

BRITISH STANDARD

Technical product specification (TPS) – Specification

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Foreword

Publishing information

This British Standard was published by BSI and came into effect on 31 October 2006. It was prepared by Technical Committee TDW/4, *Technical product specification (TPS) – Methodology, presentation and verification*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 8888:2004, which is withdrawn.

This fourth revision updates and extends the third edition, bringing in relevant standards published during 2005 and the first few months of 2006. This revision has been made with particular reference to online provision.

Relationship with other publications

The function of BS 8888 is to draw together, in an easily accessible manner, the full complement of International Standards relevant to the preparation of technical product specifications, in accordance with geometrical product specification (GPS) principles. However, it is not the intention that BS 8888 should be a “stand-alone” standard since it is part of a triumvirate of TPR (Technical Product Realization) standards comprising BS 8887 and BS 8889. The relationship of these three standards to each other is explained in Annex G.

It should be noted that BS 8888 has recently been taken up by the Ministry of Defence as part of its DEF-STAN for defence project specification and that BSI does make educational/training aids available in this field and is currently planning a major education/training initiative which, it is expected, will lead to a programme of competency assessment and certification.

“GPS Relevance” symbol

Because the principal objective of BS 8888 is to provide for accurate, unambiguous technical product specification (TPS), the particular standards provision that constitutes the GPS system of dimensioning and tolerancing will be found throughout the document.

Recognizing that on occasion it may be useful to be able to identify and pull together certain GPS elements into a continuous sequence, this edition of BS 8888 introduces the “GPS Relevance” symbol (see table below) as a means of doing this, for the first time. This segmented symbol is shaded to correlate with the layers of the GPS system itself and is placed in the margin adjacent to the clause or subclause to which it refers.

The formation of the symbol is based on the following. An unambiguous GPS is built upon a solid base of foundation standards relating to fundamental principles and presentation media, for example. While the specification of a feature or component defines size, geometry and surface.

Where no specific relevance to the GPS system can be identified the symbol is left unshaded.

GPS Relevance symbol

Symbol	Foundation	Size	Geometry	Surface
	No	No	No	No
	Yes	No	No	No
	No	Yes	No	No
	No	No	Yes	No
	No	No	No	Yes
	No	Yes	Yes	No
	Yes	Yes	Yes	No

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “shall”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

All dimensions shown in the figures in this standard are in millimetres.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This British Standard specifies requirements for the preparation of all forms of technical product specification. The requirements cross-refer substantially to International and European Standards which have been implemented as British Standards either in the BS ISO, BS EN, BS EN ISO series or as International Standards re-numbered as British Standards. The requirements are supplemented by commentary and recommendations on technical matters that are considered to be of assistance to users of this standard in the UK and which do not conflict with published International Standards in this field.

Annex A and Annex B list cross-referenced standards and other documents, normative and informative respectively, by primary reference. Annex C (normative) sets out requirements for enhanced document security. Annex D (informative) identifies the main differences in approach between the provisions of this standard and those of the American Society of Mechanical Engineers (ASME) Y14.5:1994. Annex E (informative) provides a brief history of the development of BS ISO 1101. Annex F (informative) provides a summary report on the concepts that have underwritten the development of technical product specification (TPS) and its primary constituent, geometrical product specification (GPS), to date and discusses some of the drivers for future change. Annex G (informative) gives the rationale behind the development of BS 8888. Annex H (informative) gives a list of recommended default choices in response to options that are available in the body of BS 8888.

NOTE 1 This is the paper-based version of BS 8888, which will henceforth be kept live and updated online. TPS Online, including BS 8888, can be found at <http://www.bsi-global.com/bs8888>, accompanied by the full range of cross-referenced standards, all hyperlinked to the relevant reference(s) within the text of the primary standard. When used in paper form, it is necessary that this standard be used in conjunction with the relevant cross-referenced standards

NOTE 2 This British Standard is also available in CD-ROM format.

2 References

2.1 Normative references

The normative documents listed in Annex A are indispensable for the application 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.

2.2 Informative references

This British Standard refers to other publications that provide information or guidance. These informative documents are listed in Annex B. Care should be taken to ensure that reference is made to the most recent edition.





3 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply, together with those given in:

BS ISO 10209-1	<i>Technical product documentation – Vocabulary – Part 1: Terms relating to technical drawings: general and types of drawing</i>
BS EN ISO 10209-2	<i>Technical product documentation – Vocabulary – Part 2: Terms relating to projection methods</i>
BS EN ISO 14660-1	<i>Geometrical product specification (GPS) – Geometrical features – Part 1: General terms and definitions</i>

3.1 date of acceptance

point in time at which all interested parties agree that the technical product specification is to be considered finalized to the extent that manufacturing can commence.

NOTE 1 This may be identified by other terms, e.g. “date of issue”.

NOTE 2 For the implications of the date of acceptance see 4.2.4.

3.2 geometrical product specification GPS

system for defining the shape (geometry), dimensions and surface characteristics of a workpiece

3.3 technical product document TPD

means of conveying all or part of a design definition or specification of a product for manufacturing and verification purposes

3.4 technical product specification TPS

collection of technical product documents comprising the complete design definition and specification of a product, for manufacturing and verification purposes

NOTE 1 A TPS was previously called a technical product document set.

NOTE 2 A TPS can consist of one or more TPDs.

NOTE 3 A TPS will contain GPS application (see 16.1 for first reference).



4 Global standards underpinning BS 8888

4.1 Introduction

The ISO Geometrical Product Specification (GPS) Standards Matrix (see **F.4**) embodies the concept of “global” standards that underpin the whole GPS process. This principle is adopted in BS 8888 and the following standards shall be applied as “global” standards in support of BS 8888.

BS EN ISO 1	<i>Geometrical Product Specifications (GPS) – Standard reference temperature for geometrical product specification and verification</i>
BS ISO 10579	<i>Technical drawings – Dimensioning and tolerancing – Non-rigid parts</i>
BS EN ISO 14253-1	<i>Geometrical product specifications (GPS) – Inspection by measurement of workpieces and measuring equipment – Part 1: Decision rules for proving conformance or non-conformance with specifications</i>
BS EN ISO 14253-2	<i>Geometrical product specifications (GPS) – Inspection by measurement of workpieces and measuring equipment – Part 2: Guide to the estimation of uncertainty in GPS measurement, in calibration of measuring equipment and in product verification</i>
DD ISO/TS 17450-1	<i>Geometrical product specification (GPS) – Part 1: Model for geometrical specification and verification</i>
DD ISO/TS 17450-2	<i>Geometrical product specification (GPS) – Part 2: Operators and uncertainties</i>
PD 6461-1	<i>General metrology – Part 1: Basic and general terms (VIM)</i>
PD 6461-3	<i>General metrology – Part 3: Guide to the expression of uncertainty in measurement (GUM)</i>

4.2 The fundamental TPS principles

4.2.1 Introduction

The following principles shall always be applied where compliance with BS 8888 is claimed.

4.2.2 The operator principle

A geometrical characteristic is defined by an operator, which is based upon one or more operations and controlled unambiguously by indication in a TPD.

