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

Part 4: 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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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 on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification.*

A list of all parts in the ISO 8062 series can be found on the ISO website.

Introduction

This document is a geometrical product specification (GPS) standard and is regarded as a complementary process-specific tolerance standard (see ISO 14638). It influences chain link B of the chain of standards on mouldings.

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 F.

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 GPS standards to apply the rules for calculating of 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 (± 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 GPS rules (e.g. ISO 14405-2).

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 any more when only the CAD model is available.

For these reasons, the use of ISO 8062-3 from a GPS-point of view cannot be recommended. This document avoids the insufficiencies of ISO 8062-3 described above and is in full compliance with the GPS rules. The general tolerances according to ISO 8062-3 are not comparable with the general tolerances according to this document.

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

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

1 Scope

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.

NOTE When there is no datum system (target or integral) on surfaces remaining in the final condition, this document cannot be applied.

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

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)*

ISO 5458, *Geometrical Product Specifications (GPS) — Geometrical tolerancing — Positional tolerancing*

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

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

ISO/TS 8062-2, *Geometrical product specifications (GPS) — Dimensional and geometrical tolerances for moulded parts — Part 2: Rules*

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*

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/TS 8062-2, ISO 10135, ISO 10579 and the following apply.

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

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

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

3.1
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

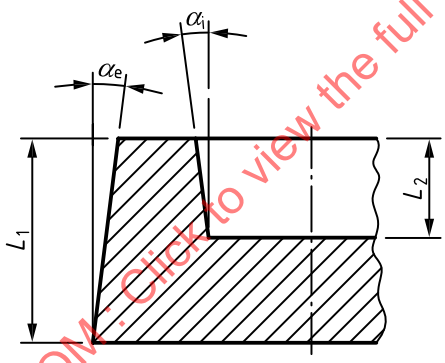
[SOURCE: ISO 8062-1:2007, 2.15, modified]

3.1.1
external draft angle
draft angle (3.1) on a surface that has no opposite surface in the direction outward of the part

Note 1 to entry: See Figure 1.

3.1.2
internal draft angle
draft angle (3.1) on a surface that has an opposite surface in the direction outward of the part

Note 1 to entry: See Figure 1.



Key

α_e external draft angle
α_i internal draft angle

Figure 1 — External and internal draft angles

3.1.3
draft angle increasing the ideal model feature(s)
draft angle (3.1) which is part of the ideal model

Note 1 to entry: See Figure 3 a).

3.1.4
draft angle increasing the tolerance of feature(s)
draft angle (3.1) which is added to the ideal model and included in the tolerance zone

Note 1 to entry: See Figure 3 b).

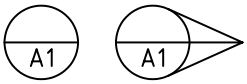
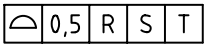
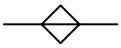
3.2
general datum system RST
datum system according to ISO 5459, using the datum letters R, S, T, locking all degrees of freedom and used for the general tolerance

Note 1 to entry: See Figure D.2.

Note 2 to entry: It is recommended to use a datum target system RST; see Figure D.1.

Note 3 to entry: The datum letters R, S, T, are reserved for the general datum system; see Rule C.

4 Symbols

Symbol	Description		Source
	moulded surface		ISO 1302
	machined surface		
	moulded or machined surface		
	surface profile tolerance		ISO 1101
	positional tolerance		
	theoretically exact dimension		
	datum of datum target		ISO 5459
	datum target, fixed, moveable		
	general tolerance		5.2, 5.3
	parting surface		ISO 10135
	parting surface	moveable	
		fixed	
	draft angle increasing the ideal model feature(s)		ISO 10135
	draft angle increasing the tolerance of feature(s)		5.8
	moulded condition		ISO/TS 8062-2
	intermediate (pre)machined		
	final machined		
	provided by supplier		

5 Rules

5.1 Rule A: Application of general tolerances for castings

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

a) the moulded condition only (see Figure D.2);

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 Rule C.

5.2 Rule B: General surface profile tolerances

The general tolerances according to this document are any surface profile tolerances related to a general datum system RST according to ISO 5459; see Rule C. The general tolerance is to be indicated in or near the drawing title block.

The general surface profile tolerance applies to all surfaces with the exception of Rule D.

