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Contents

	Page
Foreword	XV
Introduction	1
<i>Table 1 — Visual index</i>	1
1 Scope	3
2 Normative references	3
3 Terms and definitions	8
<i>Figure 1 — Surface profile trace</i>	13
4 Standards underpinning BS 8888	14
5 Technical product specification (TPS)	14
5.1 Types of specification	14
5.1.1 Functional specifications	15
<i>Figure 2 — Hierarchy of specification types</i>	15
<i>Figure 3 — Example of functional specification</i>	16
5.1.2 Manufacturing specifications	16
<i>Figure 4 — Example of manufacturing specification</i>	16
5.1.3 Verification specifications	17
<i>Figure 5 — Example of verification specification</i>	17
<i>Figure 6 — Indication of specification type in TPD</i>	17
5.2 Principles of specification	18
5.2.1 Properties	18
5.2.2 Interpretation	18
5.2.3 ISO Geometrical product specification (ISO GPS) invocation principle	19
5.2.4 Level of detail in a specification	20
<i>Table 2 — Level of detail in a TPS</i>	20
5.2.5 Independency principle	20
5.2.6 Definitive specification principle	21
5.2.7 Feature principle	21
<i>Figure 7 — Interrelationship of the geometrical feature definitions</i>	22
5.2.8 Decimal principle	22
5.2.9 Reference conditions	22
5.2.10 Rigid workpiece principle	22
5.2.11 Non-rigid workpieces	23
<i>Figure 8 — Non-rigid specification applied to a workpiece, the free state, restraining condition specification and tolerance indicator usage</i>	23
5.2.12 Size settings in 3D CAD data	23
<i>Figure 9 — Hole and shaft sizes</i>	24
<i>Table 3 — Mid-limit and nominal values for 3D CAD model</i>	24
5.2.13 Interpretations of limits of size for a feature of size	25
<i>Figure 10 — Interpretations of size limits where no form control is defined and the specification is incomplete</i>	26
<i>Figure 11 — Two-line angular size: Second association with minimax criterion</i>	27
5.2.14 Identification and classification of specification requirements	27
6 Technical product documentation (TPD)	28
6.1 Formatting of TPD	28
6.1.1 General	28
6.1.2 Product definition classification code 1 (2D drawing only) – Drawing with optional data set	28
6.1.3 Product definition classification code 2 (2D drawing with supplementary 3D CAD model) – Data set with design model and drawing containing specifications	28

6.1.4	Product definition classification code 3 (simplified 2D drawing with 3D CAD model) – Data set with design model or annotated model and simplified drawing	29
6.1.5	Product definition classification code 4 (2D drawing with 3D CAD model) – Data set with annotated model and drawing	29
6.1.6	Product definition classification code 5 (annotated 3D CAD model) – Data set with annotated model	29
	<i>Figure 12 — Data set with annotated model</i>	29
6.2	3D CAD data used in a TPD	30
6.3	Document types used in a TPD	30
	<i>Figure 13 — Example of assembly drawing</i>	31
	<i>Figure 14 — Example of part drawing</i>	31
	<i>Figure 15 — Example of fabrication drawing with title block</i>	32
6.4	Graphical representation and annotation of 3D data (3D modelling output)	32
6.5	Drawing sheets	32
6.5.1	General	32
6.5.2	Sizes	32
	<i>Table 4 — Sizes of trimmed and untrimmed sheets and the drawing space</i>	33
6.5.3	Graphical features	33
	<i>Figure 16 — Size A4 to A0</i>	33
	<i>Figure 17 — Title block in compact form</i>	34
	<i>Table 5 — Identifying, descriptive and administrative data fields in the title block</i>	34
	<i>Table 6 — Number of fields</i>	35
6.6	Line types and line widths	35
6.6.1	Types of line	35
	<i>Table 7 — Basic line types</i>	35
6.6.2	Line width	35
6.6.3	Colours	35
6.7	Scales	36
6.8	Lines	36
6.8.1	Lines and terminators	36
6.8.2	Lines, terminators and origin indicators	36
6.9	Number formats	36
6.9.1	General	36
6.9.2	Metric values	36
6.10	Lettering	37
6.10.1	General	37
6.10.2	Lettering size	37
	<i>Table 8 — Preferred line widths and lettering heights for drawing sheet sizes</i>	37
6.10.3	Notes	37
6.11	Projections	38
6.11.1	General	38
6.11.2	Conventions for arrangement of views on a TPD	38
	<i>Figure 18 — Labelled view method</i>	39
	<i>Figure 19 — First angle projection method</i>	40
	<i>Figure 20 — First angle projection method: Graphical symbol</i>	40
	<i>Figure 21 — Third angle projection method</i>	41
	<i>Figure 22 — Third angle projection method: Graphical symbol</i>	41
6.12	Views	41
6.12.1	General	41

6.12.2	Auxiliary views	41
	<i>Figure 23 — Auxiliary view showing true shape of inclined surface</i>	42
6.13	Sections	42
	<i>Figure 24 — Examples of section view in one plane</i>	43
	<i>Figure 25 — Section view in two parallel planes</i>	43
	<i>Figure 26 — Section view in three contiguous planes showing true shape of inclined surface</i>	44
6.14	Representation of components	44
6.14.1	General	44
6.14.2	Representation of moulded, cast and forged components	45
6.14.3	Representation of moulded components	45
7	Dimensioning	46
7.1	General	46
7.2	Dimensioning methods	47
7.2.1	Presentation rules	47
7.2.2	Presentation of decimals	47
7.2.3	Positioning of dimensions	47
	<i>Figure 27 — Positioning of dimensions</i>	48
	<i>Figure 28 — Arrangement and indication of dimensions internal and external features</i>	48
7.2.4	Units	49
7.2.5	Elements of dimensioning: usage	49
	<i>Figure 29 — Elements of dimensioning</i>	49
	<i>Figure 30 — Dimension line of feature that is broken</i>	50
	<i>Figure 31 — Extension lines</i>	50
	<i>Figure 32 — Oblique extension lines</i>	51
	<i>Figure 33 — Intersection of projected contours of outlines</i>	51
	<i>Figure 34 — Intersection of projected contours of transitions and similar features</i>	52
	<i>Figure 35 — Extension lines of angular dimensions</i>	52
	<i>Figure 36 — Extension line for circular features</i>	53
7.2.6	Dimensional values	53
	<i>Figure 37 — Position of dimensional values – 1</i>	53
	<i>Figure 38 — Position of dimensional values – 2</i>	54
	<i>Figure 39 — Orientation of linear dimensions</i>	54
	<i>Figure 40 — Orientation of angular dimensions</i>	55
7.2.7	Indications of special dimensions	55
	<i>Table 9 — Special dimensions</i>	55
	<i>Figure 41 — Indications of special dimensions: Radius</i>	56
	<i>Figure 42 — Indications of special dimensions: Square</i>	56
	<i>Figure 43 — Indications of special dimensions: Spherical diameter</i>	56
	<i>Figure 44 — Indications of special dimensions: Spherical radius</i>	56
	<i>Figure 45 — Indications of special dimensions: Thickness</i>	56
	<i>Figure 46 — Diameter and depth of holes and counterbore</i>	57
	<i>Figure 47 — Size and angle of countersink</i>	57
7.2.8	Auxiliary dimensions	57
7.2.9	Repeated and equally-spaced features	58
	<i>Figure 48 — Indication of features having the same dimensional value – 1</i>	58
	<i>Figure 49 — Indication of features having the same dimensional value – 2</i>	58
	<i>Figure 50 — Features with equal linear spacing</i>	59
	<i>Figure 51 — Features with equal angular spacing</i>	59
	<i>Figure 52 — Features equally spaced on a pitch diameter</i>	60

7.2.10	Chamfers	60
	<i>Figure 53 — Dimension of external chamfer not equal to 45°</i>	60
	<i>Figure 54 — Dimension of external chamfer equal to 45°</i>	60
	<i>Figure 55 — Dimension of internal chamfer not equal to 45°</i>	61
	<i>Figure 56 — Dimension of internal chamfer equal to 45°</i>	61
7.2.11	Countersink	61
	<i>Figure 57 — Dimension of countersink</i>	61
	<i>Figure 58 — Dimension of countersink: simplification</i>	61
7.2.12	Indication of levels	62
	<i>Figure 59 — Indication of level on vertical view</i>	62
	<i>Figure 60 — Indication of level on horizontal view or section</i>	62
7.2.13	Dimensioning of curved features	62
	<i>Figure 61 — Curved feature defined by radii – 1</i>	62
	<i>Figure 62 — Curved feature defined by radii – 2</i>	63
	<i>Figure 63 — Curved feature defined by coordinate dimensions</i>	63
	<i>Figure 64 — Curved features defined by coordinate dimensions</i>	63
7.2.14	Arrangements of dimensions	64
	<i>Figure 65 — Chain dimensioning</i>	64
	<i>Figure 66 — Parallel dimensioning – 1</i>	64
	<i>Figure 67 — Parallel dimensioning – 2</i>	65
	<i>Figure 68 — Two dimension lines, inclined to each other, and two origins</i>	66
	<i>Figure 69 — Running dimensioning of angles</i>	67
7.2.15	Cartesian coordinate dimensioning	67
	<i>Figure 70 — Cartesian coordinate dimensioning – 1</i>	68
	<i>Figure 71 — Cartesian coordinate dimensioning – 2</i>	69
7.3	Dimensioning common features	69
7.3.1	Dimensioning of slots	69
	<i>Figure 72 — Dimensioning slots with rounded ends</i>	69
7.3.2	Keyways	70
	<i>Figure 73 — Dimensioning of keyways</i>	70
7.3.3	Screw threads	70
7.4	Dimensional tolerancing	71
7.4.1	General	71
7.4.2	Methods of specifying dimensional tolerances	71
7.4.3	Indication of dimensional tolerances	71
	<i>Figure 74 — Expression of two deviations to the same number of decimal places</i>	71
	<i>Figure 75 — Expression of two limits of size to the same number of decimal places</i>	72
	<i>Figure 76 — Expression of deviations from dimensions displayed in accordance with BS EN ISO 286-1</i>	72
	<i>Figure 77 — Components of a toleranced dimension – 1</i>	72
	<i>Figure 78 — Components of a toleranced dimension – 2</i>	72
	<i>Figure 79 — Components of a toleranced dimension – 3</i>	73
	<i>Figure 80 — Limits of dimensions</i>	73
	<i>Figure 81 — Single limit dimension</i>	73
7.4.4	Functional dimensions	73
	<i>Figure 82 — Application of dimensions to suit functional requirements</i>	74
	<i>Figure 83 — Effect of changing datum surfaces from those determined by functional requirements</i>	74

7.5	Implied dimensions	75
	<i>Figure 84 — Example of implied distance of zero</i>	75
	<i>Figure 85 — Example of implied tangency</i>	76
	<i>Figure 86 — Example of implied 0° or 180°</i>	76
	<i>Figure 87 — Example of implied 90°</i>	76
	<i>Figure 88 — Example of implied 60°</i>	77
8	Datums and datum systems	77
8.1	General	77
8.2	Datum systems	78
8.3	Identifying datum features: Placement of the datum feature indicator	78
8.3.1	Datums based on single feature	78
	<i>Figure 89 — Datum feature indicators attached to an outline and an extension line from an outline</i>	78
	<i>Figure 90 — Datum feature indicators attached to a tolerance frame attached to the feature</i>	79
	<i>Figure 91 — Datum feature indicator attached with leader line ending in a filled dot on surface</i>	79
	<i>Figure 92 — Datum feature indicators attached to surface on 3D TPS</i>	79
	<i>Figure 93 — Datum feature indicator placed in line with dimension line for size dimension</i>	80
	<i>Figure 94 — Datum feature indicators attached to tolerance frame</i>	80
	<i>Table 10 — Example of single datum</i>	80
8.3.2	Datums based on multiple datum features	81
	<i>Figure 95 — Datum indications based on multiple datum features</i>	81
8.3.3	Datums based on threaded features, gears or splines	81
	<i>Figure 96 — Datum axis based on major diameter of external threaded feature</i>	81
8.4	Deriving datums from datum features	81
8.5	Indications of situation features in a technical product specification (TPS)	82
	<i>Figure 97 — Identifiers for situation features</i>	83
8.6	Common datums	83
8.6.1	General	83
	<i>Figure 98 — Common datum established by a group of identical features</i>	84
8.6.2	Common datums based on two coaxial cylinders	84
	<i>Figure 99 — Common datum established from two coaxial cylinders</i>	84
	<i>Figure 100 — Establishing a common datum from two coaxial cylinders</i>	85
8.6.3	Common datums based on two parallel cylinders	85
	<i>Figure 101 — Establishing a common datum from two parallel cylinders</i>	85
8.6.4	Common datums based on a group of cylinders	86
	<i>Figure 102 — Pattern of five cylinders: input for reading (drawing indication) and for writing (design intent)</i>	86
	<i>Figure 103 — Establishing a common datum from a pattern of five cylinders</i>	87
8.6.5	Association for common datums	87
	<i>Figure 104 — Association for a common datum based on two coaxial cylinders</i>	88
8.7	Datum systems and the six degrees of freedom	88
	<i>Table 11 — Examples of datum systems 1</i>	89
	<i>Table 12 — Examples of datum systems 2</i>	90
8.8	Datum targets	91
8.8.1	General	91
8.8.2	Datum target frame	91
	<i>Figure 105 — Single datum target frame</i>	91

8.8.3	Datum target symbol	91
	<i>Figure 106 — Datum target point</i>	91
	<i>Figure 107 — Non-closed datum target line</i>	92
	<i>Figure 108 — Datum target area</i>	92
8.8.4	Leader line	92
	<i>Figure 109 — Indicator for single datum target point</i>	92
	<i>Figure 110 — Indicator for single datum target line</i>	92
	<i>Figure 111 — Indicator for single datum target area – 1</i>	93
8.8.5	Datum target areas	93
	<i>Figure 112 — Indicator for single datum target area – 2</i>	93
	<i>Figure 113 — Direct and indirect indication for single datum target area</i>	93
8.8.6	Datum feature indicators used with datum targets	94
	<i>Figure 114 — Indication of datums established from datum targets</i>	94
	<i>Figure 115 — Simplification of drawing indication when there is only one datum target area</i>	94
8.8.7	Datums based on more than one datum target	94
	<i>Figure 116 — Datums based on more than one datum target</i>	95
	<i>Figure 117 — Application of datum targets</i>	96
8.9	Modifying the effects of datums	96
8.9.1	“Orientation-only” modifier	96
	<i>Figure 118 — Application of “orientation-only” modifier</i>	97
8.9.2	Situation feature modifiers	97
	<i>Table 13 — Individual situation features</i>	97
	<i>Figure 119 — Indication of which modifier is needed in the set of situation features</i>	97
	<i>Figure 120 — Examples of direct and indirect indications of a datum section</i>	98
9	Geometrical specifications	98
9.1	General	98
9.2	Basic concepts	99
9.3	Symbols	100
	<i>Table 14 — Symbols for geometrical characteristics</i>	100
	<i>Table 15 — Additional symbols</i>	101
	<i>Figure 121 — Use of several specification modifiers</i>	101
9.4	Geometrical specification indication	101
	<i>Figure 122 — Elements of a geometrical specification indication</i>	102
9.5	Tolerance indicator	102
9.5.1	General	102
	<i>Figure 123 — Three sections of the tolerance indicator</i>	102
9.5.2	Symbol section	102
9.5.3	Tolerance zone section	103
9.5.4	Datum section	103
9.6	Tolerance zones	103
	<i>Figure 124 — Width of tolerance zone applying to the specified geometry</i>	103
9.7	Toleranced features	104
	<i>Figure 125 — Terminator on the outline or the surface of a feature</i>	104
	<i>Figure 126 — Terminator as an extension of the dimension line</i>	105
	<i>Figure 127 — Specification applying to several features individually – 1</i>	105
	<i>Figure 128 — Specification applying to several features individually – 2</i>	105
	<i>Figure 129 — Tolerance applying to more than one feature</i>	106
	<i>Figure 130 — Stacked tolerance indication</i>	106
9.8	Application of geometrical specifications	106
	<i>Figure 131 — Interpretation of geometrical specifications</i>	107