COMMENTARY AND RECOMMENDATIONS ON 4.2.2

Two types of operators exist: specification operators, which are formulated as virtual measuring procedures, and verification operators, which define the sequence of operations used during the measuring process. (See DD ISO/TS 17450-1 and DD ISO/TS 17450-2.)

4.2.3 The duality principle

The duality principle states that the verification operator is the physical implementation of the specification operator.

COMMENTARY AND RECOMMENDATIONS ON 4.2.3

Were the verification operator (measuring procedure) to be a theoretically perfect implementation, the measurement result would be without measurement uncertainty. The principle that the specification operator defines the requirement in the TPS is the core of the “duality principle”, which requires that the specification operator be defined independently of any measuring procedure or item of measuring equipment. However, likely deviation of the verification operator from the specification operator indicated in the TPS will contribute to the overall measurement uncertainty (see DD ISO/TS 17450-1 and DD ISO/TS 17450-2).

4.2.4 The TPS at its acceptance date is definitive, principle.

What is not specified in a TPS at the date of acceptance cannot be required.

COMMENTARY AND RECOMMENDATIONS ON 4.2.4

Requirements only exist where explicitly indicated in the TPS at the date of acceptance or if defined in BS 8888, at that date. The implication of this is that the acceptance date of the TPS implicitly restricts the interpretation of the specification contained within the TPS to those standards in force at the date of acceptance.

4.2.5 The default principle

A complete specification operator can be indicated by the most concise indication for the relevant geometrical characteristic (i.e. the *basic GPS*).

COMMENTARY AND RECOMMENDATIONS ON 4.2.5

The basic GPS constitutes the default definition of the specification operator, which might not be visible in the TPS (see DD ISO/TS 17450-2).

4.2.6 The reference condition principle

If not otherwise indicated in the TPS, the reference temperature for the tolerances given in that TPS is 20 °C (see BS EN ISO 1) and the workpiece is assumed not to be influenced by any other external physical condition.

4.2.7 The uncertainty in conformance principle

Where no prior agreement as to the application of uncertainty exists, between two (or more) parties and:

- where conformance with a specification is to be proven, measurement uncertainty, U reduces the specification to the conformance zone at both tolerance limits and shall always be applied in the interest of the customer purchasing the part; or
- where non-conformance with a specification is to be proven, measurement uncertainty, U expands the tolerance at both tolerance limits, uncertainty of measurement shall always be applied in the interest of the manufacturer/seller of the part.

NOTE It is recognized that a specification will itself contain uncertainty.

COMMENTARY AND RECOMMENDATIONS ON 4.2.7

Within this TPS system, three categories of uncertainty are defined (DD ISO/TS 17450-2):

- specification uncertainty (attributed to the designer);*
- correlation uncertainty (attributed to the designer); and*
- measurement uncertainty (attributed to the metrologist).*



5 Expression of the concept

COMMENTARY AND RECOMMENDATIONS

Before specifying a technical product, the broad requirement should be established, with particular attention being paid to the functions that the product will be expected to fulfil. The conceptual, design intent can then be depicted in the form of a design layout, scheme or simplified computer-generated model, although this will not normally be used in the detailed TPD for manufacturing purposes.

The importance of this stage cannot be over-emphasized. Clear understanding of the purpose and function intended for the eventual product, knowledge of the requirements of the available manufacturing methods and awareness of relevant verification procedures, will help to ensure that the degree of complexity of the specification is appropriate and adequate.

It is not the aim of this standard to attempt to instruct or constrain the design process.

It is, however, of the greatest importance that the designer presents the product of his design process, i.e. the TPS containing the technical, product specification, in a manner that avoids ambiguity and any risk of misunderstanding or misinterpretation. For this reason, it is imperative that the designer be familiar with the requirements of this standard and aware of the increased precision that its use can bring.

For these and many other reasons, management of the overall design process can be complex and the following standards might be found to be of assistance in this field.

BS EN 61160	<i>Design review</i>
BS EN 60300-3-3	<i>Dependability management – Part 3-3: Application guide – Life cycle costing</i>
BS 7000-1	<i>Design management systems – Part 1: Guide to managing innovation</i>

BS 7000-2	<i>Design management systems – Part 2: Guide to managing the design of manufactured products</i>
BS 7000-10	<i>Design management systems – Part 10: Glossary of terms used in design management</i>
BS 8444-3	<i>Risk management – Part 3: Guide to risk analysis of technological systems</i>

6 Types of documentation



6.1 General

The careful targeting of TPDs to known or intended users will greatly assist the accuracy with which the specification is converted into the final product. While precision and avoidance of ambiguity should always be paramount, the means employed to convey this information should always be seen to match the capability, or potential capability, of the available or achievable manufacturing facility. Specification beyond this level is unlikely to produce satisfactory results and will often prove expensive, both in terms of the cost of the over-specification itself and in terms of inadequate or unacceptable product.



6.2 Presentation media

6.2.1 General

The presentation of the drawings shall conform to the following standards.

BS EN ISO 5457	<i>Technical product documentation – Sizes and layout of drawing sheets</i>
BS EN ISO 7200:2004	<i>Technical product documentation – Data fields in title blocks and document headers</i>

NOTE BS EN ISO 7200:2004 implements ISO 7200:2004 without change. This revision was developed to extend the scope of the standard to include TPS presented wholly or in part in the form of meta-data. Throughout its development, the United Kingdom expressed strong reservation as to the completeness of its content, particularly with regard to the omission of certain elements of the 1984 version still considered to be valid, but was unable to achieve consensus in support of their restoration. For this reason, BS 8888 includes (see 6.2.2) the requirement to apply certain additional standards as part of the application of BS ISO 7200:2004, all of which are already cross-referenced from BS 8888. These requirements are not in conflict with the provisions of the revised BS EN ISO 7200:2004 and do no more than restore these missing elements. Particular attention is drawn to Figure 1 and Figure 2 of BS EN ISO 7200:2004, which are provided by way of example but are not wholly correct in that the text is in lower case. These examples should be viewed in conjunction with the relevant clauses of BS EN ISO 3098 (all parts) and BS EN ISO 6428.

6.2.2 Application of BS ISO 7200:2004

The application of BS ISO 7200:2004 shall be extended to include relevant provisions of the following standards.

BS EN ISO 3098-0	<i>Technical product documentation – Lettering – Part 0: General requirements</i>
BS EN ISO 3098-2	<i>Technical product documentation – Lettering – Part 2: Latin alphabet, numerals and marks</i>
BS EN ISO 3098-3	<i>Technical product documentation – Lettering – Part 3: Greek alphabet</i>
BS EN ISO 3098-4	<i>Technical product documentation – Lettering – Part 4: Diacritical and particular marks for the Latin alphabet</i>
BS EN ISO 3098-5	<i>Technical product documentation – Lettering – Part 5: CAD lettering of the Latin alphabet, numerals and marks</i>
BS EN ISO 3098-6	<i>Technical product documentation – Lettering – Part 6: Cyrillic alphabet</i>
BS EN ISO 6428	<i>Technical drawing – requirements for microcopying</i>
BS EN ISO 6433	<i>Technical drawings – item references</i>
BS ISO 7573	<i>Technical drawings – Item lists</i>
BS ISO 10209-1	<i>Technical Product Documentation – Vocabulary – Terms relating to technical drawings general and types of drawings</i>

6.2.3 Format

Drawing sheets and other documents shall be presented in one of the following formats:

- a) landscape: intended to be viewed with the longest side of the sheet horizontal;
- b) portrait: intended to be viewed with the longest side of the sheet vertical.

