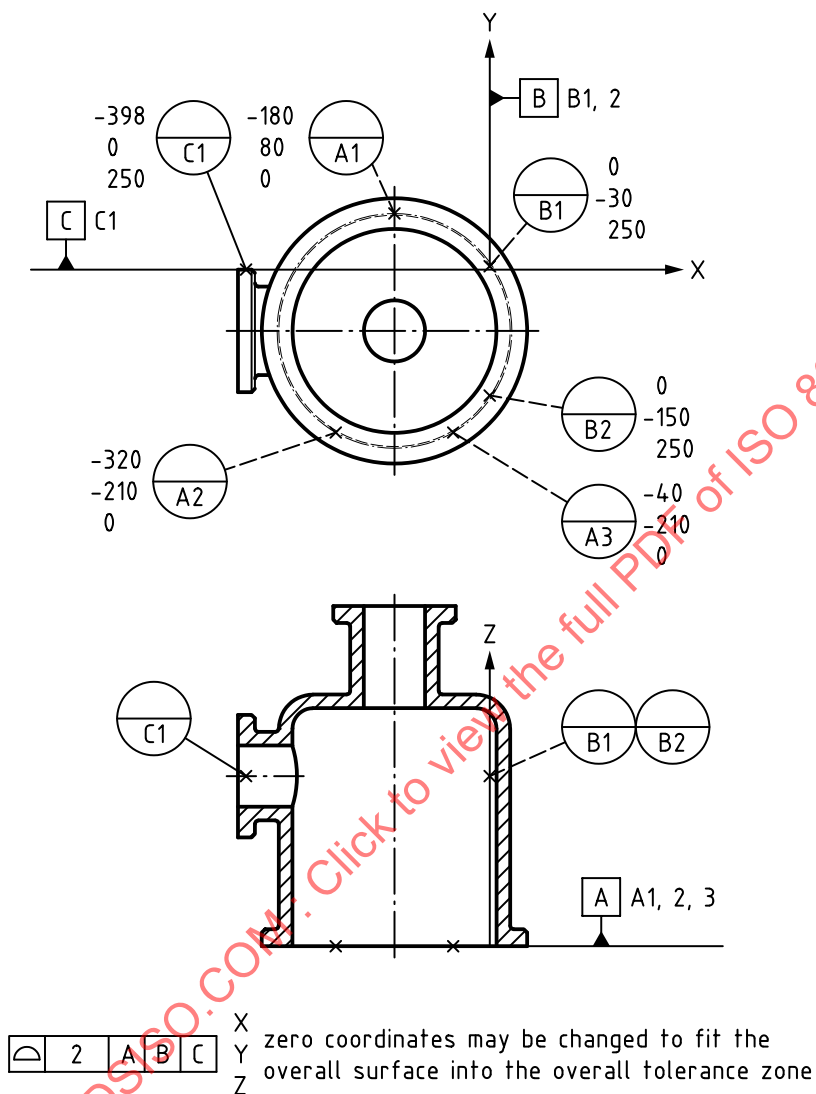


Figure D.6 — Datum system established by datum targets according to ISO 5459, location of datum targets defined by theoretically exact coordinates