9.9	Theoretically exact dimensions (TEDs)	117
	<i>Figure 132 — Use of theoretically exact dimensions (TEDs)</i>	117
9.10	Material condition modifiers	118
9.10.1	MMR applied to the toleranced feature	118
	<i>Figure 133 — Indication of the maximum material requirement – 1</i>	118
9.10.2	MMR applied with a zero tolerance	118
	<i>Figure 134 — Indication of the maximum material requirement – 2</i>	118
9.10.3	MMR applied to a datum reference in a tolerance indicator	119
	<i>Figure 135 — Indication of the maximum material requirement – 3</i>	119
9.10.4	LMR applied to the toleranced feature	119
	<i>Figure 136 — Indication of the least material requirement</i>	120
9.10.5	LMR applied with a zero tolerance	120
	<i>Figure 137 — Indication of the LMR applied with a zero tolerance</i>	120
9.10.6	LMR applied to a datum reference in a tolerance indicator	120
	<i>Figure 138 — Least material requirement applied to a datum reference in a tolerance indicator</i>	120
9.10.7	Reciprocity requirement (RPR)	121
	<i>Figure 139 — Reciprocity requirement</i>	121
9.10.8	Direct indication of virtual size	121
	<i>Figure 140 — Direct indication of virtual size</i>	121
9.11	Additional indications relating to the toleranced feature	122
9.11.1	Projected tolerance zone	122
	<i>Figure 141 — Two ways of indicating a geometrical specification with projected tolerance modifier</i>	122
9.11.2	Free state condition	122
	<i>Figure 142 — Free state condition</i>	122
9.11.3	Tolerances applied to threaded features	123
	<i>Figure 143 — Example of “MD”</i>	123
9.11.4	Tolerances applied to splines and gears	123
9.12	Unequal tolerance zone (UZ)	123
	<i>Figure 144 — Example of a UZ</i>	124
9.13	Restrictive specifications	124
9.13.1	Tolerance requirements applied to a specific restricted portion of a feature	124
	<i>Figure 145 — Tolerance applied to a restricted part of a feature</i>	125
9.13.2	Tolerance requirements applied to any given restricted portion of a feature	125
	<i>Figure 146 — Examples of tolerances of the same characteristic</i>	126
	<i>Figure 147 — Tolerance applied to an area</i>	126
9.14	Interrelationship of geometrical specifications	126
10	Additional indications for geometrical specifications	127
10.1	Between	127
	<i>Figure 148 — Use of between symbol – 1</i>	127
	<i>Figure 149 — Use of between symbol – 2</i>	127
10.2	All-around	127
	<i>Figure 150 — Use of all-round symbol</i>	127
10.3	All-over	128
	<i>Figure 151 — Use of all-over symbol</i>	128
10.4	United features	128
	<i>Figure 152 — Example united feature</i>	128

10.5	Feature patterns (CZ, CZR, SZ and SIM)	129
10.5.1	Internal and external constraints	129
	<i>Table 16 — Example showing internal and external constraints</i>	130
10.5.2	Specifying a pattern requirement	131
	<i>Figure 153 — Pattern of three flat faces subject to a combined zone flatness tolerance</i>	131
	<i>Figure 154 — Two independent patterns, one of four Ø15 holes, and one of four Ø8 holes</i>	131
10.5.3	Nested pattern requirements	132
	<i>Figure 155 — Eight independent specifications</i>	132
	<i>Table 17 — Sequences of modifiers and their meaning</i>	133
	<i>Table 18 — Use of CZ, SZ and CZR modifiers</i>	134
10.5.4	Combined geometrical specifications	136
	<i>Figure 156 — Two patterns locked together by the SIM indicator</i>	137
	<i>Figure 157 — Examples of indication of simultaneous requirements from two separate specifications</i>	137
10.6	Plane and feature indicators	138
10.6.1	Intersection plane indicator	138
	<i>Figure 158 — Intersection plane indicator symbol</i>	138
	<i>Table 19 — Geometrical specification symbols used with an intersection plane indicator</i>	138
	<i>Figure 159 — Example use of intersection plane indicators</i>	139
10.6.2	Orientation plane indicator	139
	<i>Figure 160 — Orientation plane indicator symbol</i>	139
	<i>Table 20 — Geometrical specification symbols used with an orientation plane indicator</i>	139
	<i>Figure 161 — Example uses of orientation plane indicators</i>	140
10.6.3	Collection plane	140
	<i>Figure 162 — Collection plane indicator symbol</i>	140
	<i>Table 21 — Geometrical specification symbols used with a collection plane indicator</i>	141
	<i>Figure 163 — Example uses of collection plane indicators</i>	141
10.6.4	Direction feature	141
	<i>Figure 164 — Direction feature symbol</i>	142
	<i>Table 22 — Geometrical specification symbols used with a direction feature indicator</i>	142
	<i>Figure 165 — An example use of the direction feature</i>	142
11	General tolerances	142
11.1	General tolerance specifications	142
11.1.1	General	142
11.1.2	Application of general dimensional tolerances	143
11.1.3	Application of general geometrical specifications	143
11.1.4	Application of general tolerances for surface texture and edge conditions	143
11.2	General dimensional tolerances	143
11.2.1	General dimensional tolerance with a single value	143
11.2.2	General dimensional tolerances with range of values	143
	<i>Table 23 — Tolerances allocated according to dimension value</i>	144
11.3	General tolerances and 3D CAD data	144
11.4	General geometrical and size specifications (BS EN ISO 22081)	144
	<i>Figure 166 — General tolerances – ISO 22081</i>	145
11.5	General dimensional values (BS EN 22786-1)	145
	<i>Table 24 — Tolerance limits for general specifications of linear sizes</i>	146
11.6	General tolerances for specific manufacturing processes	146
12	Statistical tolerancing	147
	<i>Figure 167 — Statistical tolerance symbol</i>	147
	<i>Figure 168 — Population specification</i>	147
	<i>Figure 169 — Dual specification</i>	147

13	Edges	148
	<i>Figure 170 — Edge condition indication</i>	148
	<i>Table 25 — Meaning of indications</i>	149
	<i>Table 26 — Examples of indication of edges</i>	149
14	Welding symbols	150
14.1	The use of welding symbols on a TPS	150
14.2	Welding symbol basic requirements	150
	<i>Figure 171 — Basic welding symbol (joint details and type not specified)</i>	151
14.3	Arrow line	151
	<i>Figure 172 — Examples of use of multiple arrow lines</i>	151
14.4	Reference line	152
	<i>Figure 173 — Reference lines illustrating arrow side and other side for System A and System B</i>	153
14.5	Tail	153
	<i>Figure 174 — Examples of the use of a tail on welding symbols</i>	154
14.6	Elementary symbols	154
	<i>Table 27 — Elementary symbols for metal welds</i>	154
14.7	Broken arrow lines	157
	<i>Table 28 — Example uses of broken arrow line for metal welds</i>	157
14.8	Supplementary symbols	157
	<i>Table 29 — Common supplementary symbols for metal welds</i>	158
	<i>Figure 175 — Comprehensive welding symbols showing the location of weld elements</i>	159
15	Surface texture specification details	159
15.1	General	160
15.2	Profile surface texture	160
15.2.1	General	160
	<i>Figure 176 — Use of stylus device</i>	161
15.2.2	Profiles	162
	<i>Figure 177 — Relationship between the primary surface profile, P-profile, W-profile and R-profile</i>	162
15.2.3	Profile surface texture indications	162
	<i>Figure 178 — Graphical symbols indication profile surface texture</i>	163
	<i>Figure 179 — Structure of profile surface texture symbol</i>	163
	<i>Figure 180 — Minimal indications for parameter with defined defaults (all defaults apply)</i>	164
	<i>Figure 181 — Minimal indications for parameter without defined defaults</i>	164
	<i>Figure 182 — Indication for evaluation length R-parameters including all optional specification elements</i>	165
	<i>Figure 183 — Indication for section length R-parameters including all optional specification elements</i>	166
15.2.4	Symbols for surface lay type and direction	166
	<i>Table 30 — Symbols, interpretation and examples for the indication of surface lay</i>	167
	<i>Table 31 — Symbols, examples of indication and interpretation of surface lay and direction of lay</i>	168
15.2.5	Profile direction	168
	<i>Table 32 — Graphical symbols for the indication of the profile direction</i>	168
15.3	Areal surface texture indications	169
	<i>Table 33 — Graphical symbols for the indication of areal surface texture</i>	169
	<i>Figure 184 — Areal surface requirement for all six surfaces represented by outline on workpiece</i>	169
	<i>Figure 185 — Positions of surface texture requirements in the complete graphical symbol</i>	170

16	Conformity and non-conformity	170
16.1	Measurement uncertainty	171
16.2	Decision rules	171
16.2.1	General	171
16.2.2	Guard bands	172
16.2.3	Simple acceptance/rejection decision rule	172
16.2.4	Stringent acceptance/relaxed rejection decision rule	172
	<i>Figure 186 — Stringent acceptance with relaxed rejection</i>	173
16.2.5	Relaxed acceptance/stringent rejection decision rule	173
	<i>Figure 187 — Relaxed acceptance with stringent rejection</i>	174
16.2.6	Stringent acceptance/stringent rejection decision rule	174
	<i>Figure 188 — Stringent acceptance with stringent rejection</i>	175
16.2.7	Other decision rules	175
17	Symbols and abbreviations	175
17.1	General	175
17.2	Standard symbols and abbreviations	176
18	Document handling	177
18.1	Types of documentation	177
18.1.1	General	177
18.1.2	Presentation media	177
18.2	Security	177
18.2.1	Introduction	177
18.2.2	General security	177
18.2.3	Enhanced security	177
18.2.4	Security level identification	178
18.3	Storage	178
18.4	Marking	178
18.4.1	General	178
18.4.2	Enhanced security	178
18.5	Protection notices	178
Annex A	(informative) Datums and datum systems: Definitions and explanations	179
A.1	Datum feature	179
A.2	Datum feature indicator	179
	<i>Figure A.1 — Datum feature indicator</i>	179
A.3	Datum feature identifier	179
A.4	Common datum	179
A.5	Datum section	179
	<i>Figure A.2 — Datum section of a tolerance indicator defining a datum system</i>	179
A.6	Primary datum	180
A.7	Secondary datum	180
A.8	Tertiary datum	180
A.9	Six degrees of freedom	180
	<i>Figure A.3 — Degrees of freedom</i>	180
A.10	Situation feature	181
	<i>Table A.1 — Situation features</i>	181
A.11	Associated feature	183
A.12	Association	183
A.13	Association criterion	183
A.14	Objective function (for association)	184
A.15	Association constraints	184

Annex B	(informative) Associations	185
B.1	Association operations	185
B.2	Default association operations	185
	<i>Table B.1 — Default association operations used when defining datums</i>	186
B.3	Non-default association operations	186
	<i>Table B.2 — Objective function symbols</i>	187
	<i>Table B.3 — Material constraint</i>	187
	<i>Table B.4 — Material offset</i>	187
	<i>Figure B.1 — Example of individual specification operator for a datum association</i>	188
B.4	Examples of datums obtained from different datum features	188
	<i>Figure B.2 — Primary datum based on a planar datum feature</i>	189
	<i>Figure B.3 — Primary datum based on two parallel opposed planes</i>	190
	<i>Figure B.4 — Primary datum based on an external cylindrical feature</i>	192
	<i>Figure B.5 — Primary datum based on an external spherical feature</i>	194
	<i>Figure B.6 — Primary datum feature based on a conical feature</i>	195
	<i>Figure B.7 — Primary datum based on a wedge</i>	196
	<i>Figure B.8 — Primary datum based on a prismatic surface</i>	198
	<i>Figure B.9 — Primary datum based on a complex surface</i>	200
Annex C	(informative) Implementation in CAD	201
	<i>Figure C.1 — Implementation according to BS 8888 and BS EN ISO 5459</i>	201
Annex D	(normative) Document security: Enhanced	202
D.1	Enhanced security	202
D.2	Identification of security classification	202
D.3	Marking for enhanced security	202
Annex E	(informative) Tolerancing system: Former practice	203
	<i>Figure E.1 — BS 8888 independency system symbol</i>	203
	<i>Figure E.2 — BS 8888 dependency system symbol</i>	203
Annex F	(informative) Selected ISO fits: Hole and shaft basis	204
F.1	General	204
	<i>Table F.1 — Values of standard tolerance grades for nominal sizes up to 3 150 mm</i>	204
	<i>Figure F.1 — Fundamental deviations of holes and shafts</i>	205
F.2	Determination of limit deviations using Table F.1 and Table F.2	205
	<i>Figure F.2 — Preferred fits for general engineering</i>	206
	<i>Table F.2 — Selected ISO fits: Hole basis</i>	207
	<i>Table F.3 — Selected ISO fits: Shaft basis</i>	208
Annex G	(informative) Filtration	209
G.1	Introduction	209
	<i>Figure G.1 — Mechanical profile, showing the effect of mechanical filtering</i>	209
G.2	Filter types	210
	<i>Table G.1 — Basic semantics in designating filters</i>	210
	<i>Table G.2 — Filter symbols</i>	211
G.3	Filters and nesting indices	212
	<i>Figure G.2 — Effect of filtering using a filter with a 0.25 mm cut-off</i>	212
	<i>Table G.3 — Nesting indices</i>	213
G.4	Harmonic content	213
	<i>Figure G.3 — Harmonic groups</i>	214