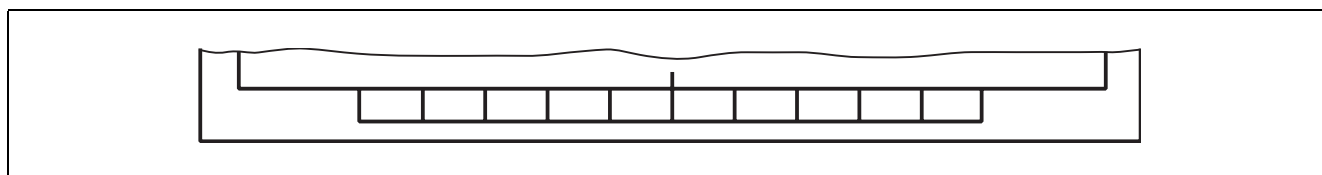
NOTE Contrary to BS EN ISO 5457, A4 sheets may be used in landscape or portrait mode.

6.2.4 Metric reference graduation

COMMENTARY AND RECOMMENDATIONS

Any metric reference graduation (scale bar) should be figure-less, have a minimum length of 100 mm and be graduated at 10 mm intervals. It should be located symmetrically about a centring mark, near the frame and within the border. It should have a maximum width of 5 mm and the continuous strokes should be of 0.5 mm maximum thickness (see Figure 1).

Figure 1 Metric reference graduations



6.3 Combined drawing

COMMENTARY AND RECOMMENDATIONS

A combined drawing should display an assembly, item list and constituent details, drawn separately but all on the same drawing.



6.4 Diagram

COMMENTARY AND RECOMMENDATIONS

The function of a system, or the relationship between component parts, may be depicted in a diagram employing simplified representations, as recommended in the following standards.

BS EN ISO 3952-1	<i>Kinematic diagrams – Graphical symbols – Part 1</i>
BS EN ISO 3952-2	<i>Kinematic diagrams – Graphical symbols – Part 2</i>
BS EN ISO 3952-3	<i>Kinematic diagrams – Graphical symbols – Part 3</i>
BS EN ISO 3952-4	<i>Technical drawings – Simplified representation for kinematics – Part 4: Miscellaneous mechanisms and their components</i>
BS 5070-1	<i>Engineering diagram drawing practice – Part 1: Recommendations for general principles</i>
BS 5070-3	<i>Engineering diagram drawing practice – Part 3: Recommendations for mechanical/fluid flow diagrams</i>
BS 5070-4	<i>Engineering diagram drawing practice – Part 4: Recommendations for logic diagrams</i>
BS EN 61082-2	<i>Preparation of documents used in electrotechnology – Part 2: Function-oriented diagrams</i>



6.5 Document list – Drawing list

COMMENTARY AND RECOMMENDATIONS

A document list should consist of a list of all graphical representations and selected specifications required to build the assembly from which it derives its title and primary identifier.



7 Scales

Scales shall conform to the following standard.

BS EN ISO 5455	<i>Technical drawings – Scales</i>
----------------	------------------------------------



8 Lines, arrows and terminators

8.1 Lines and terminators

Lines shall conform to the following standards, as appropriate.

BS EN ISO 128-20	<i>Technical drawings – General principles of presentation – Part 20: Basic conventions for lines</i>
BS EN ISO 128-21	<i>Technical drawings – General principles of presentation – Part 21: Preparation of lines by CAD systems</i>
BS ISO 128-22	<i>Technical drawings – General principles of presentation – Part 22: Basic conventions and applications for leader lines and reference lines</i>
BS ISO 128-23	<i>Technical drawings – General principles of presentation – Part 23: Lines on construction drawings</i>
BS ISO 128-24	<i>Technical drawings – General principles of presentation – Part 24: Lines on mechanical engineering drawings</i>
BS ISO 128-25	<i>Technical drawings – General principles of presentation – Part 25: Lines on shipbuilding drawings</i>

8.2 Lines, terminators and origin indicators

Arrows and terminators composed of lines shall conform to the following standard.

BS ISO 129-1	<i>Technical drawings – Indications of dimensions and tolerances – Part 1: General principles</i>
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9 Lettering

9.1 General

Lettering shall conform to the following standard.

BS EN ISO 3098-0	<i>Technical product documentation – Lettering – Part 0: General requirements</i>
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Lettering shall also conform to the following standards, as appropriate.

BS EN ISO 3098-2	<i>Technical product documentation – Lettering – Part 2: Latin alphabet, numerals and marks</i>
BS EN ISO 3098-3	<i>Technical product documentation – Lettering – Part 3: Greek alphabet</i>
BS EN ISO 3098-4	<i>Technical product documentation – Lettering – Part 4: Diacritical and particular marks for the Latin alphabet</i>

- BS EN ISO 3098-5 *Technical product documentation – Lettering – Part 5: CAD lettering of the Latin alphabet, numerals and marks*
- BS EN ISO 3098-6 *Technical product documentation – Lettering – Part 6: Cyrillic alphabet*

9.2 Notes

When a landscape-format drawing sheet is used in its normal orientation, with the title block at the bottom right-hand corner, notes shall be lettered parallel to the long side of the sheet. When a landscape-format drawing sheet is used in portrait orientation, the title block shall be located at the left-hand side and notes shall be lettered parallel to the short side of the sheet.

COMMENTARY AND RECOMMENDATIONS ON 9.2

Placement

Notes of a general nature should, wherever practicable, be grouped together and not distributed over the drawing. Notes relating to specific details should appear near the relevant feature, but not so near as to crowd the view.

Underlining

Underlining of notes is not recommended. Where emphasis is required, larger characters should be used.

10 Projections

Projections shall conform to one of the following standards:

- BS EN ISO 5456-2 *Technical drawings – Projection methods – Part 2: Orthographic representations*
- BS EN ISO 5456-3 *Technical drawings – Projection methods – Part 3: Axonometric representations*
- BS ISO 5456-4 *Technical drawings – Projection methods – Part 4: Central projection*
- BS EN ISO 10209-2 *Technical product documentation – Vocabulary – Part 2: Terms relating to projection methods*

NOTE BS EN ISO 5456-1, Technical drawing – Projection methods – Part 1: Synopsis, contains a survey of the various projection methods.

11 Views

11.1 General

Views shall conform to the following standards.