5.3 Rule C: General datum system

A general datum system RST shall be indicated in the drawing.

When a general datum system RST is used, established by datum targets (preferred method), the general profile tolerances according to Table 1 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 1 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;

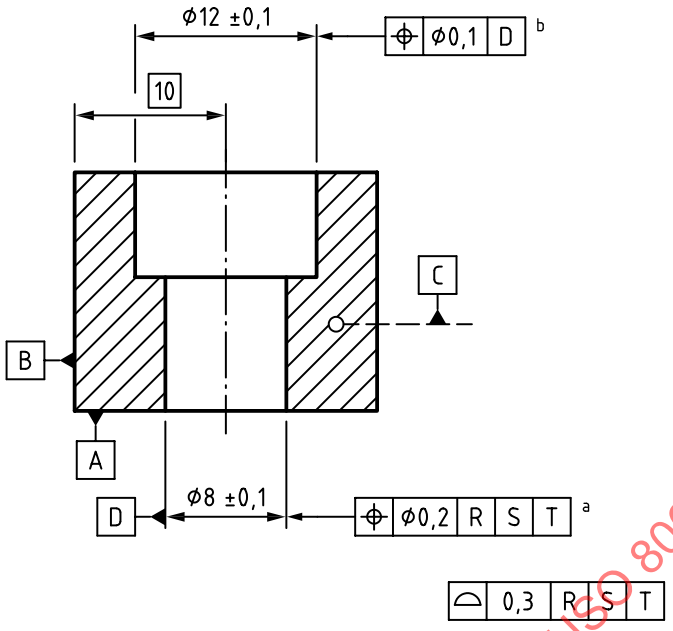
— a profile tolerance related to the primary datum for the secondary datum;

— a profile tolerance related to the primary and to the secondary datum for the tertiary datum.

NOTE When there is no datum system (target or integral) on surfaces remaining in the final condition, this document cannot be applied.

5.4 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 2.



Key

a Directly related to the general datum system RST.

b Indirectly related to the general datum system RST.

Figure 2 — Individually indicated locational tolerances 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.

5.5 Rule E: Additional tolerances

Other tolerances than those described in rules B and D, i.e. not related to the general datum system RST, apply in addition to the general tolerances as further constraints.

5.6 Rule F: Machined condition [application case A c)]

The final machined condition shall be possible to be achieved.

When the tolerances for the machined surfaces are related to a datum or datum system 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.

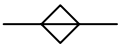
5.7 Rule G: Required machining allowances (RMAs)

Surfaces to be machined require a machining allowance RMA. The RMA shall be selected from Table 3 and shall be indicated on the drawing. For information on the selection of RMAs; see Annex C.

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 E gives examples for the calculation of the dimension of the moulded condition (raw dimension).

5.8 Rule H: Draft angle (taper)

The parting surface shall be indicated by the symbols  and  in accordance with ISO 10135.

There are three possible ways to indicate a draft angle (taper):

a) as already included in the ideal model or drawing outlines;

b) by the symbol ;

c) by the symbol .