G.5	Transmission characteristics of linear filters	215
	<i>Figure G.4 — Long-wave transmission function of the Gaussian filter for an open profile</i>	215
	<i>Figure G.5 — Open Gaussian filter with ($\lambda c = 0,8$ mm), using the moment retainment criterion for end effect correction, applied on a milled surface</i>	216
	<i>Figure G.6 — Transmission characteristic of the long-wave profile component for closed profile filters of different UPR values</i>	217
	<i>Figure G.7 — Roundness profile with a dominant tenth and thirtieth harmonic and individual harmonics isolated via use of filters on unfiltered profile</i>	218
G.6	Surface texture	218
	<i>Figure G.8 — Transmission characteristic of High/Band/Long pass filters</i>	219
	<i>Figure G.9 — Different components of a profile separated via filters</i>	219
	<i>Figure G.10 — Effects of filtering on unfiltered profile using different cut-off values</i>	220
	<i>Figure G.11 — Indication for an evaluation length R-parameter including all definable specification elements by using no default</i>	222
	<i>Table G.4 — Explanation of filter settings for example in Figure G.11</i>	222
G.7	Geometric tolerances	222
	<i>Table G.5 — Indication for specifying long-wave, short-wave and band pass filters</i>	222
	<i>Table G.6 — Examples of use of filters with geometrical specifications</i>	224
	<i>Figure G.12 — Extracted profile for straightness measurement</i>	225
	<i>Figure G.13 — Extracted profile for roundness measurement</i>	226
G.8	Datums	226
	<i>Figure G.14 — Illustration of filtration applied to a nominally flat surface</i>	226
	<i>Figure G.15 — Illustration of filtration applied to a nominally cylindrical surface</i>	227
G.9	Advantages and disadvantages of different filter types	227
	<i>Table G.7 — Advantages and disadvantages of various filter types</i>	228
Annex H	(informative) Dimensioning of slots	229
H.1	Defining the size of the slot	229
	<i>Figure H.1 — Dimensioning slots with rounded ends</i>	229
	<i>Figure H.2 — Profile tolerance</i>	230
H.2	Defining the location of the slot	230
	<i>Figure H.3 — Defining the location of a slot</i>	230
Annex I	(informative) Guidance for parts produced by additive manufacture (AM)	231
I.1	General	231
I.2	Dimensional size	231
I.3	Geometric form	231
I.4	Surface finish	232
I.5	Unique geometry	232
I.6	Functional grading and four-dimensional shape transformation	232
I.7	Hybrid manufacturing	232
Annex J	(informative) Castings	233
J.1	Background	233
J.2	Whether to use BS EN ISO 8062-3 or BS ISO 8062-4	234

Annex K	(informative) Examples of profile and areal surface texture specifications, and summary of changes from BS EN ISO 1302	235
K.1	Examples of profile surface texture specification	235
	<i>Figure K.1 — Minimal indication for an R-parameter with defined defaults by using all defaults</i>	235
	<i>Table K.1 — Explanation and valid defaults for the example in Figure K.1</i>	235
	<i>Figure K.2 — Indication for an evaluation length R-parameter including all definable specification elements by using no default</i>	236
	<i>Table K.2 — Explanation for the example in Figure K.2</i>	236
K.2	Summary of changes from BS EN ISO 1302	236
K.3	Areal surface texture specifications	237
	<i>Figure K.3 — Example of areal surface texture specification – 1</i>	237
	<i>Figure K.4 — Example of areal surface texture specification – 2</i>	238
	Bibliography	239

Summary of pages

This document comprises a front cover, an inside front cover, pages I to XVI, pages 1 to 240, an inside back cover and a back cover.

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Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 October 2025. It was prepared by Subcommittee TPR/1/8, *Technical Product Realization - BS 8888 Technical product specification*, under the authority of Technical Committee TPR/1, *Technical product realization*. A list of organizations represented on these committees can be obtained on request to the committee manager.

Supersession

This British Standard supersedes BS 8888:2020, which is withdrawn.

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. However, it is not the intention for BS 8888 to be a standalone standard. TPR/1 is responsible for a suite of related national standards, including the various parts of [BS 8887](#) and [PD 68888](#), a new training document.

Information about this document

This is a full revision of the document, and introduces relevant international standards published since the 2020 edition. It also incorporates more fully than previous editions some of the fundamental requirements of the key international standards relevant to the preparation of technical product specifications, such as [BS EN ISO 1101:2017](#) and [BS EN ISO 5459](#). It is hoped that UK industry will find this edition of BS 8888 more user-friendly than previous editions. It aims to help organizations better understand and implement the full complement of international standards developed by ISO/TC 213, *Geometrical product specifications and verification*, and ISO/TC 10, *Technical product documentation*.

Copyright is claimed on [Figure 72](#), [Figure 85](#), [Figure 97](#), [Figure 131](#), [Figure B.1](#), [Figure B.3](#), [Figure B.7](#), [Figure B.9](#), [Figure C.1](#), [Figure H.1](#), [Figure H.2](#), [Figure H.3](#), [Table 18](#), [Table G.6](#). Copyright holder is Iain Macleod Associated Ltd, 29 Clay Lane, Hale, Altrincham, Cheshire, WA15 8PJ, United Kingdom.

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Presentational conventions

The provisions of this document 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 British Standard are in millimetres.

Where words have alternative spellings, the preferred spelling of the *Shorter Oxford English Dictionary* is used (e.g. “organization” rather than “organisation”).

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

Introduction

Table 1 is a visual index and an innovation to improve the useability of the standard. It is not exhaustive, but a first attempt to improve the accessibility of the content.

Table 1 — Visual index

Symbol	Explanation	Relevant clause
	Non-rigid parts	5.2.11
	Envelope requirement	5.2.13.2
	Drawing sheets	6.5
	Views and projections	6.11.2
	Sections	6.13
	Dimensions	Clause 7
	Symbols for dimensions	7.2.7
	Running dimensioning	7.2.14.4
$\pm$	Dimensional tolerances	7.4.3
	Datums	Clause 8
	Datum targets	8.8
	Geometrical specifications	Clause 9
	Maximum material requirement	9.10.1
	Least material requirement	9.10.4
	Reciprocity requirement	9.10.7
	Projected tolerance zones	9.11.1
	All-around/over	Clause 10
A ↔ B	Between	10.1
UF	United feature	10.4
CZ/SZ	Feature patterns	10.5
4 × A/2 × B 	Nested patterns	10.5.3
	Plane and feature indicators	10.6
	Statistical tolerancing	Clause 12
	Edge conditions	Clause 13
	Welding symbols	Clause 14
	Surface texture	Clause 15
	Document handling	Clause 18

The annexes have been updated to reflect the changes in the content:

- [Annex A](#): Datums and datum systems: Definitions and explanations;
- [Annex B](#): Associations;
- [Annex C](#): Implementation in CAD;
- [Annex D](#): Document security – Enhanced;
- [Annex E](#): Tolerancing system: Former practice;
- [Annex F](#): Selected ISO fits: Hole and shaft basis;
- [Annex G](#): Filtration;
- [Annex H](#): Dimensioning of slots;
- [Annex I](#): Guidance for parts produced by additive manufacture (AM);
- [Annex J](#): Castings;
- [Annex K](#): Examples of profile and areal surface texture specifications, and summary of changes from BS EN ISO 1302 (withdrawn).

1 Scope

This British Standard specifies requirements for technical product specification and documentation, principally for manufacturing industries and organizations associated with engineering disciplines, such as mechanical, electrical, nuclear, automotive and aerospace.

The needs of building, architectural, civil, and structural engineering and construction services industries continue to be covered by the [BS EN ISO 19650](#) series.

Most of this British Standard consists of an implementation of the ISO system for technical product specification and documentation. The ISO system is defined in a large number of interlinked and related international standards which are referenced in this British Standard.

The purpose of this British Standard is to facilitate the use of the ISO system by providing:

- a) an index to the international standards which make up the ISO system, referencing them according to their area of application;
- b) key elements of the ISO standards to facilitate their application;
- c) references to additional British and European standards where they provide information or guidance over and above that provided by ISO standards; and
- d) commentary and recommendations on the application of the standards where this is deemed useful.

The requirements refer to international and European standards which have been implemented as British Standards, either in the BS EN, BS EN ISO, BS ISO series or as international standards renumbered as British Standards.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions, or limits the application, of this document¹⁾. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[BS 1916-1](#), *Limits and fits for engineering – Part 1: Guide to limits and tolerances*

[BS 1916-2](#), *Limits and fits for engineering – Part 2: Guide to the selection of fits in BS 1916-1*

[BS 1916-3](#), *Limits and fits for engineering – Part 3: Guide to tolerances, limits and fits for large diameters*

[BS 3238-1](#), *Graphical symbols for components of servo mechanisms – Part 1: Transducers and magnetic amplifiers*

[BS 3238-2](#), *Graphical symbols for components of servo mechanisms – Part 2: General servo-mechanisms*

[BS 3643-1:2007](#), *ISO metric screw threads – Part 1: Principles and basic data*

[BS 3643-2:2007](#), *ISO metric screw threads – Part 2: Specification for selected limits of size*

[BS 4500](#), *Limits and fits – Guidance for system of cone (taper) fits and tolerances for cones from $C = 1:3$ to $1:500$, lengths from 6 mm to 630 mm and diameters up to 500 mm*

[BS 4827:1972](#), *Specification for ISO miniature screw threads – Metric series*

[BS EN 2066](#), *Aerospace series – Extruded section in aluminium alloys – General tolerances*

¹⁾ Documents that are referred to solely in an informative manner are listed in the Bibliography.

- [BS EN 10058](#), *Hot rolled flat steel bars for general purposes – Dimensions and tolerances on shape and dimensions*
- [BS EN 22768-1:1993](#), *General tolerances – Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*
- [BS EN 80000-13](#), *Quantities and units – Part 13: Information science and technology*
- [BS EN 80000-14](#), *Quantities and units – Part 14: Telebiometrics related to human physiology*
- [BS EN ISO 128-2:2022](#), *Technical product documentation (TPD) – General principles of representation – Part 2: Basic conventions for lines*
- [BS EN ISO 129-1](#), *Technical product documentation (TPD) – Indications of dimensions and tolerances – Part 1: General principles*
- [BS EN ISO 286-1:2010](#), *Geometrical product specifications (GPS) – ISO code system for tolerances on linear sizes – Part 1: Basis of tolerances, deviations and fits*
- [BS EN ISO 286-2:2010](#), *Geometrical product specifications (GPS) – ISO code system for tolerances on linear sizes – Part 2: Tables of standard tolerance classes and limit deviations for holes and shafts*
- [BS EN ISO 1101:2017](#), *Geometrical product specifications (GPS) – Geometrical tolerancing – Tolerances of form, orientation, location and run-out*
- [BS EN ISO 1119:2011](#), *Geometrical product specifications (GPS) – Series of conical tapers and taper angles*
- [BS EN ISO 1660](#), *Geometrical product specifications (GPS) – Geometrical tolerancing – Profile tolerancing*
- [BS EN ISO 2162-1](#), *Technical product documentation – Springs – Part 1: Simplified representation*
- [BS EN ISO 2162-2](#), *Technical product documentation – Springs – Part 2: Presentation of data for cylindrical helical compression springs*
- [BS EN ISO 2203](#), *Technical drawings – Conventional representation of gears*
- [BS EN ISO 2553](#), *Welding and allied processes – Symbolic representation on drawings – Welded joints*
- [BS EN ISO 2692](#), *Geometrical product specifications (GPS) – Geometrical tolerancing – Maximum material requirement (MMR), least material requirement (LMR) and reciprocity requirement (RPR)*
- [BS EN ISO 3040](#), *Geometrical product specifications (GPS) – Dimensioning and tolerancing – Cones*
- [BS EN ISO 3098](#) (all parts), *Technical product documentation – Lettering*
- [BS EN ISO 4063](#), *Welding, brazing, soldering and cutting – Nomenclature of processes and reference numbers*
- [BS EN ISO 5261:1999](#), *Technical drawings – Simplified representation of bars and profile sections*
- [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 EN ISO 5457](#), *Technical product documentation – Sizes and layout of drawing sheets*
- [BS EN ISO 5458](#), *Geometrical product specifications (GPS) – Geometrical tolerancing – Positional tolerancing*
- [BS EN ISO 5459](#), *Geometrical product specifications (GPS) – Geometrical tolerancing – Datums and datum systems*
- [BS EN ISO 5817](#), *Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections*

[BS EN ISO 5845-1](#), *Technical drawings – Simplified representation of the assembly of parts with fasteners – Part 1: General principles*

[BS EN ISO 6410-1](#), *Technical drawings – Screw threads and threaded parts – Part 1: General conventions*

[BS EN ISO 6410-2](#), *Technical drawings – Screw threads and threaded parts – Part 2: Screw thread inserts*

[BS EN ISO 6411](#), *Technical drawings – Simplified representation of centre holes*

[BS EN ISO 6412-1](#), *Technical drawings – Simplified representation of pipelines – Part 1: General rules and orthogonal representation*

[BS EN ISO 6412-2](#), *Technical drawings – Simplified representation of pipelines – Part 2: Isometric projection*

[BS EN ISO 6412-3](#), *Technical drawings – Simplified representation of pipelines – Part 3: Terminal features of ventilation and drainage systems*

[BS EN ISO 6413](#), *Technical drawings – Representation of splines and serrations*

[BS EN ISO 6428](#), *Technical drawings – Requirements for microcopying*

[BS EN ISO 6947](#), *Welding and allied processes – Welding positions*

[BS EN ISO 7083](#), *Technical product documentation – Symbols used in technical product documentation – Proportions and dimensions*

[BS EN ISO 7200](#), *Technical product documentation – Data fields in title blocks and document headers*

[BS EN ISO 8015](#), *Geometrical product specifications (GPS) – Fundamentals – Concepts, principles and rules*

[BS EN ISO 8062-1](#), *Geometrical product specifications (GPS) – Dimensional and geometrical tolerances for moulded parts – Part 1: Vocabulary*

[BS EN ISO 8062-3](#), *Geometrical product specifications (GPS) – Dimensional and geometrical tolerances for moulded parts – Part 3: General dimensional and geometrical tolerances and machine allowances for castings using $\pm$ tolerances for indicated dimensions*

[BS EN ISO 8826-1](#), *Technical drawings – Roller bearings – Part 1: General simplified representation*

[BS EN ISO 8826-2](#), *Technical drawings – Roller bearings – Part 2: Detailed simplified representation*

[BS EN ISO 9013](#), *Thermal cutting – Classification of thermal cuts – Geometrical product specification and quality tolerances*

[BS EN ISO 9222-1](#), *Technical drawings – Seals for dynamic application – Part 1: General simplified representation*

[BS EN ISO 9222-2](#), *Technical drawings – Seals for dynamic application – Part 2: Detailed simplified representation*

[BS EN ISO 10042](#), *Welding – Arc-welded joints in aluminium and its alloys – Quality levels for imperfections*

[BS EN ISO 10135](#), *Geometrical product specifications (GPS) – Drawing indications for moulded parts in technical product documentation (TPD)*

[BS EN ISO 10209:2022](#), *Technical product documentation – Vocabulary – Terms relating to technical drawings, product definition and related documentation*

[BS EN ISO 10579](#), *Geometrical product specifications (GPS) – Dimensioning and tolerancing – Non-rigid parts*

[BS EN ISO 11442](#), *Technical product documentation – Document management*

[BS EN ISO 12180-1](#), *Geometrical product specifications (GPS) – Cylindricity – Part 1: Vocabulary and parameters of cylindrical form*

[BS EN ISO 12180-2](#), *Geometrical product specifications (GPS) – Cylindricity – Part 2: Specification operators*

[BS EN ISO 12181-1](#), *Geometrical product specifications (GPS) – Roundness – Part 1: Vocabulary and parameters of roundness*