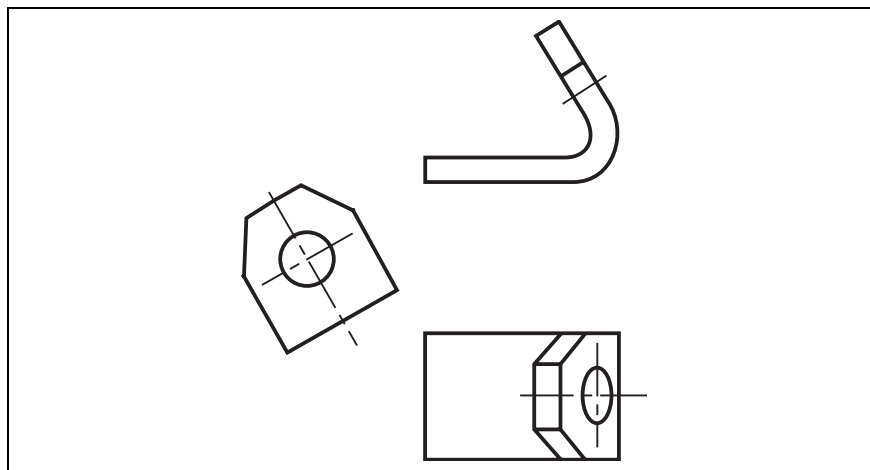
- BS ISO 128-30 *Technical drawings – General principles of presentation – Part 30: Basic conventions for views*
- BS ISO 128-34 *Technical drawings – General principles of presentation – Part 34: Views on mechanical engineering drawings*



11.2 Auxiliary views

Where true representation of features is necessary, but cannot be achieved on the orthographic views, the features shall be shown in projected auxiliary views. An example is shown in Figure 2.

Figure 2 Auxiliary view showing true shape of inclined surface



12 Sections

Sections shall conform to the following standards.

- | | |
|---------------|---|
| BS ISO 128-40 | <i>Technical drawings – General principles of presentation – Part 40: Basic conventions for cuts and sections</i> |
| BS ISO 128-44 | <i>Technical drawings – General principles of presentation – Part 44: Sections on mechanical engineering drawings</i> |
| BS ISO 128-50 | <i>Technical drawings – General principles of presentation – Part 50: Basic conventions for representing areas on cuts and sections</i> |

NOTE ISO 128-44 and ISO 128-50 contained presentational defects in some figures (e.g. line types, line thickness, terminators and letter heights), which have, unavoidably, been carried forward to the BS implementations. It is stressed that the text of these standards is technically correct and users should, therefore, regard the figures as illustrations only.

13 Symbols and abbreviations

13.1 General

13.1.1 Abbreviations (text equivalents) shall be the same in the singular and plural. Full stops shall not be used except where the abbreviation forms a word (e.g. NO. as an abbreviation for “number”).

13.1.2 Symbols used for physical quantities and units of measurement shall conform to the following standards, as appropriate.

- | | |
|-------------|---|
| BS ISO 31-0 | <i>Specification for quantities, units and symbols – Part 0: General principles</i> |
| BS ISO 31-1 | <i>Specification for quantities, units and symbols – Part 1: Space and time</i> |

BS ISO 31-2	<i>Specification for quantities, units and symbols – Part 2: Periodic and related phenomena</i>
BS ISO 31-3	<i>Specification for quantities, units and symbols – Part 3: Mechanics</i>
BS ISO 31-4	<i>Specification for quantities, units and symbols – Part 4: Heat</i>
BS ISO 31-5	<i>Specification for quantities, units and symbols – Part 5: Electricity and magnetism</i>
BS ISO 31-6	<i>Specification for quantities, units and symbols – Part 6: Light and related electromagnetic radiations</i>
BS ISO 31-7	<i>Specification for quantities, units and symbols – Part 7: Acoustics</i>
BS ISO 31-8	<i>Specification for quantities, units and symbols – Part 8: Physical chemistry and molecular physics</i>
BS ISO 31-9	<i>Specification for quantities, units and symbols – Part 9: Atomic and nuclear physics</i>
BS ISO 31-10	<i>Specification for quantities, units and symbols – Part 10: Nuclear reactions and ionizing radiations</i>
BS ISO 31-11	<i>Specification for quantities, units and symbols – Part 11: Mathematical signs and symbols for use in physical sciences and technology</i>
BS ISO 31-12	<i>Specification for quantities, units and symbols – Part 12: Characteristic numbers</i>
BS ISO 31-13	<i>Specification for quantities, units and symbols – Part 13: Solid state physics</i>
BS ISO 1000	<i>Specification for SI Units and recommendation for the use of their multiples and of certain other units</i>



13.2 Standard symbols and abbreviations

Symbols appropriate to technical product specification are provided and detailed throughout the suite of documents cross referenced from this standard and these shall be used where appropriate.

NOTE 1 It is strongly recommended that abbreviations not be used.

Where, in particular technical fields, certain abbreviations are in common use and generally understood, it is accepted that these may continue to be used but new abbreviations shall not be introduced.

NOTE 2 Former practice has resulted in certain abbreviations becoming accepted as symbols and these should not be considered to provide precedence for the proliferation of abbreviations

COMMENTARY AND RECOMMENDATIONS ON CLAUSE 13

In the existing environment of outsourcing across national borders, every effort is being made to make the use of GPS, independent of language through the adoption of standard symbology. It is for this reason that the continued use of abbreviations is deprecated. Where particular specification requirements cannot be expressed using the available GPS system, full text description should be employed. It is suggested that where such a requirement occurs frequently, this be drawn to the attention of the relevant ISO committee through the appropriate BSI Technical committee.

For diagrams used in technical applications, a library of harmonized graphical symbols has been developed with close cooperation between ISO and IEC. This is published in the following series of standards and it is recommended that they be applied wherever practicable to improve the universal applicability of the TPS.

BS ISO 14617-1	<i>Graphical symbols for diagrams – Part 1: General information and indexes</i>
BS ISO 14617-2	<i>Graphical symbols for diagrams – Part 2: Symbols having general application</i>
BS ISO 14617-3	<i>Graphical symbols for diagrams – Part 3: Connections and related devices</i>
BS ISO 14617-4	<i>Graphical symbols for diagrams – Part 4: Actuators and related devices</i>
BS ISO 14617-5	<i>Graphical symbols for diagrams – Part 5: Measurement and control devices</i>
BS ISO 14617-6	<i>Graphical symbols for diagrams – Part 6: Measurement and control functions</i>
BS ISO 14617-7	<i>Graphical symbols for diagrams – Part 7: Basic mechanical components</i>
BS ISO 14617-8	<i>Graphical symbols for diagrams – Part 8: Valves and dampers</i>
BS ISO 14617-9	<i>Graphical symbols for diagrams – Part 9: Pumps, compressors and fans</i>
BS ISO 14617-10	<i>Graphical symbols for diagrams – Part 10: Fluid power converters</i>
BS ISO 14617-11	<i>Graphical symbols for diagrams – Part 11: Devices for heat transfer and heat engines</i>
BS ISO 14617-12	<i>Graphical symbols for diagrams – Part 12: Devices for separating, purification and mixing</i>



14 Representation of features

Conventions used for the representation of features shall conform to the following standards, as appropriate.