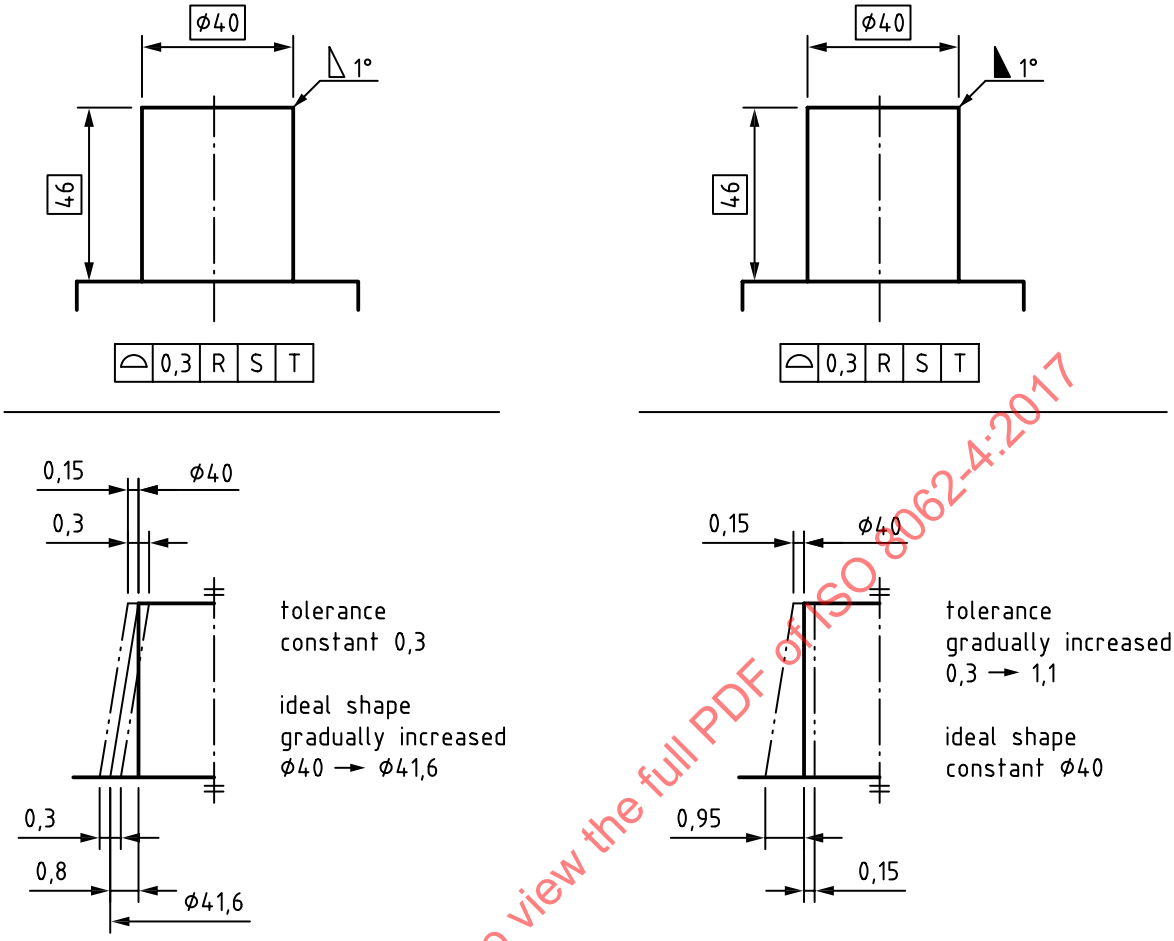
In case a), the general surface profile tolerance zone is located symmetrically to the nominal surface that includes the draft angles (tapers).

In case b), the general surface profile tolerance zone is located symmetrically to the surface when the draft angles (tapers) are added to the nominal model which excludes the draft angles in the tolerance zone; see Figure 3 a).

In case c), the general surface profile tolerance zone increases steadily as shown in Figure 3 b).

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

When the draft angles (tapers) are already included in the nominal model or in the drawing outlines, “Draft angles included” shall be indicated in or near the drawing title block.



a) Draft angle increasing the ideal model feature(s)

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

Figure 3 — Draft angles

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.

6 General tolerances

Table 1 gives the general surface profile tolerances for the moulded condition of castings. The tolerances are related to the sizes of the ideal models of the castings (diameter of the smallest enveloping sphere). See Annex A for more information. The tolerance grades P are related to the material and to the manufacturing method; see Table B.1 and Table B.2.

NOTE This general tolerance is constant throughout the casting.

Table 1 — General surface profile tolerances for the moulded condition of castings

Dimensions in mm

Moulded space diagonal		General surface profile tolerances for tolerance grades P														
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		—	—	—	—
100	300	0,15	0,23	0,35	0,5	0,7	0,1	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, surface mismatch is included in the general surface profile tolerance.

For the application of draft angles (tapers); see Rule H.

For sizes (diameters) of complete cylinders, as a further restriction (see Rule E), the values given in Table 2 apply as dimensional tolerances. Unless otherwise specified, ± of half the values of Table 2 apply.

If the values for the general tolerances of Table 2 are not required, the drawing 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 Rule E), the values given in Table 2 apply as dimensional tolerances. Unless otherwise specified, ± of half the values apply. Unless otherwise specified, one grade coarser than for sizes shall apply.