[BS EN ISO 12181-2](#), *Geometrical product specifications (GPS) – Roundness – Part 2: Specification operators*

[BS EN ISO 12780-1](#), *Geometrical product specifications (GPS) – Straightness – Part 1: Vocabulary and parameters of straightness*

[BS EN ISO 12780-2](#), *Geometrical product specifications (GPS) – Straightness – Part 2: Specification operators*

[BS EN ISO 12781-1](#), *Geometrical product specifications (GPS) – Flatness – Part 1: Vocabulary and parameters of flatness*

[BS EN ISO 12781-2](#), *Geometrical product specifications (GPS) – Flatness – Part 2: Specification operators*

[BS EN ISO 13715](#), *Technical product documentation – Edges of undefined shape – Indication and dimensioning*

[BS EN ISO 13919](#) (all parts), *Welding – Electron and laser beam welded joints – Guidance on quality levels for imperfections*

[BS EN ISO 13920](#), *Welding – General tolerances for welded constructions – Dimensions for lengths and angles, shape and position*

[BS EN ISO 14171](#), *Welding consumables – Solid wire electrodes, tubular cored electrodes and electrode/flux combinations for submerged arc welding of non alloy and fine grain steels – Classification*

[BS EN ISO 14253](#) (all parts), *Geometrical product specifications (GPS) – Inspection by measurement of workpieces and measuring equipment*

[BS EN ISO 14341](#), *Welding consumables – Wire electrodes and weld deposits for gas shielded metal arc welding of non alloy and fine grain steels – Classification*

[BS EN ISO 14405-1](#), *Geometrical product specifications (GPS) – Dimensional tolerancing – Part 1: Linear sizes*

[BS EN ISO 14405-2](#), *Geometrical product specifications (GPS) – Dimensional tolerancing – Part 2: Dimensions other than linear or angular sizes*

[BS EN ISO 14405-3](#), *Geometrical product specifications (GPS) – Dimensional tolerancing – Part 3: Angular sizes*

[BS EN ISO 15785](#), *Technical drawings – Symbolic presentation and indication of adhesive, fold and pressed joints*

[BS EN ISO 16610](#) (all parts), *Geometrical product specifications (GPS) – Filtration*

[BS EN ISO 17295:2023](#), *Additive manufacturing – General principles – Part positioning, coordinates and orientation*

[BS EN ISO 17450](#) (all parts), *Geometrical product specifications (GPS) – General concepts*

[BS EN ISO 21920](#) (all parts), *Geometrical product specifications (GPS) – Surface texture: Profile*

- [BS EN ISO 22432](#), *Geometrical product specifications (GPS) – Features used in specification and verification*
- [BS EN ISO 25178](#) (all parts), *Geometrical product specifications (GPS) – Surface texture: Areal*
- [BS EN ISO 26909](#), *Springs – Vocabulary*
- [BS EN ISO 80000-1](#), *Quantities and units – Part 1: General*
- [BS EN ISO 80000-2](#), *Quantities and units – Part 2: Mathematics*
- [BS EN ISO 80000-3](#), *Quantities and units – Part 3: Space and time*
- [BS EN ISO 80000-4](#), *Quantities and units – Part 4: Mechanics*
- [BS EN ISO 80000-5](#), *Quantities and units – Part 5: Thermodynamics*
- [BS EN ISO 80000-8](#), *Quantities and units – Part 8: Acoustics*
- [BS EN ISO 80000-9](#), *Quantities and units – Part 9: Physical chemistry and molecular physics*
- [BS EN ISO 80000-10](#), *Quantities and units – Part 10: Atomic and nuclear physics*
- [BS EN ISO 80000-11](#), *Quantities and units – Part 11: Characteristic numbers*
- [BS EN ISO 80000-12](#), *Quantities and units – Part 12: Condensed matter physics*
- [BS ISO 128](#) (all parts), *Technical product documentation (TPD) – General principles of presentation*
- [BS ISO 261](#), *ISO general purpose metric screw threads – General plan*
- [BS ISO 262](#), *ISO general purpose metric screw threads – Selected sizes for screws, bolts and nuts*
- [BS ISO 965-1](#), *ISO general purpose metric screw threads – Tolerances – Part 1: Principles and basic data*
- [BS ISO 1219-1](#), *Fluid power systems and components – Graphical symbols and circuit diagrams – Part 1: Graphical symbols for conventional use and data-processing applications*
- [BS ISO 3302-1](#), *Rubber – Tolerances for products – Part 1: Dimensional tolerances*
- [BS ISO 3302-2](#), *Rubber – Tolerances for products – Part 2: Geometrical tolerances*
- [BS ISO 5456-4](#), *Technical drawings – Projection methods – Part 4: Central projection*
- [BS ISO 5623](#), *Plastics – Joining of thermoplastic moulded components – Specification for quality levels for imperfections*
- [BS ISO 7573](#), *Technical product documentation – Parts lists*
- [BS ISO 8062-4](#), *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*
- [BS ISO 13583-1](#), *Centrifugally cast steel and alloy products – Part 1: General testing and tolerances*
- [BS ISO 14617-1](#), *Graphical symbols for diagrams – Part 1: General rules*
- [BS ISO 14617-2](#), *Graphical symbols for diagrams – Part 2: Graphical symbols*
- [BS ISO 16016](#), *Technical product documentation – Protection notices for restricting the use of documents and products*
- [BS ISO 16792](#), *Technical product documentation – Digital product definition data practices*
- [BS EN ISO 19650](#) (all parts), *Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling*
- [BS ISO 20457](#), *Plastics moulded parts – Tolerances and acceptance conditions*

[BS ISO 29845](#), *Technical product documentation – Document types*

[BS ISO 80000-7](#), *Quantities and units – Part 7: Light and radiation*

[ISO/IEC Guide 98-3](#), *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

[ISO/IEC Guide 99](#), *International vocabulary of metrology – Basic and general concepts and associated terms (VIM)*

[PD CEN ISO/TS 8062-2](#), *Geometrical Product Specifications (GPS) – Dimensional and geometrical tolerances for moulded parts – Part 2: Rules*

3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in [BS EN ISO 10209](#), [BS EN ISO 17450](#) (all parts) and [BS EN ISO 25378](#) apply, together with the following.

3.1 association

feature operation used to fit ideal feature(s) to non-ideal feature(s) according to a criterion

NOTE This is sometimes referred to as a “best fit” operation.

[SOURCE: [BS EN ISO 17450-1:2011](#), 3.4.1.4]

3.2 associated feature

ideal feature established from a non-ideal surface model or from a real feature through an association operation

[SOURCE: [BS EN ISO 17450-1:2011](#), 3.3.8]

3.3 date of issue

point in time at which the technical product specification is officially released for its intended use

NOTE The date of issue is important for legal reasons, e.g. patent rights, traceability.

3.4 derived feature

geometrical feature, which does not exist physically on the real surface of the workpiece and which is not natively a nominal integral feature

NOTE The following are derived features:

- centre plane (or median plane or median surface);
- a centre line (or axis or median line); and
- a centre point.

[SOURCE: [BS EN ISO 17450-1:2011](#), 3.3.6, modified – notes 1 and 2 and examples 1 to 3 omitted and replaced with new note]

3.5 extracted feature

geometrical feature defining a set of a finite number of points

NOTE The set of data obtained by sampling a real feature in a measurement operation is an extracted feature. The set of data representing a derived feature (e.g. a median surface, median line or median point) which has been derived from data extracted from a real feature is also known as an extracted feature.

[SOURCE: [BS EN ISO 17450-1:2011](#), 3.3.7, modified – notes 1 to 3 omitted and replaced with a new note]

3.6 extracted surface

finite set of data points sampled from the primary surface

3.7 free state

condition of a part subjected only to the force of gravity

[SOURCE: BS EN ISO 10579:2013, 3.2]

3.8 geometrical product specification and verification

system developed in ISO by technical committee ISO/TC213 for the definition and verification of geometrical requirements for mechanical parts

NOTE This is also known as “Geometrical Product Specification” and “ISO GPS”.

3.9 integral feature

geometrical feature belonging to the real surface of the workpiece or to a surface model

NOTE An integral feature is continuous (i.e. composed of an infinite number of points).

[SOURCE: BS EN ISO 17450-1:2011, 3.3.5, modified – notes 1 to 3 omitted and replaced with a new note]

3.10 nesting index

N_{is}, N_{ic}, N_{if}

number or set of numbers indicating the relative level of nesting for a particular primary mathematical model

NOTE 1 For some types of filters, this might be referred to as a “cut-off”.

NOTE 2 The cut-off wavelength for the Gaussian filter is an example of a nesting index.

NOTE 3 Using the different nesting indices, specific lateral scale components of a scale-limited profile or surface are extracted.

[SOURCE: BS EN ISO 16610-1:2015, 3.2.1, modified – definition and notes revised]

3.11 nominal feature

ideal feature defined in the technical product documentation by the product designer

[SOURCE: BS EN ISO 17450-1:2011, 3.3.3, modified – notes and example omitted]

3.12 real feature

geometrical feature corresponding to a part of the workpiece real surface

[SOURCE: BS EN ISO 17450-1:2011, 3.3.4]

3.13 skin model**non-ideal surface model**

<of a workpiece> model of the physical interface of the workpiece with its environment

[SOURCE: BS EN ISO 17450-1:2011, 3.2.2]

3.14 specification

expression of permissible limits on a characteristic

NOTE Some specifications are expressed as limits for a value (i.e. a tolerance on a dimension). Some specifications are expressed as a space limited by one or more ideal features within which a non-ideal real feature is contained (i.e. a tolerance applied to flatness).

[SOURCE: BS EN ISO 17450-1:2011, 3.6, modified – note added]

3.15 surface texture terms

3.15.1 surface texture

geometrical irregularities contained in a scale-limited profile

NOTE Surface texture does not include geometrical irregularities contributing to the form or shape of the profile.

[SOURCE: BS EN ISO 21920-2:2022, 3.1.2]

3.15.2 areal surface texture

surface texture defined and evaluated over a portion of a surface

NOTE 1 This is covered by the BS EN ISO 25178 series of standards.

NOTE 2 Areal surface texture can be considered as 3D surface texture.

3.15.3 electromagnetic profile

profile obtained by the electromagnetic interaction with the skin model of a workpiece

NOTE The electromagnetic profile is the profile trace obtained with an optical measuring instrument.

[SOURCE: BS EN ISO 21920-2:2022, 3.1.7, modified – notes replaced]

3.15.4 electromagnetic surface

surface obtained by the electromagnetic interaction with the skin model of a workpiece

NOTE The electromagnetic surface is the surface with which an optical measurement system interacts.

[SOURCE: BS EN ISO 14406:2010, 3.1.2, modified – notes replaced]

3.15.5 evaluation area A $\tilde{A}$

portion of the scale-limited surface for specifying the area under evaluation

NOTE The symbol A is used for the numerical value of the evaluation area and the symbol $\tilde{A}$ for the domain (of integration or definition).

3.15.6 evaluation length l_e

length in the direction of the x-axis used for identifying the geometrical structures characterizing the scale-limited profile

NOTE The traverse length is longer than the evaluation length.

3.15.7 feature parameter

parameter defined from a subset of predefined topographic features from the scale-limited surface, such as S_{pd} , S_{vd} or S_{10_z}

[SOURCE: BS EN ISO 21920-2:2022, 3.2.2, modified – text added]

3.15.8 field parameter

parameter defined from all the points on a scale-limited surface, such as S_a , S_z or S_p

[SOURCE: BS EN ISO 21920-2:2022, 3.2.1, modified – text added]

3.15.9 mechanical profile

boundary of the mathematical erosion, by a circular disc of radius r , of the locus of the centre of an ideal tactile sphere, also with radius r , rolled along a trace over the skin model of a workpiece

NOTE The mechanical profile is the profile trace obtained with a mechanical contact measuring instrument.

[SOURCE: BS EN ISO 21920-2:2022, 3.1.5, modified – notes replaced]

3.15.10 mechanical surface

boundary of the mathematical erosion, by a sphere of radius r , of the locus of the centre of an ideal tactile sphere, also with radius r , rolled over the skin model of a workpiece

NOTE The mechanical surface is the surface with which a contact measurement system interacts.

[SOURCE: BS EN ISO 14406:2010, 3.1.1, modified – notes replaced]

3.15.11 nesting index

N_{is} , N_{ic} , N_{if}

number or set of numbers indicating the relative level of nesting for a particular primary mathematical model

NOTE 1 For some types of filters, this might be referred to as a “cut-off”.

NOTE 2 The cut-off wavelength for the Gaussian filter is an example of a nesting index.

NOTE 3 Using the different nesting indices, specific lateral scale components of a scale-limited profile or surface are extracted.

[SOURCE: BS EN ISO 16610-1:2015, 3.2.1, modified – definition and notes revised]

3.15.12 number of sections

n_{sc}

integer number used to obtain section length parameters

NOTE Default values of n_{sc} are contained in BS EN ISO 21920-3.

[SOURCE: BS EN ISO 21920-2:2022, 3.1.18]

**3.15.13 primary profile
P-profile**

scale-limited profile at any position x derived from the primary surface profile by removing the form using a profile F-operation with nesting index N_{if}

NOTE The primary profile is the basis for evaluation of the P-parameters.

[SOURCE: BS EN ISO 21920-2:2022, 3.1.14.1, modified – notes 1, 3 and 4 omitted]

3.15.14 primary surface

surface portion obtained when a surface portion is represented as a specified primary mathematical model with specified nesting index

NOTE An S-filter is used to derive the primary surface.

3.15.15 primary surface profile

surface profile trace obtained when a surface profile trace is represented as a specified primary mathematical model with specified nesting index N_{is}

NOTE In the BS EN ISO 21920 series, a profile S-filter is used to derive the primary surface profile from a profile trace (e.g. mechanical profile).

[SOURCE: BS EN ISO 21920-2:2022, 3.1.12, modified – notes 2 and 3 omitted]

3.15.16 profile F-operation

operation which removes form from a profile or surface

[SOURCE: BS EN ISO 21920-2:2022, 3.1.13.3, modified]

3.15.17 profile L-filter

profile filter which removes large lateral scale (long wavelength) components from a profile or surface

[SOURCE: BS EN ISO 21920-2:2022, 3.1.13.2, modified]

3.15.18 profile S-filter

profile filter which removes small lateral scale (short wavelength) components from a profile or surface

[SOURCE: BS EN ISO 21920-2:2022, 3.1.13.1, modified]

3.15.19 profile surface texture

surface texture defined and evaluated in a plane perpendicular to the surface with a specified orientation

NOTE 1 This is covered by the BS EN ISO 21920 series of standards.

NOTE 2 Profile surface texture can be considered as 2D surface texture.

3.15.20 reference line

line corresponding to a specific large lateral scale component

NOTE 1 The x-axis of the specification coordinate system coincides with the reference line of the assessed profile and the z-axis is oriented in an outward direction (from the material to the surrounding medium).

NOTE 2 The reference line for the primary profile and waviness profile are the large lateral scale component of primary surface profile removed by the profile F-operation.

NOTE 3 The reference line for the roughness profile is the component of the primary profile removed by the profile L-filter.