BS EN ISO 4063	<i>Welding and allied processes – Nomenclature of processes and reference numbers</i>
BS EN ISO 5261	<i>Technical drawings – Simplified representation of bars and profile sections</i>
BS EN ISO 5845-1	<i>Technical drawings – Simplified representation of the assembly of parts with fasteners – Part 1: General principles</i>
BS EN ISO 6410-1	<i>Technical drawings – Screw threads and threaded parts – Part 1: General conventions</i>
BS EN ISO 6410-2	<i>Technical drawings – Screw threads and threaded parts – Part 2: Screw thread inserts</i>
BS EN ISO 6410-3	<i>Technical drawings – Screw threads and threaded parts – Part 3: Simplified representation</i>
BS EN ISO 6411	<i>Technical drawings – Simplified representation of centre holes</i>

BS EN ISO 6413	<i>Technical drawings – Representation of splines and serrations</i>
BS ISO 13715	<i>Technical drawings – Edges of unidentified shape – Vocabulary and indications</i>
BS EN ISO 14660-2	<i>Geometrical Product Specifications (GPS) – Geometrical features – Part 2: Extracted median line of a cylinder and a cone, extracted median surface, local size of an extracted feature</i>
BS EN ISO 15785	<i>Technical drawings – Symbolic presentation and indication of adhesive, fold and pressed joints</i>
BS EN 22553	<i>Welded, brazed and soldered joints – Symbolic representation on drawings</i>

NOTE The BS ISO 128 series of standards covers the general subject of feature representation.



15 Representation of components

15.1 General

Conventions used for the representation of components shall conform to the following standards, as appropriate.

BS EN ISO 2162-1	<i>Technical product documentation – Springs – Part 1: Simplified representation</i>
BS EN ISO 2162-2	<i>Technical product documentation – Springs – Part 2: Presentation of data for cylindrical helical compression springs</i>
BS EN ISO 2162-3	<i>Technical product documentation – Springs – Part 3: Vocabulary</i>
BS EN ISO 2203	<i>Technical drawings – Conventional representation of gears</i>
BS 2917-1	<i>Graphic symbols and circuit diagrams for fluid power systems and components – Part 1: Specification for graphic symbols</i>
BS 3238-1	<i>Graphical symbols for components of servo-mechanisms – Part 1: Transducers and magnetic amplifiers</i>
BS 3238-2	<i>Graphical symbols for components of servo-mechanisms – Part 2: General servo-mechanisms</i>
BS EN ISO 5845-1	<i>Technical drawings – Simplified representation of the assembly of parts with fasteners – Part 1: General principles</i>
BS EN ISO 6410-1	<i>Technical drawings – Screw threads and threaded parts – Part 1: General conventions</i>
BS EN ISO 6410-2	<i>Technical drawings – Screw threads and threaded parts – Part 2: Screw thread inserts</i>
BS EN ISO 6410-3	<i>Technical drawings – Screw threads and threaded parts – Part 3: Simplified representation</i>

BS EN ISO 6412-1	<i>Technical drawings – Simplified representation of pipelines – General rules and orthogonal representation</i>
BS EN ISO 6412-2	<i>Technical drawings – Simplified representation of pipelines – Isometric projection</i>
BS EN ISO 6412-3	<i>Technical drawings – Simplified representation of pipelines – Terminal features of ventilation and drainage systems</i>
BS EN ISO 8826-1	<i>Technical drawings – Roller bearings – Part 1: General simplified representation</i>
BS EN ISO 8826-2	<i>Technical drawings – Roller bearings – Part 2: Detailed simplified representation</i>
BS EN ISO 9222-1	<i>Technical drawings – Seals for dynamic application – Part 1: General simplified representation</i>
BS EN ISO 9222-2	<i>Technical drawings – Seals for dynamic application – Part 2: Detailed simplified representation</i>

NOTE The BS ISO 128 series of standards covers the general subject of component representation.

15.2 Representation of moulded, cast and forged components

Dimensional tolerancing for metal and metal alloy castings shall conform to BS 6615:1996.

COMMENTARY AND RECOMMENDATIONS ON 15.2

It is recommended that tolerances for the dimensions of plastics mouldings be applied in accordance with the system provided in BS 7010.

ISO 8062:1994 which is implemented in full by BS 6615 is currently undergoing extensive revision under the generic title Geometrical product specifications (GPS) — Dimensional and geometrical tolerances for moulded parts. This will be published in three parts:

- Part 1: Vocabulary;
- Part 2: Rules; and
- Part 3: General dimensional and geometrical tolerances and machining allowances for castings.

Parts 1 and 3 of ISO 8062 will be published as BS ISO 8062 Part 1 and Part 3, early in 2007 and it is expected that Part 2 will become available by the end of that year. Together, the three parts of BS ISO 8062:2007 will cancel and replace ISO 8062:1994 of which they will constitute a technical revision. Future action with regard to BS 7010 will be decided at that time.



16 Dimensioning and tolerancing

16.1 Interpretations of limits of size for the control of form

16.1.1 General

COMMENTARY AND RECOMMENDATIONS

The limits of size of an individual feature-of-size may be defined using one of the following principles:

- a) *the principle of independency of size and form, where the limits of size are intended to exercise control only over the size of the feature-of-size, and not to exercise any control over its form; or*
- b) *the principle of dependency of size and form, where the limits of size are intended to exercise control over the form of the feature-of-size as well as its size.*

In both cases, an individual feature-of-size is defined as one cylindrical or spherical surface or as a pair of parallel surfaces, each feature-of-size being defined by a linear dimension.

In neither case do the limits of size control the orientation of, or the spatial relationship between, individual features-of-size. If such relationships are functionally important, they need to be controlled separately by specifying geometrical tolerances.

For example, a cube consists of three individual features-of-size, each composed of a pair of plane parallel surfaces. The perpendicularity of those individual features-of-size is not controlled by their size tolerances, and therefore if the function requires a perpendicularity tolerance, it should be specified.

If the principle of dependency is applied then BS ISO 8015 becomes an informative document only.

16.1.2 Limits of size with independency of size and form

COMMENTARY AND RECOMMENDATIONS

With independency of size and form, limits of size control only the actual local sizes (two-point measurements) of a feature-of-size, and not its deviations of form (e.g. the circularity and straightness deviations of a cylindrical feature, or the flatness deviations of two parallel plane surfaces). Therefore, at the maximum material limit of size, the maximum limiting value of the form tolerance still applies (i.e. at maximum material limit of size it is permissible to have imperfect form). When applying the principle of independency it is necessary to specify each and every form tolerance (see Figure 3).