If draft angles are involved, the ± tolerance for the wall thickness shall be large enough to include the draft angles. If necessary, individual ± tolerances shall be indicated.

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

Table 2 — General dimensional tolerances for sizes (diameters) of complete cylinders, and for wall thicknesses

Dimensions in mm

Casting size[a]		General dimensional tolerances for tolerance grades S														
above <	up to, including ≤	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—	10	0,05	0,06	0,1	0,12	0,17	0,25	0,35	0,5	0,7	1	1,4	2	—	—	—
10	30	0,06	0,07	0,12	0,15	0,2	0,3	0,4	0,6	0,8	1,2	1,7	2,5	3	4	5
30	100	0,07	0,1	0,14	0,2	0,25	0,4	0,5	0,8	1	1,5	2	3	4	5	7
100	300	0,08	0,12	0,17	0,25	0,35	0,5	0,7	1	1,4	2	3	4	5	7	9

[a] Size or wall thickness of the nominal contour in the moulded condition.

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 1 or Table 2 leads to two different results (a larger and a smaller dimensional tolerance). In such cases, the smaller dimensional tolerance applies.

7 Required machining allowances

The RMAs are given in Table 3. The RMA grades are related to the material and to the manufacturing method; see Table C.1.

Table 3 — Required machining allowance grades

Dimensions in mm

Moulded space diagonal		RMA grades									
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 Table 1 and Table 2, in order to avoid excess material.

8 Draft angles (tapers)

If indicated in the general drawing indication (see Clause 9) and if not otherwise individually indicated, the draft angles (tapers) according to Table 4 to Table 8 apply.

The rules for the indication of draft angles (tapers) are given in ISO 10135. The draft angle (taper) applies as continuously increasing the tolerance (not increasing the ideal model); see Rule H c).

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

Table 4 — Draft angles (tapers) 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)
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 5 — Draft angles (tapers) for machine 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	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	3,9° (0,5 mm)	4,4° (0,6 mm)	4,7° (0,7 mm)	6,0° (0,8 mm)
10	16	2,7° (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)

Table 5 *(continued)*

Height range of feature for draft angle mm		Grade A (DA) (fine)		Grade B (DB) (coarse)	
above <	up to, including ≤	External	Internal	External	Internal
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 6 — Draft angles (tapers) 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	8,5° (0,3 mm)	11,3° (0,4 mm)	11,3° (0,4 mm)	11,3° (0,4 mm)
4	6,3	3,3° (0,3 mm)	5,6° (0,5 mm)	5,6° (0,5 mm)	5,6° (0,5 mm)
6,3	10	3,5° (0,5 mm)	4,9° (0,7 mm)	4,9° (0,7 mm)	5,6° (0,8 mm)
10	16	3,1° (0,7 mm)	1,4° (1,0 mm)	3,5° (0,8 mm)	5,3° (1,2 mm)
16	25	2,8° (1,0 mm)	3,9° (1,4 mm)	3,4° (1,2 mm)	4,5° (1,6 mm)
25	40	2,5° (1,4 mm)	3,5° (2,0 mm)	3,2° (1,8 mm)	4,1° (2,3 mm)
40	63	2,2° (2,0 mm)	2,8° (2,5 mm)	2,8° (2,5 mm)	3,6° (3,2 mm)
63	100	1,8° (2,5 mm)	2,8° (4,0 mm)	2,5° (3,6 mm)	3,2° (4,5 mm)
100	160	1,8° (4,0 mm)	2,2° (5,0 mm)	1,6° (5,0 mm)	2,6° (6,0 mm)
160	250	1,7° (6,0 mm)	1,8° (6,5 mm)	2,0° (7,0 mm)	2,2° (8,0 mm)
250	400	1,4° (8,0 mm)	1,6° (9,0 mm)	1,6° (9,0 mm)	1,8° (10,0 mm)
400	630	1,2° (11,0 mm)	1,3° (12,0 mm)	1,3°(12,0 mm)	1,5° (13,0 mm)