[SOURCE: BS EN ISO 21920-2:2022, 3.1.15]

3.15.21 reference surface

<surface texture> surface associated to the scale-limited surface according to a criterion

NOTE This reference surface is used as the origin of heights for surface texture parameters.

3.15.22 restrained state

condition of a part subjected to forces in addition to gravity

**3.15.23 roughness profile
R-profile**

scale-limited profile at any position x derived from the primary profile by removing large-scale lateral components by a specific type of profile L-filter with a nesting index N_{ic}

NOTE The roughness profile is the basis for evaluation of the R-parameters.

[SOURCE: BS EN ISO 21920-2:2022, 3.1.14.3]

3.15.24 scale-limited profile

profile structure scale components between specified nesting indices

EXAMPLE: A profile is scale-limited after applying a profile filter with a specified nesting index.

[SOURCE: BS EN ISO 21920-2:2022, 3.1.14]

3.15.25 scale-limited surface

S-F surface or S-L surface

3.15.26 section length

l_{sc}

length in the direction of the x -axis used to obtain section length parameters such as R_z , R_p and R_v

NOTE Default values of l_{sc} are found in [BS EN ISO 21920-3](#).

[SOURCE: [BS EN ISO 21920-2:2022](#), 3.1.17]

3.15.27 setting class

Scn

identifier to label default settings

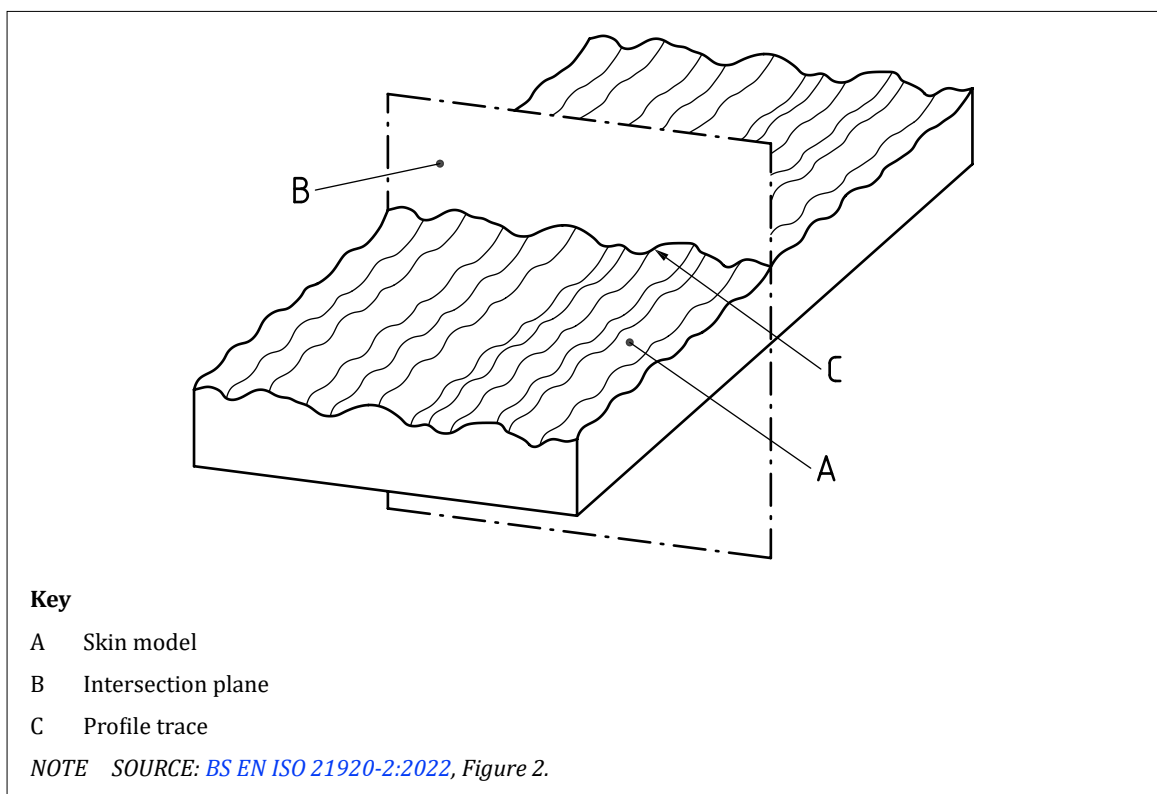
3.15.28 surface profile trace

intersection of the skin model by an intersection plane perpendicular to the skin model and in a specified direction

NOTE See [Figure 1](#).

[SOURCE: [BS EN ISO 21920-2:2022](#), 3.1.4, modified]

Figure 1 — Surface profile trace

**3.15.29 S-parameter**

field parameter or feature parameter that is not a V-parameter

3.15.30 S-F surface

surface derived from the primary surface by removing the form using an F-operation

3.15.31 S-L surface

surface derived from the S-F surface by removing the large-scale components using an L-filter

3.15.32 V-parameter

material volume or void volume field parameter

**3.15.33 waviness profile
W-profile**

scale-limited profile at any position x derived from the primary profile by removing small-scale lateral components by a specific type of profile S-filter with a nesting index N_{ic}

NOTE The waviness profile is the basis for evaluation of the W-parameters.

[SOURCE: [BS EN ISO 21920-2:2022](#), **3.1.14.2**, modified – notes 2 and 3 omitted]

3.16 technical product documentation (TPD)

means of conveying all or part of a design definition or specification of a product

[SOURCE: [BS EN ISO 10209:2022](#), **3.10.163**]

3.17 technical product specification (TPS)

technical product documentation comprising the complete design definition and specification of a product for manufacturing and verification purposes

NOTE A TPS (which may contain drawings, 3-D models, parts lists or other documents forming an integral part of the specification, in whatever format they are presented) may consist of one or more TPDs.

[SOURCE: [BS EN ISO 10209:2022](#), **3.10.164**]

4 Standards underpinning BS 8888

The following documents shall be applied as “global” standards in support of BS 8888.

- [ISO/IEC Guide 98-3](#), *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*.
- [ISO/IEC Guide 99](#), *International vocabulary of metrology – Basic and general concepts and associated terms (VIM)*.

The principles in [Clause 5](#) shall always be applied where conformity with BS 8888 is claimed.

5 Technical product specification (TPS)**5.1 Types of specification***COMMENTARY ON 5.1*

Specifications relating to mechanical engineering products can be broadly categorized as functional, manufacturing or verification specifications. Functional specifications specify design intent which is imperative to the safe function and performance of products. Product functionality is paramount and thus differentiation between requirement types is necessary to prevent functional requirements from being unintentionally or unnecessarily affected or obscured by changes in manufacturing or verification processes. Differentiation between specification types also facilitates communication between stakeholders and provides clarity on ownership of requirements throughout the supply chain. This clause provides a structure of GPS specifications in accordance with [PD ISO/TS 21619:2018](#) to facilitate differentiation between functional, manufacturing and verification specifications. Each of these specification types can be at the assembly, sub-assembly or component/part level.

“The functional specification (FUN-SPEC) of the assembly is the master specification for the functional sub-assembly specification(s) (FUN-SPEC-SUB) and the functional component specification(s) (FUNSPEC-COM). All functional specifications in the three levels are master specifications for the manufacturing specification and the verification specification.”

[SOURCE: PD ISO/TS 21619:2018, 4.1]

NOTE All specifications may be documents other than drawings.

5.1.1 Functional specifications

COMMENTARY ON 5.1.1

“A functional specification is a document stating functional requirements.”

[SOURCE: PD ISO/TS 21619:2018, 3.8]

Functional specifications are typically the responsibility of the designer and shall not contain manufacturing or verification requirements.

NOTE 1 Functional specifications may be used to manufacture or verify products.

Functional specifications shall be manufacturing and verification process agnostic.

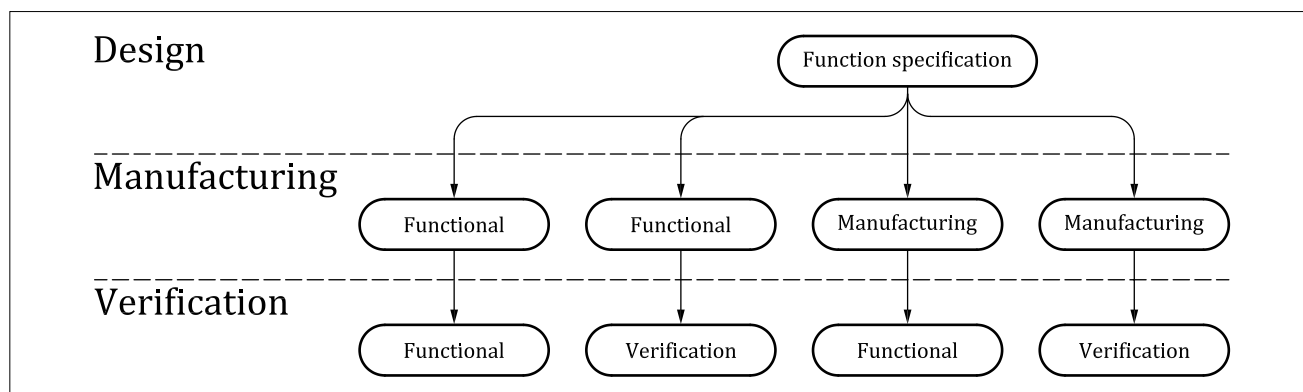
NOTE 2 Where features of the manufacturing process need to be taken into account at a functional level, they may be included in the functional specification. This can be due, for example, to split lines from moulding/casting, surface roughness lay from machining, welds from fabrication or anisotropic material properties due to additive manufacturing processes.

As illustrated in Figure 2, functional specifications may be used to derive manufacturing and verification specifications, but manufacturing and verification specifications shall not be used to express functional requirements.

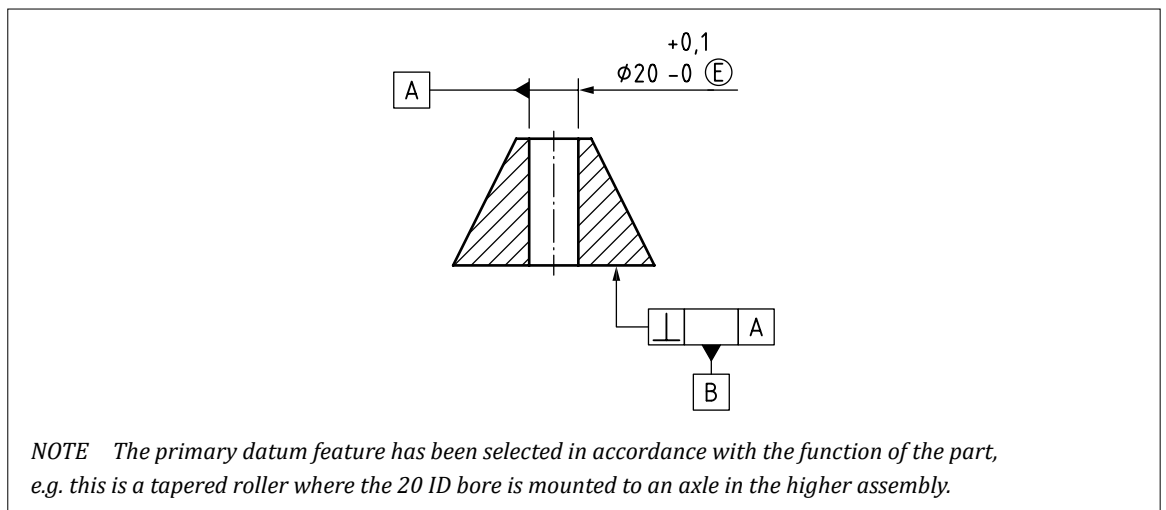
Since manufacturing and verification specifications are more frequently subject to change due to non-functional factors, such as manufacturing locations, manufacturing or verification equipment and contractual agreements, removal of these requirements from functional specifications shall be used to facilitate:

- better differentiation between types of requirements;
- better communication; and
- greater clarity in contractual obligations (the designer is not responsible for how a part/sub-assembly/assembly is manufactured or verified).

Figure 2 — Hierarchy of specification types



NOTE 3 An example of a functional specification is shown in Figure 3.

Figure 3 — Example of functional specification

5.1.2 Manufacturing specifications

COMMENTARY ON 5.1.2

“A manufacturing specification is a document stating manufacturing process-related requirements.”

[SOURCE: PD ISO/TS 21619:2018, 3.9]

The manufacturer or manufacturing engineering function is typically responsible for manufacturing specifications.

Manufacturing specifications shall be derived from functional specifications.

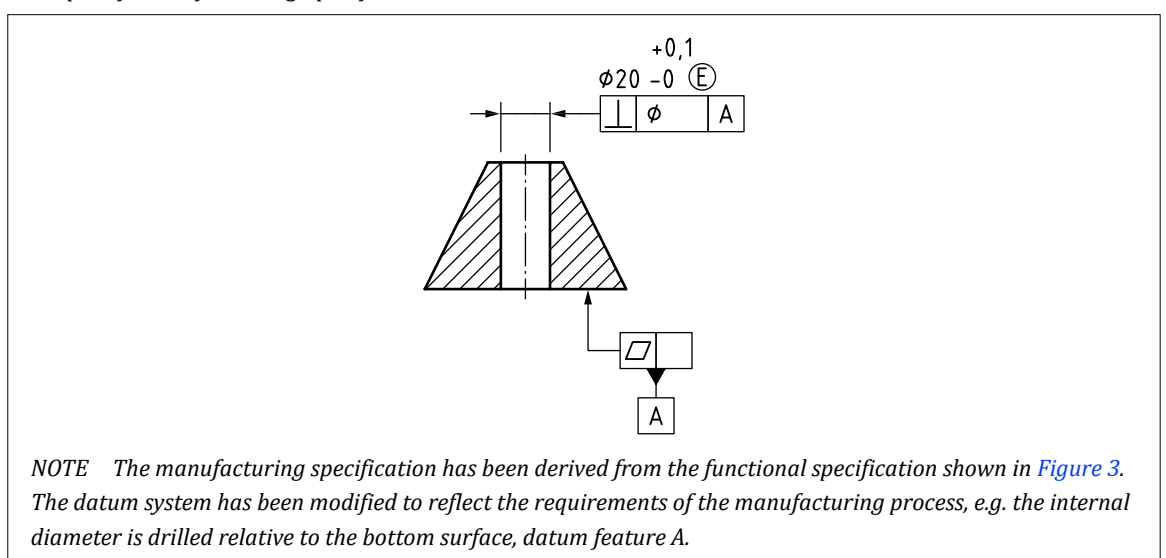
NOTE 1 One or more manufacturing specifications may be derived from a single functional specification.

The transcription of the requirements between the functional and manufacturing specifications is the responsibility of the party doing the transformation.

Measures shall be implemented to prevent incorrect or ambiguous transmission of information between the specifications and to manage change where derived specifications exist.

NOTE 2 An example of a manufacturing specification is shown in Figure 4.

NOTE 3 Conformity to one or more individual manufacturing specifications does not guarantee conformity to the functional specification.

Figure 4 — Example of manufacturing specification

5.1.3 Verification specifications

COMMENTARY ON 5.1.3

"A verification specification is a document stating verification related requirements."