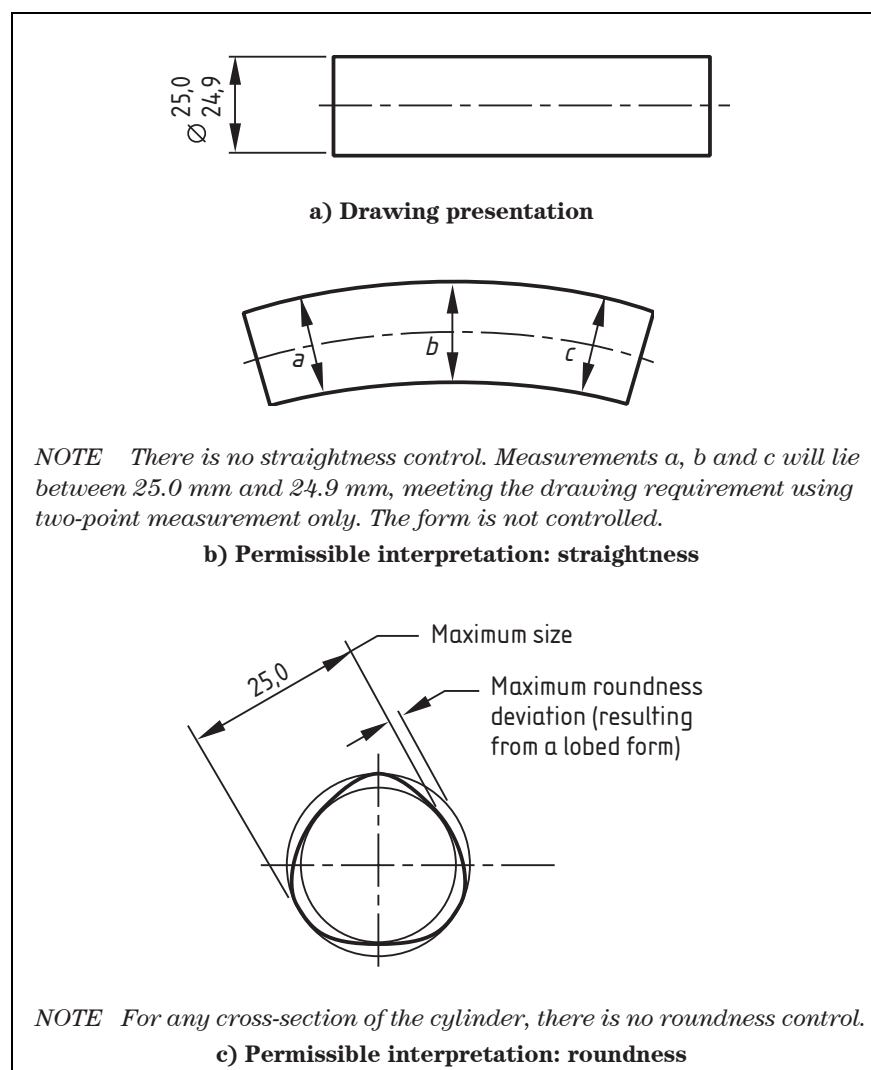
According to the principle of independency, each specified dimensional and geometrical requirement on a drawing is met independently, unless a particular relationship is specified. Consequently, if a particular relationship of size and form is required, it needs to be specified on the drawing. This can be achieved by the use of the envelope requirement (see BS ISO 8015) or material modifiers. In effect this introduces the boundary or envelope of perfect form in the same manner as the principle of dependency (i.e. the maximum material limit of size defines the boundary or envelope of perfect form for the relevant surfaces).

According to the principle of independency, each specified dimensional and geometrical requirement on a drawing is met independently, unless a particular relationship is specified. Therefore, where no relationship is specified, the geometrical tolerance applies regardless of feature size, and the two requirements are treated as unrelated (see Figure 3). Consequently, if a particular relationship of:

- size and form; or
- size and location; or
- size and orientation;

is required, it needs to be specified on the drawing.

Figure 3 Interpretations using the principle of independency for a cylindrical component for which a tolerance of size only is given on the drawing



16.1.3 Limits of size with mutual dependency of size and form

COMMENTARY AND RECOMMENDATIONS

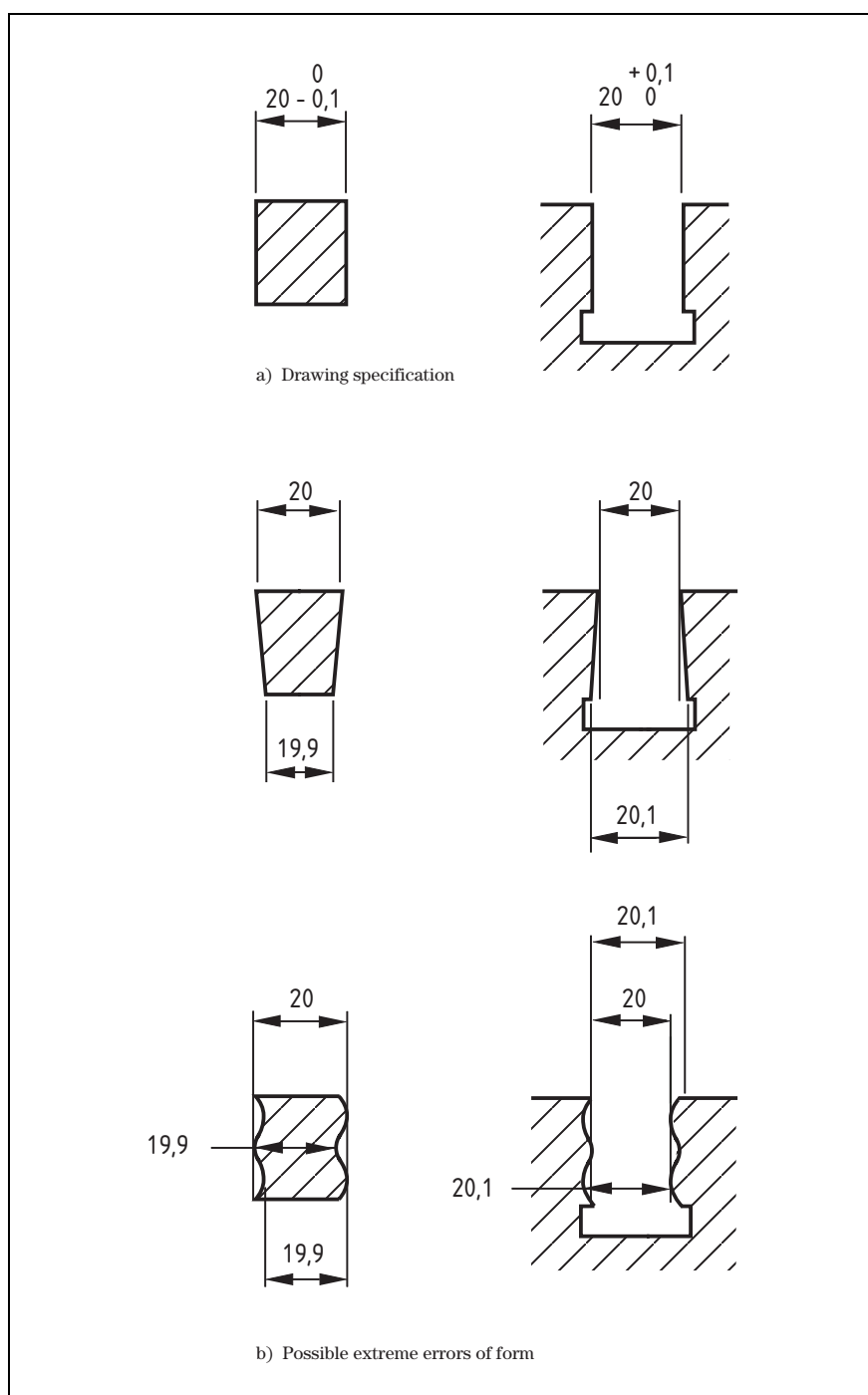
Where the feature-of-size is defined by limits of size only, the maximum material limit of size (i.e. the high limit of size of an external feature or the low limit of size of an internal feature) defines the boundary or envelope of perfect form for the relevant surfaces. If an individual feature-of-size is everywhere on its maximum material limit of size, the feature will have perfect form. If the individual feature-of-size is not on its maximum material size, errors in form will be acceptable provided that no part of the finished surfaces extends beyond the maximum material boundary or envelope of the perfect form, and that the feature-of-size is everywhere in accordance with its specified limits of size (see Figure 4).