Table 7 — Draft angles (tapers) 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	5,7° (0,2 mm)	8,5° (0,3 mm)	8,5° (0,3 mm)	11,3° (0,4 mm)
4	6,3	2,2° (0,2 mm)	3,3° (0,3 mm)	3,3° (0,3 mm)	5,6° (0,5 mm)
6,3	10	2,1° (0,3 mm)	2,8° (0,4 mm)	2,8° (0,4 mm)	4,9° (0,7 mm)
10	16	1,3° (0,3 mm)	2,2° (0,5 mm)	2,2° (0,5 mm)	4,0°(0,9 mm)
16	25	2,8° (0,4 mm)	2,0° (0,7 mm)	2,0° (0,7 mm)	3,4° (1,2 mm)
25	40	2,5° (0,7 mm)	2,1° (1,2 mm)	2,1° (1,2 mm)	3,5° (2,0 mm)
40	63	2,2° (1,0 mm)	1,7° (1,5 mm)	1,7° (1,5 mm)	2,8° (2,5 mm)
63	100	0,8° (1,2 mm)	1,4° (2,0 mm)	1,4° (2,0 mm)	2,5° (3,5 mm)
100	160	0,9° (2,0 mm)	1,3° (3,0 mm)	1,3° (3,0 mm)	2,2° (5,0 mm)
160	250	0,7° (2,5 mm)	1,1° (4,0 mm)	1,1° (4,0 mm)	2,0° (7,0 mm)
250	400	0,5° (3,0 mm)	0,9° (5,5 mm)	0,9° (5,5 mm)	1,6° (9,0 mm)
400	630	0,5° (4,0 mm)	0,8° (7,0 mm)	0,8° (7,0 mm)	1,2° (11,0 mm)

Table 8 — 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 Table 4 to Table 8, in order to avoid excess material.

9 General drawing indication

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

— 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;

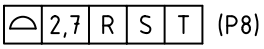
— the manufacturing method, together with the draft angle (taper) grade;

— the draft angles included in the ideal model (if draft angles are included in the ideal model);

— the casting size, SØ, of the smallest enveloping sphere;

— the part condition identifier(s) (see ISO/TS 8062-2).

For example: ISO 8062-4



Cylinder diameters S8

Wall thicknesses S9

RMA 2,5

Machine moulding DB

Draft angles included in the nominal model

Casting size SØ 880

Annex A
(informative)

Concept of general tolerancing

General tolerances according to this document are surface profile tolerances related to a general datum system RST. If a datum target system is used, it is established by six datum targets for rigid workpieces and by a minimum of six datum targets for flexible workpieces. The datum targets are indicated in the drawing.

The general tolerances on surface profile apply in principle to all surfaces of the workpiece, with the exception of datum features when a datum system established by integral features is used.

In special cases, larger or smaller surface profile tolerances related to the general datum system may be individually indicated for particular surfaces. Individually indicated tolerances, directly or indirectly related to the general datum system, override the general tolerances. See Figure 2.

For sizes, general positional tolerances related to the general datum system RST may be specified, overruling the general surface profile tolerances.

Other individually indicated tolerances are complementary, i.e. they apply in addition as a further constraint to the general tolerances.

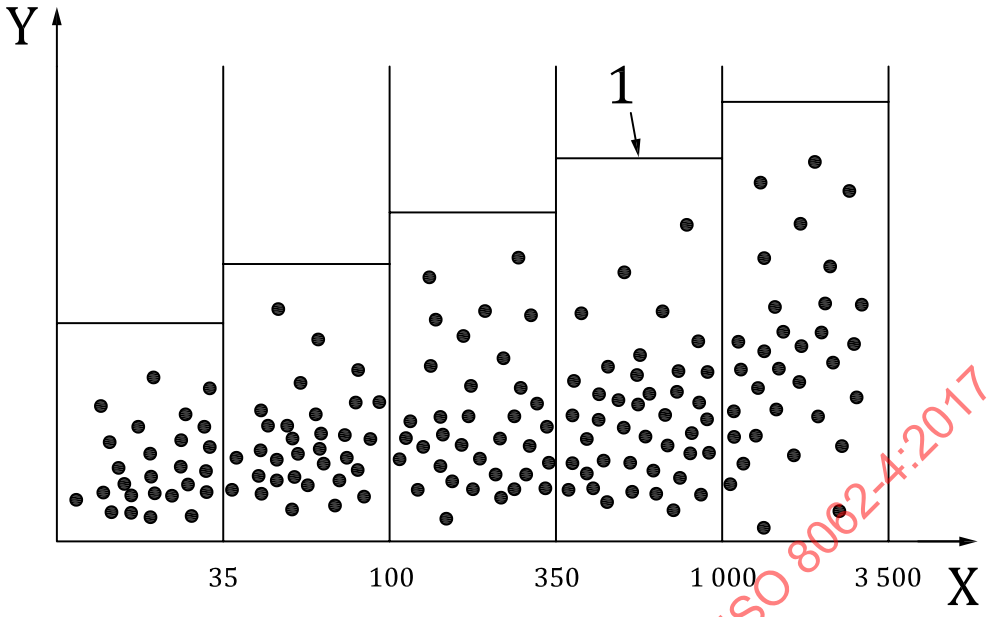
Dimensional tolerances (± tolerances) should only be used when necessary and only for diameters and widths (sizes) together with positional tolerances, and for wall thicknesses.