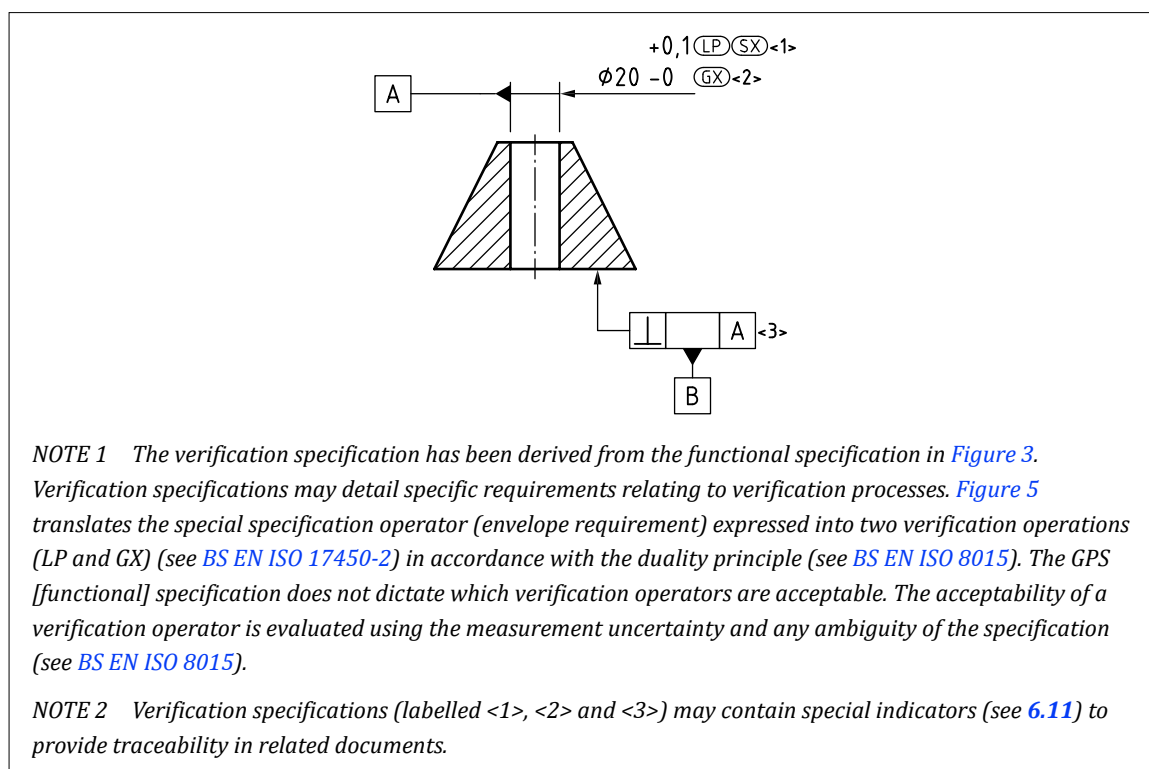
[SOURCE: PD ISO/TS 21619:2018, 3.10]

The manufacturer, verifier or quality function is typically responsible for verification specifications. Verification specifications may relate to and be derived from either functional or manufacturing specifications. One or more verification specifications may be derived from functional or manufacturing specifications. The transcription of the requirements from the functional or manufacturing specifications to verification specifications is the responsibility of the party doing the transformation.

Measures shall be implemented to prevent incorrect or ambiguous transmission of information between the specifications and to manage change where derived specifications exist.

NOTE 1 An example of a verification specification is shown in Figure 5.

Figure 5 — Example of verification specification

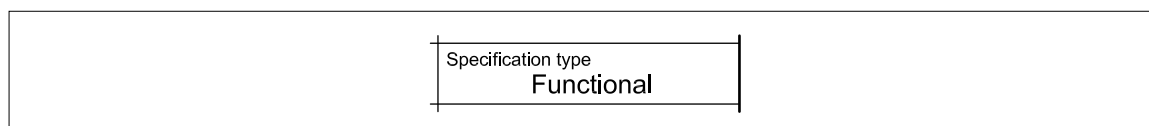


NOTE 2 If the verification specification(s) has been correctly derived and cover all the requirements contained in a functional specification, conformity to the verification specification(s) should be interpreted as demonstrating conformity to the functional specification.

Throughout the derivation and translation of dependent requirements, traceability shall be verified and documented such that conformity to the master (functional) specifications is proven.

NOTE 3 The type of specification may be indicated in technical product documentation (TPD). The field "Specification Type" can be added to title blocks as shown in Figure 6.

Figure 6 — Indication of specification type in TPD



5.2 Principles of specification

5.2.1 Properties

COMMENTARY ON 5.2.1

A TPS defines various properties and requirements. Some properties or requirements may be defined for an entire workpiece (e.g. a material specification), some for part of a workpiece (e.g. a particular surface treatment), and some for individual features on a workpiece (e.g. a size requirement). Properties or requirements may also be defined for a process or procedure. Properties which may be specified include:

- size;
- location;
- orientation;
- form;
- surface texture;
- surface imperfections;
- properties of edges;
- material;
- coatings and finishes;
- hardness;
- chemical composition;
- treatments which are to be applied to the workpiece;
- processing requirements;
- recycling requirements;
- packaging requirements; and
- handling requirements.

Properties of location and orientation may be defined solely with toleranced dimensions (see [Clause 7](#)), but this results in ambiguous specifications which are open to a wide range of interpretations.

For an unambiguous definition of the size, location, orientation and form of features on the workpiece, the ISO system of Geometrical Product Specification (GPS) shall be used.

NOTE This utilizes datums and geometrical specifications to minimize ambiguity (see [Clause 8](#) and [Clause 9](#)).

5.2.2 Interpretation

A TPS shall clearly indicate which standards, or systems of standards, apply to its interpretation.

If different versions of standards apply to changes or updates to a TPS, this shall be clearly indicated.

When the format of data in a TPS conforms to the British and ISO standards identified in BS 8888, a reference to BS 8888 itself shall be used to indicate that these standards apply to the specification. Such a reference shall take the following form:

CONFORMS TO BS 8888

NOTE 1 This note may be placed in the title block, in a drawing note or elsewhere within the drawing frame.

NOTE 2 The phrase “format of data” refers to 2D and 3D TPS, and includes aspects such as format of attributes, layout of drawing borders and title blocks, layout of views and projections, format of letters, numbers, dimensions and tolerances, and use of different line types and thicknesses.

When the geometry of a workpiece is defined according to the requirements of ISO Geometrical Product Specification and Verification (ISO GPS) which are documented in standards such as [BS EN ISO 8015](#), [BS EN ISO 5459](#) and [BS EN ISO 1101:2017](#), a reference to [BS EN ISO 8015](#) shall be used to indicate that all geometrical product specification and verification standards apply to the interpretation of that specification. Such a reference shall take the following form:

TOLERANCING ISO 8015

NOTE 3 This note may be placed in the title block, in a drawing note or elsewhere within the drawing frame. This note is required in addition to any reference to BS 8888. This marking is a BS 8888 requirement, and not a requirement of [BS EN ISO 8015](#) and is necessary to avoid possible misinterpretation of which system of standards govern the interpretation of a TPS.

NOTE 4 Reference to [BS EN ISO 8015](#) is not just important to confirm which standards interpretation method is required for the TPS. Reference to [BS EN ISO 8015](#) also enables the invocation principle in [BS EN ISO 8015](#) and, as such, no further reference to other ISO GPS standards is required; for instance reference to [BS EN ISO 5459](#) for Datums is not required, reference to [BS EN ISO 1101:2017](#) for Geometrical Tolerancing is not required, etc.

5.2.3 ISO Geometrical product specification (ISO GPS) invocation principle

“Once a portion of the GPS and verification system is invoked on a mechanical engineering product specification, the entire GPS and verification system shall be invoked, unless otherwise indicated on the specification e.g. by reference to a relevant document.

“Unless otherwise indicated on the specification” means that it is indicated on the specification that it has been prepared in accordance with a regional, national or company standard, then that standard, and not the GPS and verification system, shall be used to interpret those elements of the specification that are covered by that standard.

NOTE 1 The “entire geometrical product specification and verification system is invoked” means that fundamental and general GPS standards apply and, consequently that e.g. the reference temperature given in [BS EN ISO 129-1](#) and the decision rules given in [BS EN ISO 14253-1](#) apply, unless otherwise indicated. The purpose of the invocation principle is to provide the formal traceability for these GPS standards and rules.”

[SOURCE: [BS EN ISO 8015:2011](#), 5.1, modified – “Tolerancing [ISO 8015](#)” can optionally be indicated in or near the title block for information, but is not required to invoke the GPS and verification system, note removed]

NOTE 2 The GPS and verification system is defined in a hierarchy of standards that includes the following types of standards in the given order:

- *fundamental GPS standards;*
- *general GPS standards; and*
- *complementary GPS standards.*

See [BS EN ISO 14638](#) for further details.

“The rules given in standards at a higher level in the hierarchy apply in all cases, unless rules in standards at lower levels in the hierarchy specifically give other rules.”

[SOURCE: [BS EN ISO 8015:2011](#), 5.2]

All rules given in fundamental GPS standards shall apply, in addition to those specifically given in general GPS standards, e.g. [BS EN ISO 1101:2017](#), except where the rules in the general GPS standard are explicitly different from the rules given in fundamental GPS standards and unless the rules in a specific complementary GPS standard give other rules that apply within its scope.

All rules given in fundamental and general GPS standards shall apply in addition to the rules specifically given in complementary GPS standards, including [BS EN 22768-1](#), except where the rules in the complementary GPS standard are explicitly different from the rules given in fundamental and general GPS standards.

5.2.4 Level of detail in a specification

COMMENTARY ON 5.2.4

When a specification leaves certain requirements undefined, or open to more than one interpretation, it is ambiguous.

The more ambiguity which exists in a specification, the greater the risk that a manufactured product conforms to that specification but is still unfit for purpose. Conversely, there is also greater risk of rejecting a workpiece which is fit for purpose.

The less ambiguity which exists in a specification, the greater the likelihood that the conforming manufactured product is fit for purpose.

It is not always necessary to minimize or eliminate the ambiguity in a specification. A high level of ambiguity can be acceptable when the specifier is willing to rely on the skill, craftsmanship and knowledge of the manufacturer or fitter to achieve a satisfactory result. The benefit is a very simple specification, but the consequences could include a high degree of variation from one part to the next, a lack of interchangeability and inconsistent quality.

Higher levels of ambiguity also mean much greater probability of disputes over whether a manufactured product is acceptable or not.

The use of datums, geometrical specifications, surface texture requirements and edge tolerances is not obligatory. However, not using these specification elements results in greater ambiguity.

The specifier shall determine what level of detail is required in a specification and define the workpiece in an appropriate manner (see [Table 2](#)).

Table 2 — Level of detail in a TPS

Specification elements included	Level of detail			
	Sketch	Technical model/drawing	Technical model/drawing with geometrical tolerancing	GPS and verification
3D/2D geometry	✓	✓	✓	✓
Dimensions	—	✓	✓	✓
+/- Tolerances	—	✓	✓	✓
Datums	—	—	✓	✓
Geometrical specifications	—	—	✓	✓
Surface texture requirements	—	—	—	✓
Edge tolerances	—	—	—	✓
Level of ambiguity in the specification	Very high	High	Low	Very low

5.2.5 Interdependency principle

“By default, every GPS requirement for a feature or relation between features shall be fulfilled independently of other requirements, except when it is stated in a standard or by special indication (e.g. modifiers $\textcircled{M}$ or $\textcircled{L}$ in accordance with [BS EN ISO 2692](#) or CZ or CZR in accordance with [BS EN ISO 5458](#)) as part of the actual specification.”

[SOURCE: [BS EN ISO 8015:2011](#), 5.5]

5.2.6 Definitive specification principle

The specification is definite: requirements of the specification shall apply to the finished state of the workpiece unless otherwise indicated. Requirements which apply to an intermediate state of the workpiece shall be identified as such.

NOTE Where geometrical or dimensional properties are affected by a finishing process such as plating or heat treatment, there is often confusion over whether specification requirements apply before or after the process. In such cases, a statement can be used such as “all dimensions and tolerances apply after plating”, unless otherwise specified.

5.2.7 Feature principle

COMMENTARY ON 5.2.7

The GPS and verification defines several different types of features. The main types of features are:

- a) *integral features: features which consist of, or represent, surfaces on the workpiece;*
- b) *features of size: integral features which have a size characteristic and include (but are not limited to) the following types of feature:*
 - 1) *two parallel opposed planes;*
 - 2) *a cylinder;*
 - 3) *a sphere;*
 - 4) *two non-parallel planes (a wedge);*
 - 5) *a cone;*
 - 6) *the two rounded ends of a slot or protrusion (see [Annex H](#)); and*
 - 7) *a torus;*
- c) *derived features: theoretical features such as axes or median lines, which are derived from a feature of size (axis or median line, median plane or median surface and centre points).*

The GPS and verification also defines a number of different “worlds” or “states” in which features can exist. The features can exist in an ideal form, such as in the specification, while in other states they exist in a non-ideal form, such as surfaces on the manufactured workpiece (see [Figure 7](#)).

In the specification features are represented in an ideal state. These features have ideal form, and ideal relationships with each other. These are known as nominal features.

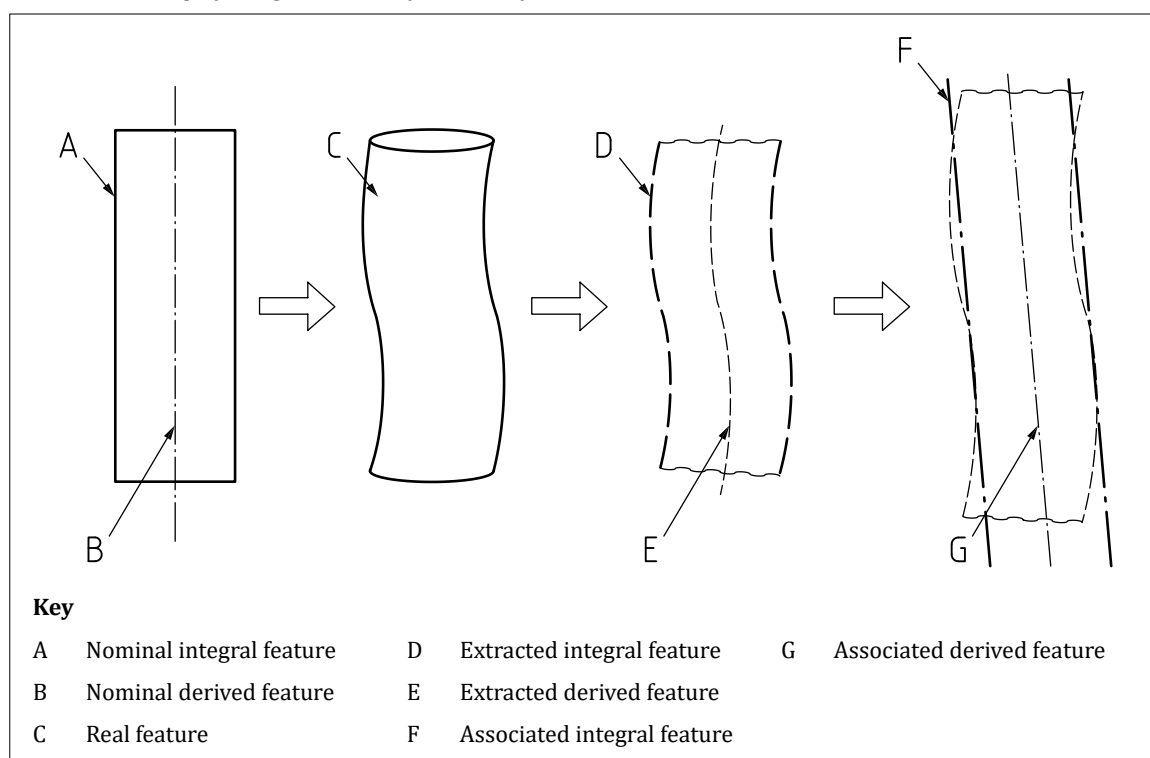
On the manufactured workpiece, features are non ideal and are known as real features.