NOTE An external feature is also known as a “shaft type feature” and an internal feature is also known as a “hole type feature”.

If the limits of size for the feature-of-size is at the least material limit of size (i.e. the low limit of size of an external feature or the high limit of size of an internal feature) then the form deviation can be at its maximum within the confines of the boundary or envelope of perfect form. If the limits of size specified permit form deviations large enough to be functionally unacceptable as the feature-of-size approaches its least material limit size, then these deviations can be controlled by specifying appropriate form tolerances. Such form tolerances will be maximum limiting values. The effect of these values will decrease as the feature-of-size approaches its maximum material limit of size, as no part of the finished surfaces of the feature-of-size is permitted to extend beyond the maximum material limit of perfect form.

Where the principle of dependency is applied, verification of the feature-of-size and permissible form deviation is possible using “go/no-go” gauging techniques. The Taylor principle states that effective verification can only take place with a gauge touching the whole feature, ensuring that a mating part will “go” at the maximum material limit, while rejection checking is accomplished as a single examination with the two-point method (verification of least material limits). The application of the dependency principle however, implies that all features of size will have perfect form at maximum material limits and could impose higher production costs.

Figure 4 Interpretation of limits of size with dependency of size and form



16.2 General

Dimensioning and tolerancing shall conform to the following standards, as appropriate:

BS ISO 129-1	<i>Technical drawings – Indications of dimensions and tolerances – Part 1: General principles</i>
BS ISO 406	<i>Technical drawings – Tolerancing of linear and angular dimensions</i>
BS EN ISO 1119	<i>Geometrical product specifications (GPS) – Series of conical tapers and taper angles</i>



BS EN ISO 1660	<i>Technical drawings – Dimensioning and tolerancing of profiles</i>
BS 1916-1	<i>Limits and fits for engineering – Part 1: Limits and tolerances</i>
BS 1916-2	<i>Limits and fits for engineering – Part 2: Guide to the selection of fits in BS 1916:Part 1</i>
BS 1916-3	<i>Limits and fits for engineering – Part 3: Recommendations for tolerances, limits and fits for large diameters</i>
BS ISO 3040	<i>Technical drawings – Dimensioning and tolerancing – Cones</i>
BS 4500-4	<i>ISO limits and fits – Specification for system of cone (taper) fits for cones from $C = 1:3$ to $1:500$, lengths from 6 mm to 630 mm and diameters up to 500 mm</i>
BS 4500-5	<i>ISO limits and fits – Specification for system of cone tolerances for conical workpieces from $C = 1:3$ to $1:500$ and lengths from 6 mm to 630 mm</i>
BS EN ISO 5458	<i>Geometrical Product Specifications (GPS) – Geometrical tolerancing – Positional tolerancing</i>
BS EN ISO 6410-1	<i>Technical drawings – Screw threads and threaded parts – Part 1: General conventions</i>
BS 6615	<i>Specification for dimensional tolerances for metal and metal alloy castings</i>
BS 7010	<i>Code of practice for a system of tolerances for the dimensions of plastic mouldings</i>
BS EN ISO 7083	<i>Technical drawings – Symbols for geometrical tolerancing – Proportions and dimensions</i>
BS ISO 8015	<i>Technical drawings – Fundamental tolerancing principle</i>
BS ISO 10579	<i>Technical drawings – Dimensioning and tolerancing – Non-rigid parts</i>
BS ISO 13920	<i>Welding – General tolerances for welded constructions – Dimensions for lengths and angles – Shape and position</i>
BS EN 20286-1	<i>ISO system of limits and fits – Part 1: Bases of tolerances, deviations and fits</i>
BS EN 20286-2	<i>ISO system of limits and fits – Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts</i>

COMMENTARY AND RECOMMENDATIONS ON 16.2

Gaps between extension lines and features.

It is the practice in the UK to leave a small gap between the extension line and the feature. In BS ISO 129-1 the illustrated examples do not show a gap but 5.3, includes the text, “in certain technical fields, a gap between the feature and the beginning of the extension line is acceptable”. The UK has always held to the view that for reasons of clarity a gap is preferable and given that in the revised standard the gap is permissible, it is intended that the current UK practice should be maintained.



16.3 Presentation of decimals

16.3.1 Decimal marker

The decimal marker shall be a comma.

16.3.2 Non-indicated decimals in tolerances

Non-indicated decimals in a tolerance indication shall be taken as zeros e.g. 0,2 is the same as 0,2000000000....

COMMENTARY AND RECOMMENDATIONS ON 16.3

It is recommended that each group of three digits, counting from the decimal marker to the left and to the right, be separated from other digits by a small space (e.g. 12 345,067 8). In view of the requirement of 16.3.1, the use of a comma or a point for this purpose is deprecated, i.e. it is further recommended that separation of items in lists be effected by the use of a semi-colon. (See BS ISO 31-0, Specification for quantities, units and symbols – Part 0: General principles.)