In order to achieve the full economic success, the general tolerances are to be respected without special effort and with a high probability. The corresponding amount of the general tolerances shall be derived from measurements on workpieces out of the normal production; see Figure A.1.

According to this investigation, the general tolerances are to be selected from the tables.

The use of general tolerances enables drawings to be more easily understood because fewer individual tolerances are required. Additionally, where individual tolerances requiring special attention are indicated, these can easily be identified during the manufacturing and inspection process, thus enabling more economic production.

The foundry should determine by measurements what its customary foundry accuracy is and accept only those drawings which have general tolerances equal to or larger than its customary foundry accuracy.



Key

1 general profile deviation limit (L)

X workpiece overall size (smallest enveloping sphere diameter)

Y max. profile deviation of workpiece (measured)

Figure A.1 — General tolerances derived from measurements

Unless otherwise stated, workpieces exceeding the general tolerances shall not lead to automatic rejection, provided that the ability of the workpiece to function is not impaired.

The design authority should be consulted to agree suitability of the non-conformance.

Annex B
(informative)

Selection of general tolerances

See Table B.1 and Table B.2.

Table B.1 — Tolerance grades P and S for general tolerances for long-series or mass production of castings

	Sand cast hand moulding	Sand cast machine mould and shell moulding	Metallic permanent mould	Pressure die casting	Investment casting
Steel	11–14	8–12	—	—	4–9
Grey iron	11–14	8–12	7–9	—	4–9
S. G. iron	11–14	8–12	7–9	—	4–9
Malleable iron	11–14	8–12	7–9	—	4–9
Copper alloys	10–13	8–10	7–9	6–8	4–9
Zinc alloys	10–13	8–10	7–9	3–6	4–9
Light metal alloys	9–12	7–9	6–8	6–9	4–9
Nickel based alloys	11–14	8–12	—	—	4–9
Cobalt based alloys	11–14	8–12	—	—	4–9

Table B.2 — Tolerance grades P and S for general tolerances for short-series or single production of castings

	Sand cast hand moulding	
	Clay-bonded	Chemically bonded
Steel	13–14	12–14
Grey iron	13–15	11–14
S. G. iron	13–15	11–14
Malleable iron	13–15	11–14
Copper alloys	13–15	10–13
Light metal alloys	11–13	10–13
Nickel based alloys	13–15	12–14
Cobalt based alloys	13–15	12–14

Annex C
(informative)

Selection of required machining allowances (RMAs)

See Table C.1.

Table C.1 — RMA grades

	Sand cast hand moulding	Sand cast machine mould and shell moulding	Metallic permanent mould	Pressure die casting	Investment casting
Steel	G to K	F to H	—	—	E
Grey iron	F to H	E to G	D to F	—	E
S. G. iron	F to H	E to G	D to F	—	E
Malleable iron	F to H	E to G	D to F	—	—
Copper alloys	F to H	E to G	D to F	B to D	E
Zinc alloys	F to H	E to G	D to F	A to D	—
Light metal alloys	F to H	E to G	D to F	B to D	E
Nickel based alloys	G to K	F to H	—	—	E
Cobalt based alloys	G to K	F to H	—	—	—

Annex D
(informative)

Example of using general tolerances

See Figure D.1 and Figure D.2.