In verification, a feature is represented by a set of data obtained by sampling the workpiece with measuring instruments. This set of data represents the non-ideal real feature and is known as an extracted feature.

The extracted feature is used when determining whether a tolerance requirement has been met.

In verification, an ideal feature may be “fitted” to, or associated with, either the real feature or the extracted feature. This ideal feature is known as an associated feature.

The associated feature is used when determining the orientation of size measurements, or when defining a datum. A range of different association methods may be used.

Figure 7 — Interrelationship of the geometrical feature definitions

A workpiece shall be made up of a number of features limited by natural boundaries. By default, every specification requirement for a feature or relation between features shall apply to the entire feature and each specification requirement shall apply only to one feature or one relation between features.

NOTE This default can only be overridden by explicit indications on the drawing.

5.2.8 Decimal principle

Non-indicated decimals shall be taken as zeros.

NOTE 1 0,2 is the same as 0,200 000 000 000 000 000 000 000 000 000 ... etc.

NOTE 2 10 is the same as 10,000 000 000 000 000 000 000 000 000 000 ... etc.

5.2.9 Reference conditions

Unless otherwise stated, all specification requirements shall apply at 20 °C with the workpiece free from contaminants.

NOTE For more guidance on the conditions, see [BS EN ISO 129-1](#) and [BS EN ISO 8015](#).

Any additional or alternative conditions that apply, e.g. humidity conditions, shall be defined in the specification.

5.2.10 Rigid workpiece principle

Unless otherwise stated, a workpiece shall be treated as having infinite stiffness. All specification requirements shall apply in the free state, with the workpiece undeformed by any external forces (including gravity). Any additional or alternative conditions that apply shall be defined in the specification.

5.2.11 Non-rigid workpieces

Where a workpiece is not to be treated as infinitely stiff, this shall be indicated with the statement “ISO 10579-NR” placed in or near the title block or in the notes for the TPS.

Specification requirements shall be applied either to a free state condition or to a restrained state condition.

NOTE 1 A specification may contain solely free state requirements or solely restrained state requirements or a combination of both.

For free-state requirements, the TPS shall define the direction in which gravity applies and the manner in which the workpiece is supported.

NOTE 2 Free state requirements are identified with the $\textcircled{F}$ symbol.

For constrained-state requirements, the TPS shall define the restrained condition. When ISO 10579-NR is invoked, specification requirements shall apply in the restrained condition unless otherwise indicated (e.g. with the $\textcircled{F}$ symbol).

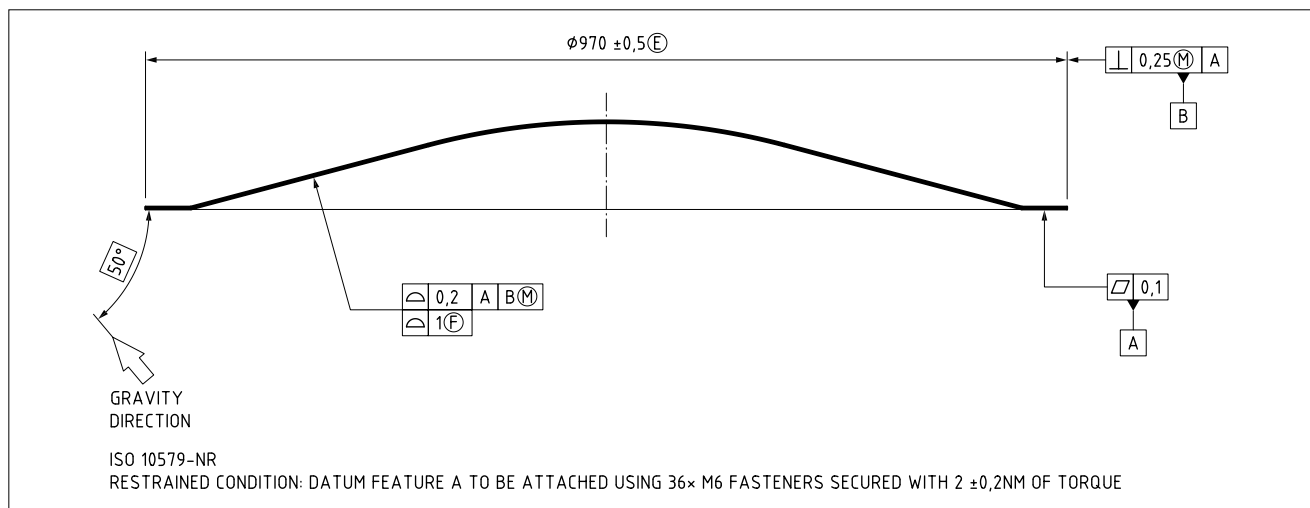
Where more than one free state or restrained state is required, flag notes shall be used to indicate to which state each specification requirement applies.

NOTE 3 The restrained state is usually intended to replicate the assembled condition of the workpiece.

NOTE 4 The restrained state can be identified directly on the TPS with notes, or indirectly with a reference to another document.

NOTE 5 Figure 8 shows an example of ISO 10579-NR non-rigid body applied to a workpiece, the free state, restraining condition specification and tolerance indicator usage.

Figure 8 — Non-rigid specification applied to a workpiece, the free state, restraining condition specification and tolerance indicator usage



5.2.12 Size settings in 3D CAD data

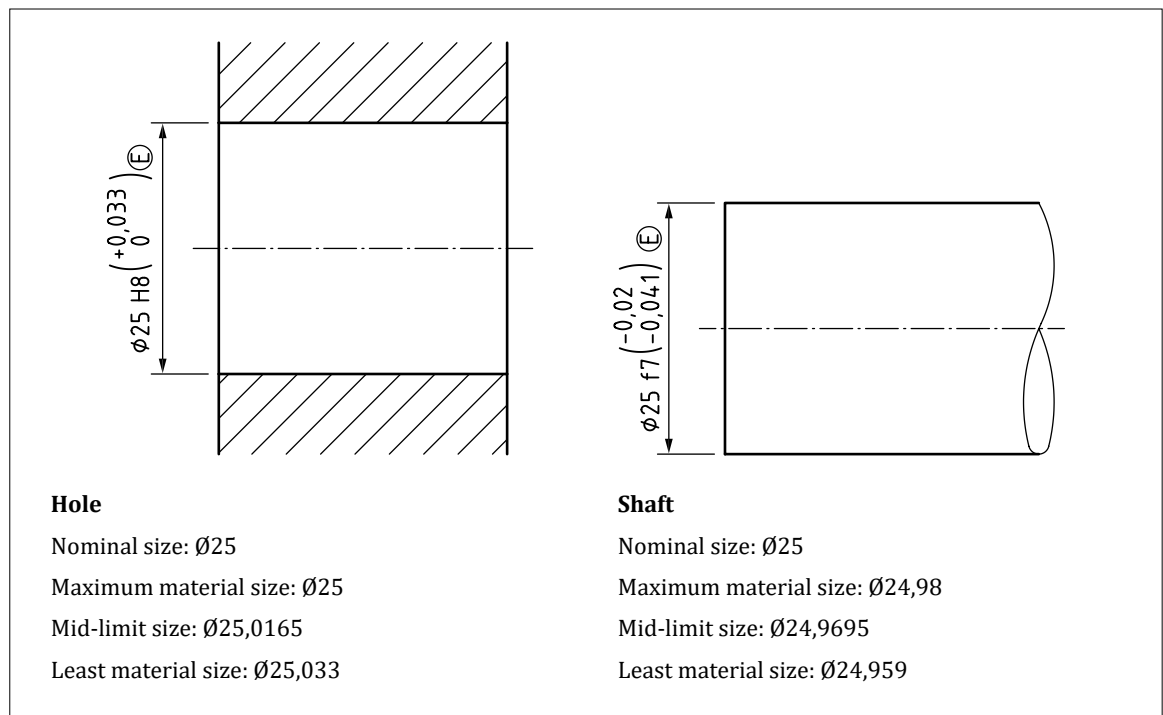
COMMENTARY ON 5.2.12

See [BS ISO 16792](#) for requirements for the preparation, revision and presentation of data sets in support of 3D modelling.

Where the 3D CAD geometry includes features of size, two different practices are widely used. These are to model the feature at “nominal” size or to model the feature at “mid-limit” size (see [Figure 9](#)).

The “nominal” size is the dimension value to which the tolerance is applied (dimensions which are shown as upper and lower limits do not have a nominal value). The “mid-limit” size is the value half-way through the tolerance range.

Where symmetrical size tolerances are used, “nominal” and “mid-limit” are the same. When non-symmetrical tolerances are used, such as limit and fit codes, they are different.

Figure 9 — Hole and shaft sizes

When a nominal size is provided by means of a specification or dimension, all features of size shall be modelled to nominal size or to mid-limit value of the tolerance limits.

Where a nominal size is not provided, all features of size shall be modelled to the mid-limit value of the tolerance limits, unless otherwise stated.

NOTE Table 3 shows example mid-limit and nominal values for a 3D CAD model.

Within a 3D CAD model, wherever non-symmetrical size tolerances are used, one practice shall be consistently followed.

Table 3 — Mid-limit and nominal values for 3D CAD model

Dimension	Nominal value	Value to be modelled when working to nominal	Mid-limit value	Value to be modelled when working to "mid-limit"
Ø15 Ø13	Not stated	Ø14	Ø14	Ø14
20,4 19,6	Not stated	20	20	20
10 ±1	10	10	10	10
Ø25 H8(E)	Ø25	Ø25	Ø25,016 5	Ø25,016 5
Ø25 f7(E)	Ø25	Ø25	Ø24,969 5	Ø24,969 5
+1,5 Ø13,5 -0,5	Ø13,5	Ø13,5	Ø14	Ø14
+1 Ø14 0	Ø14	Ø14	Ø14,5	Ø14,5
R0,5 max.	R0,5	R0,5	R0,25 ^{A)}	R0,25

^{A)} Min. value = 0.

5.2.13 Interpretations of limits of size for a feature of size

5.2.13.1 Relevant standards

Limits of size for a feature of size shall be interpreted according to the principles and rules defined in the following standards.

- [BS EN ISO 8015](#), *Geometrical product specifications (GPS) – Fundamentals – Concepts, principles and rules*.
- [BS EN ISO 14405-1](#), *Geometrical product specifications (GPS) – Dimensional tolerancing – Part 1: Linear sizes*.
- [BS EN ISO 14405-2](#), *Geometrical product specifications (GPS) – Dimensional tolerancing – Part 2: Dimensions other than linear or angular sizes*.
- [BS EN ISO 14405-3](#), *Geometrical product specifications (GPS) – Dimensional tolerancing – Part 3: Angular sizes*.
- [BS EN ISO 17450-1](#), *Geometrical product specifications (GPS) – General concepts – Part 1: Model for geometrical specification and verification*.
- [BS EN ISO 17450-2](#), *Geometrical product specifications (GPS) – General concepts – Part 2: Basic tenets, specifications, operators, uncertainties and ambiguities*.
- [BS EN ISO 17450-3](#), *Geometrical product specifications (GPS) – General concepts – Part 3: Toleranced features*.
- [BS EN ISO 22432](#), *Geometrical product specifications (GPS) – Features used in specification and verification*.

5.2.13.2 Interpretations of limits of size for a linear feature of size

A linear size specification shall be interpreted as a two-point local size requirement unless otherwise indicated (see [BS EN ISO 14405-1](#)).

When a different specification operator is required, it shall be invoked using the appropriate symbol applied to the individual size specification, or by defining a different default linear size specification operator for the entire TPS (see [BS EN ISO 14405-1](#)).

If the default size specification operator is to be changed for an entire TPS, the following indication shall appear in or near the title block of each drawing:

LINEAR SIZE ISO 14405 X

where X is the symbol representing the required operator.

EXAMPLE

If the envelope requirement is to be made the default interpretation of linear size specifications for the entire TPS, the indication is:

LINEAR SIZE ISO 14405 ⓔ

NOTE 1 A additional explanatory note should be used on the drawing as this indication might be overlooked or misunderstood.

NOTE 2 The consequence of using the default “two-point” definition of a linear size tolerance is that size limits only apply to any “two-point” size measurement of a feature. Therefore, the size limits do not control the form deviations of the feature. For example:

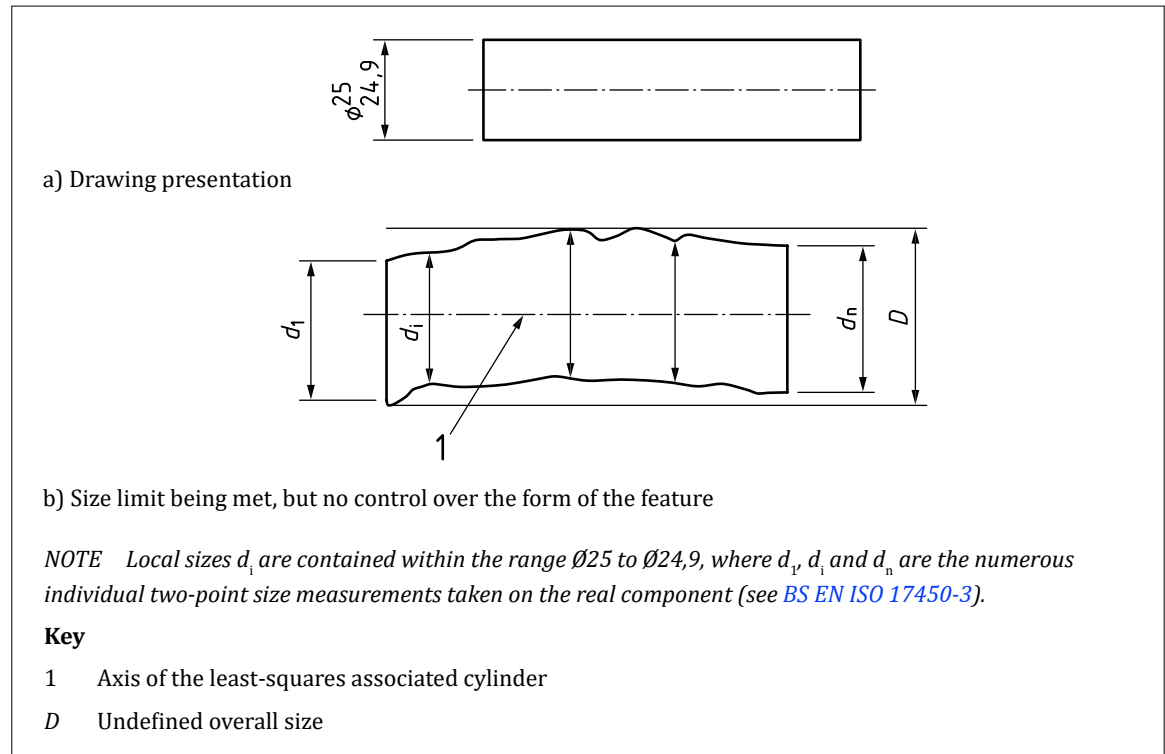
- the size limits on a cylindrical feature do not control its roundness or straightness; and
- the size limits on a feature consisting of two parallel, opposed planes do not control the flatness of the two planes.