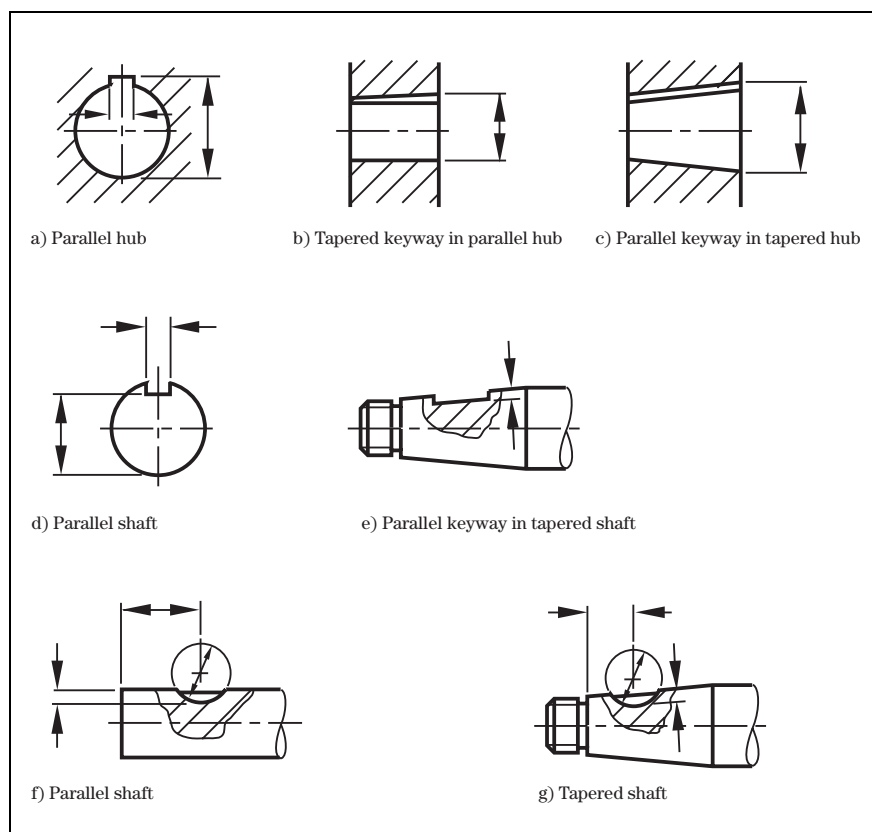


16.4 Keyways

Keyways in hubs or shafts shall be dimensioned by one of the methods shown in Figure 5.

NOTE Further information on keys and keyways is given in BS 4235-1, Specification for metric keys and keyways – Part 1: Parallel and taper keys, and BS 4235-2, Specification for metric keys and keyways – Part 2: Woodruff keys and keyways.

Figure 5 Dimensioning of keyways





16.5 Screw threads

Screw threads shall be specified according to functional requirement.

COMMENTARY AND RECOMMENDATIONS ON 16.5

The following standards provide the definition for metric ISO screw threads.

BS ISO 261	<i>ISO general purpose metric screw threads – General plan.</i>
BS ISO 262	<i>ISO general purpose metric screw threads – Selected sizes for screws, bolts and nuts.</i>
BS ISO 965-1	<i>ISO general purpose metric screw threads – Tolerances – Part 1: Principles and basic data</i>



16.6 Methods of specifying tolerances

COMMENTARY AND RECOMMENDATIONS

The necessary tolerances can be specified in one or more of the following ways:

- separate indication on the drawing;*
- reference to general tolerances noted on the drawing;*
- reference to a standard containing general tolerances;*
- reference to other documents.*



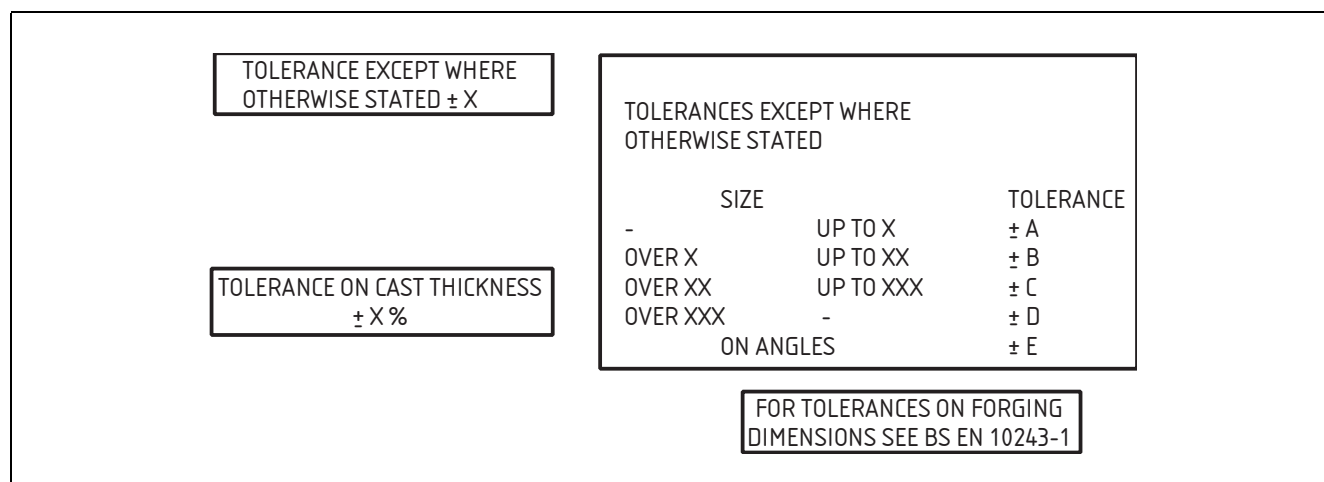
16.7 General tolerancing

COMMENTARY AND RECOMMENDATIONS

If reference to BS EN 22768-1 or BS EN 22768-2 for general tolerances is inappropriate, general tolerance notes may be used to apply a common tolerance to many of the features on a drawing. The example shown in Figure 6 illustrates the wide field of application of this system.

Due to the inherent risk of unintentionally over-specifying form and orientation controls that can result from the use of general geometrical tolerances, reference to BS EN 22768-2 is inadvisable.

Figure 6 Examples of general tolerance notes





17 Geometrical tolerancing

17.1 General

Geometrical tolerancing shall conform to the following standards, as appropriate.

BS ISO 1101	<i>Technical drawings – Geometrical tolerancing – Tolerancing of form, orientation, location and run-out – Generalities, definitions, symbols, indications on drawings</i>
BS ISO 2692	<i>Technical drawings – Geometrical tolerancing – Maximum material principle</i>
BS EN ISO 5458	<i>Geometrical Product Specifications (GPS) – Geometrical tolerancing – Positional tolerancing</i>
BS ISO 5459	<i>Technical drawings – Geometrical tolerancing – Datums and datum-systems for geometrical tolerances</i>
BS EN ISO 7083	<i>Technical drawings – Symbols for geometrical tolerancing – Proportions and dimensions</i>
BS ISO 10578	<i>Technical drawings – Tolerancing of orientation and location – Projected tolerance zone</i>



18 Surface texture indication

Indication of surface texture shall conform to the following standards.

BS EN ISO 1302	<i>Geometrical Product Specifications (GPS) – Indication of surface texture in technical product documentation</i>
BS EN ISO 8785	<i>Geometrical product specification (GPS) – Surface imperfections – Terms definitions and parameters</i>

The correct application of BS EN ISO 1302 requires the use of the following standards. Other normative references of BS EN ISO 1302 are also referenced in this standard.

BS EN ISO 3274	<i>Geometrical Product Specifications (GPS) – Surface texture: profile method – Nominal characteristics of contact (stylus) instruments</i>
BS EN ISO 4287	<i>Geometrical Product Specifications (GPS) – Surface texture: Profile method – Terms, definitions and surface texture parameters</i>
BS EN ISO 4288	<i>Geometrical Product Specification (GPS) – Surface texture – Profile method: Rules and procedures for the assessment of surface texture</i>
BS ISO 10135	<i>Technical drawings – Simplified representation of moulded, cast and forged parts</i>