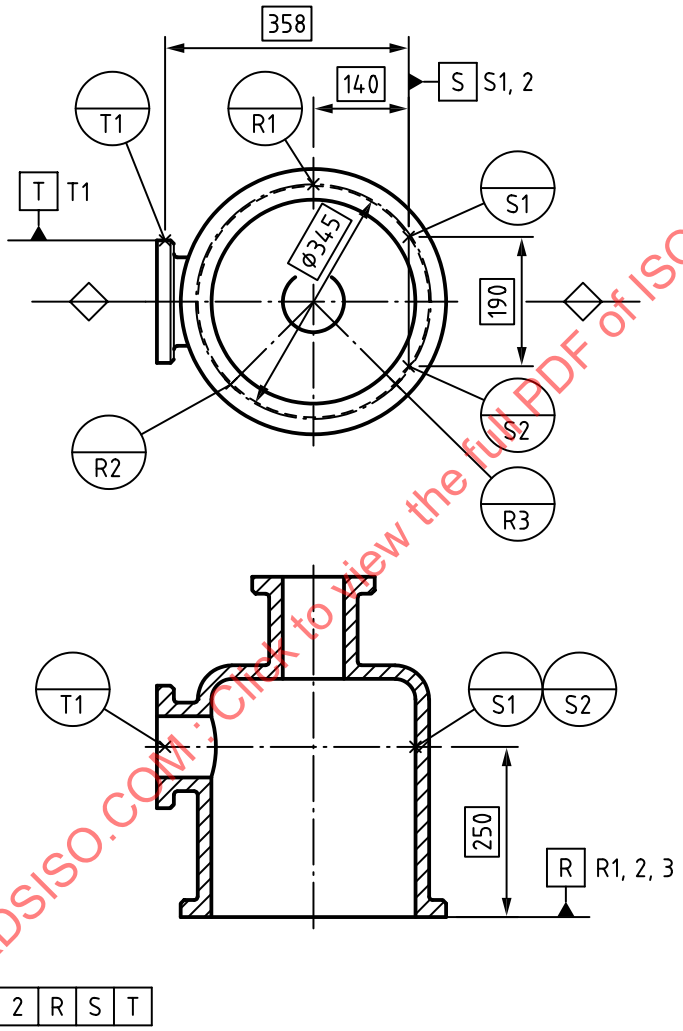
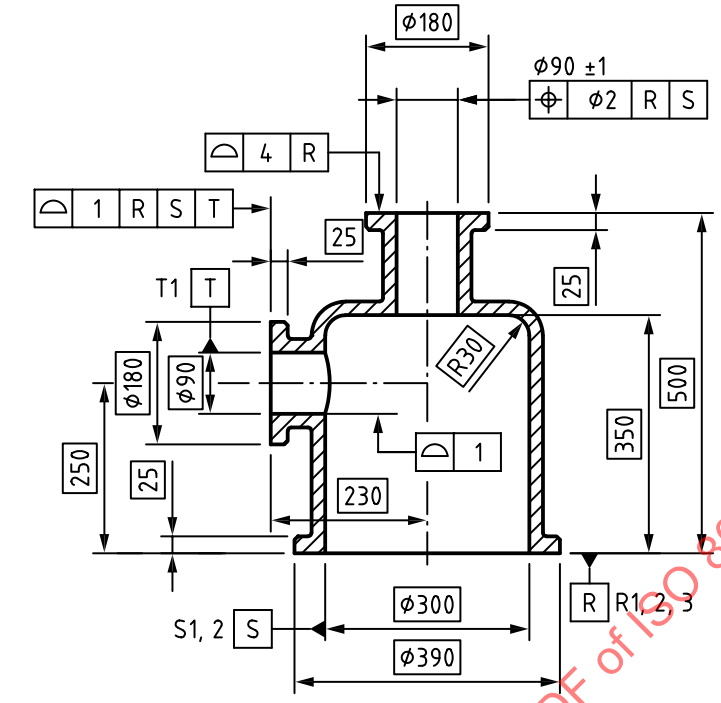


Figure D.1 — Datum target system and parting surface, example



wall thicknesses 20 S9 roundings R5

ISO 8062-4 D 2,7 R S T (P8)

Casting size S ⌀880

a) Drawing indication