Form deviations can be controlled by:

- 1) individually specified geometrical specifications;
- 2) general geometrical specifications;
- 3) the use of the envelope requirement, $\textcircled{E}$ (where the maximum material limit of size defines an envelope of perfect form for the relevant surfaces, see [BS EN ISO 14405-1](#)); or
- 4) the use of another global size characteristic (see [BS EN ISO 14405-1](#)).

NOTE 3 [Figure 10](#) gives examples of how size limits could be interpreted where no form control is defined and the specification is incomplete.

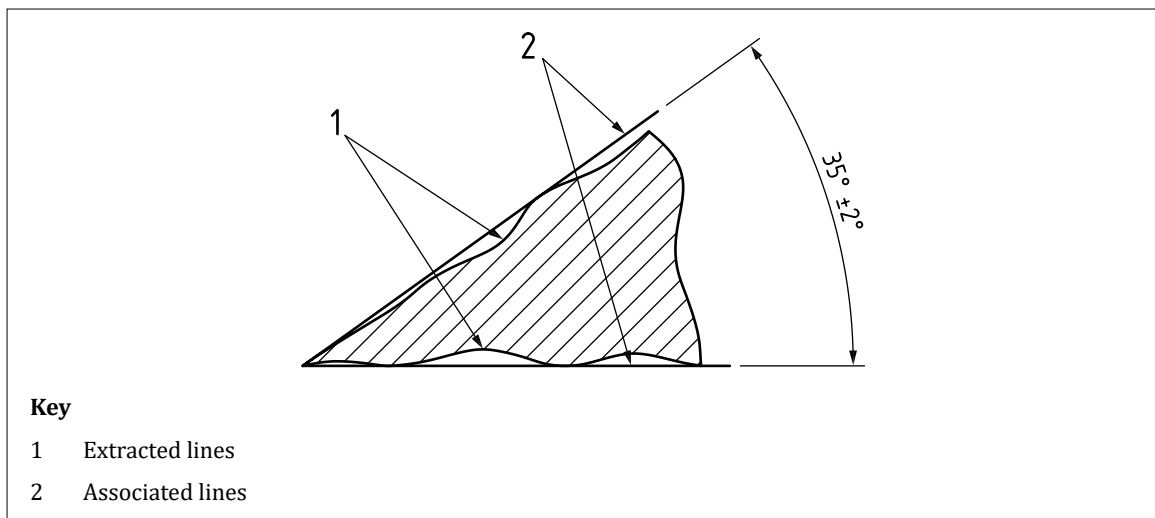
Figure 10 — Interpretations of size limits where no form control is defined and the specification is incomplete



5.2.13.3 Interpretations of limits of size for an angular feature of size

An angular size specification shall be interpreted as a two-line angular size requirement, with minimax association, unless otherwise indicated.

NOTE 1 For angular size, the angle applies to an ideal line or plane fitted (associated) to the manufactured surface. “Minimax” association (also known as a “Chebyshev” association) is a method used for fitting an ideal feature to a manufactured surface (see [Figure 11](#)). The minimax association works by minimizing the maximum deviations between the ideal feature and the manufactured feature. It can be further modified by applying a material constraint such as “outside the material” or “inside the material”, but this makes no difference to the orientation of the ideal feature, and no material constraint is specified when evaluating angular sizes.

Figure 11 — Two-line angular size: Second association with minimax criterion

When a different specification operator is required, it shall be invoked using the appropriate modifier applied to the individual angular size specification, or by defining a different default angular size specification operator for the entire TPS (see [BS EN ISO 14405-3](#)).

If the default size specification operator is to be changed for an entire TPS, the following indication shall appear in or near the title block of each drawing:

ANGULAR SIZE ISO 14405 X

where X is the modifier representing the required operator.

EXAMPLE

If the global angular size with least-squares association is to be made the default interpretation of angular size specifications for the entire TPS, the indication is:

ANGULAR SIZE ISO 14405 (LG)

NOTE 2 A note on the drawing should be used in addition to the ISO 14405-3 reference, for clarity.

5.2.14 Identification and classification of specification requirements

5.2.14.1 General

When an identification or a classification system is used on a TPS, it shall contain a description of indication, criteria for classification and method of identification.

NOTE 1 Identification and classification may be combined or applied separately using methods and systems used or adopted by the company responsible for product specification.

NOTE 2 The use of identification and/or classification for specification is optional.

5.2.14.2 Identification

COMMENTARY ON 5.2.14.2

The use of identification is beneficial to the design, manufacture and verification of a product. Identification provides the framework for specification to be traceable throughout the product life cycle, e.g. links to sources of functional requirements, tolerance sharing and allocation, impact assessment of specification changes. Additionally, identification enables the physical verification of specification to be easily associated to the source requirement, e.g. via a control plan, inspection report or non-conformity.

Where specification is to be uniquely identified, it shall have indication associated to a feature, dimension or tolerance in a TPD, e.g. via a label, tag, flag, note, model-based attribute.

NOTE 1 The format and content of the identification system is not standardized and is specified according to company or industry standards.

NOTE 2 Identification of TPS may conform to [BS EN ISO 7533](#).

5.2.14.3 Classification

COMMENTARY ON 5.2.14.3

The use of TPS classification is beneficial to the design, manufacture and verification of the product. By identifying what is important, over-specifying is avoided. Classification allows product characteristics to be categorized based on a functional analysis of the product, e.g. risk analysis. Classification therefore enables efficient product manufacture and verification while managing product risk appropriately. Classification enables product families, common characteristics, manufacturing processes and tolerance capabilities to be collectively monitored, understood and improved for existing and future products.

Where a classification system is used, product characteristics shall be risk assessed and classified according to the severity and susceptibility of specification non-conformity affecting product safety, compliance with regulations, fit, function, performance or subsequent processing.

NOTE 1 The format and coding for a classification system is not standardized and is specified according to company or industry standards.

NOTE 2 Classification of TPS may conform to [BS EN ISO 24096-1](#).

NOTE 3 A collection of features, dimensions or tolerances may be identified as belonging to a single class or category with a similar level of risk and sharing one or more common characteristics such as geometry, material type, tolerance values, physical characteristics or other properties.

NOTE 4 Classification might have implications for the method of manufacture, verification and control of the product's individual or population characteristic to which the specification applies.

6 Technical product documentation (TPD)

6.1 Formatting of TPD

6.1.1 General

A TPD shall conform to one of the five classifications identified in [BS ISO 16792](#). Data management for TPDs shall conform to [BS EN ISO 11442](#).

6.1.2 Product definition classification code 1 (2D drawing only) – Drawing with optional data set

COMMENTARY ON 6.1.2

The TPD consists of a 2D drawing in hardcopy or digital format.

The drawing(s) shall provide all the necessary views, sections, datums, dimensions, tolerances and general notation to provide suitable and sufficient information to define the workpiece.

NOTE A workpiece can consist of a component, fabrication or assembly.

6.1.3 Product definition classification code 2 (2D drawing with supplementary 3D CAD model) – Data set with design model and drawing containing specifications

The drawing(s) shall provide all the necessary views, sections, datums, dimensions, tolerances and general notation to provide suitable and sufficient information to define the workpiece.

NOTE The 3D CAD model can be used as supplementary information but is not required for complete definition of the workpiece.

6.1.4 Product definition classification code 3 (simplified 2D drawing with 3D CAD model) – Data set with design model or annotated model and simplified drawing

The drawing and CAD model together shall provide all the necessary views, sections, datums, dimensions, tolerances and general notation to provide suitable and sufficient information to define the workpiece.

NOTE 1 Neither drawing nor CAD model is sufficient on its own to fully define the workpiece.

In the absence of any dimension on the drawing, values shall be obtained from an interrogation of the 3D model geometry.

NOTE 2 Annotation may appear in either or both of the 2D or 3D documents.

There shall be no discrepancy between the 2D and the 3D documents, except where required for the simplified representation of machine elements such as screw threads.

6.1.5 Product definition classification code 4 (2D drawing with 3D CAD model) – Data set with annotated model and drawing

The drawing and CAD model shall each provide all the necessary views, details, sections, datums, dimensions, tolerances and general notation to provide suitable and sufficient information to define the workpiece.

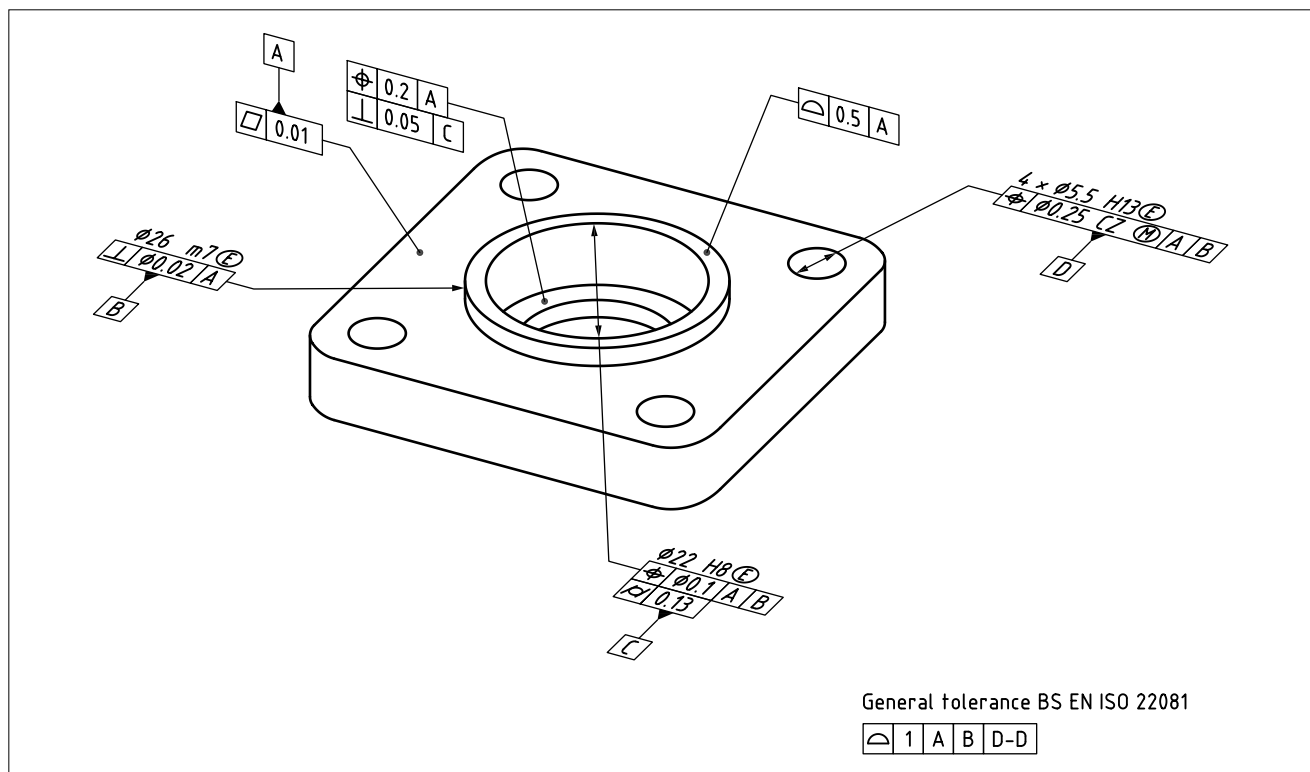
NOTE Either the drawing or the CAD model is sufficient to fully define the workpiece on its own.

6.1.6 Product definition classification code 5 (annotated 3D CAD model) – Data set with annotated model

The data set shall be an annotated model without a supporting drawing.

NOTE 1 An example annotated model is shown in Figure 12.

Figure 12 — Data set with annotated model



NOTE 2 The TPD consists of a 3D CAD model.

The 3D data set shall provide all the necessary details, sections, datums, dimensions, tolerances and general notation to provide suitable and sufficient information to define the workpiece.

NOTE 3 No 2D drawing is used as part of the specification, but ancillary 2D documents may be used to express or share data which are derived from the 3D TPD. The use of this type of TPD is sometimes referred to as Model Based Definition (MBD) or Product and Manufacturing Information (PMI).

6.2 3D CAD data used in a TPD

The ability to query the model shall be available.

All model values and resolved dimensions shall be obtained from the model (although they can be displayed on a drawing).

Dimensions displayed on the model, or obtained through a query of the model, shall be rounded to the number of decimal places specified in the model precision.

Values obtained from the model for any feature(s), which are not one of the following items, shall be auxiliary dimensions:

- a) values not covered by any tolerance;
- b) values which specify the location of a datum target; and
- c) values which specify the location and extent of a restricted portion of a feature.

When a 3D model is used as the whole/part of the definition its dimensional condition shall be stated with the maximum material, least material, nominal size or mid-limit. Where the model has a combination of these this shall be clearly defined.

NOTE 1 A standardized approach for modelling/dimensioning holes and shafts should also be in place.

NOTE 2 Additional requirements can be found in [BS ISO 16792](#).

6.3 Document types used in a TPD

COMMENTARY ON 6.3

Various types of documents are used to provide technical information to define the features and requirements for a component or assembly (see [Clause 5](#)). A parts list can also be included on the drawing. See [BS ISO 29845](#) for further document types.

An assembly drawing (see [Figure 13](#)) represents the relative position and/or shape of a group of assembled parts. It depicts the constituents of a parts list.

The list of parts is normally provided in a separate document, i.e. a parts list, but can be included within the drawing, with the individual parts annotated with ballooned numbers matching the item numbers in the parts list.

Relevant information can also be added, torque settings can either be shown adjacent to the item balloon or in a torque table, and other information, e.g. lubricating grease, thread adhesive, can be shown alongside corresponding flag notes. Overall and key dimensions can also be included, along with mass and centre of gravity.

A part drawing includes all the necessary information required for the definition of the part, e.g. material properties, dimensions, tolerances, surface texture (see [Figure 14](#)).

A fabrication drawing depicts a workpiece which is permanently joined together by means of welding, brazing, adhesion or other method. The constituents can be fully specified (see [Figure 15](#)).

The drawing types used in a TPD shall be in accordance with [BS EN ISO 5457](#).

Figure 13 — Example of assembly drawing

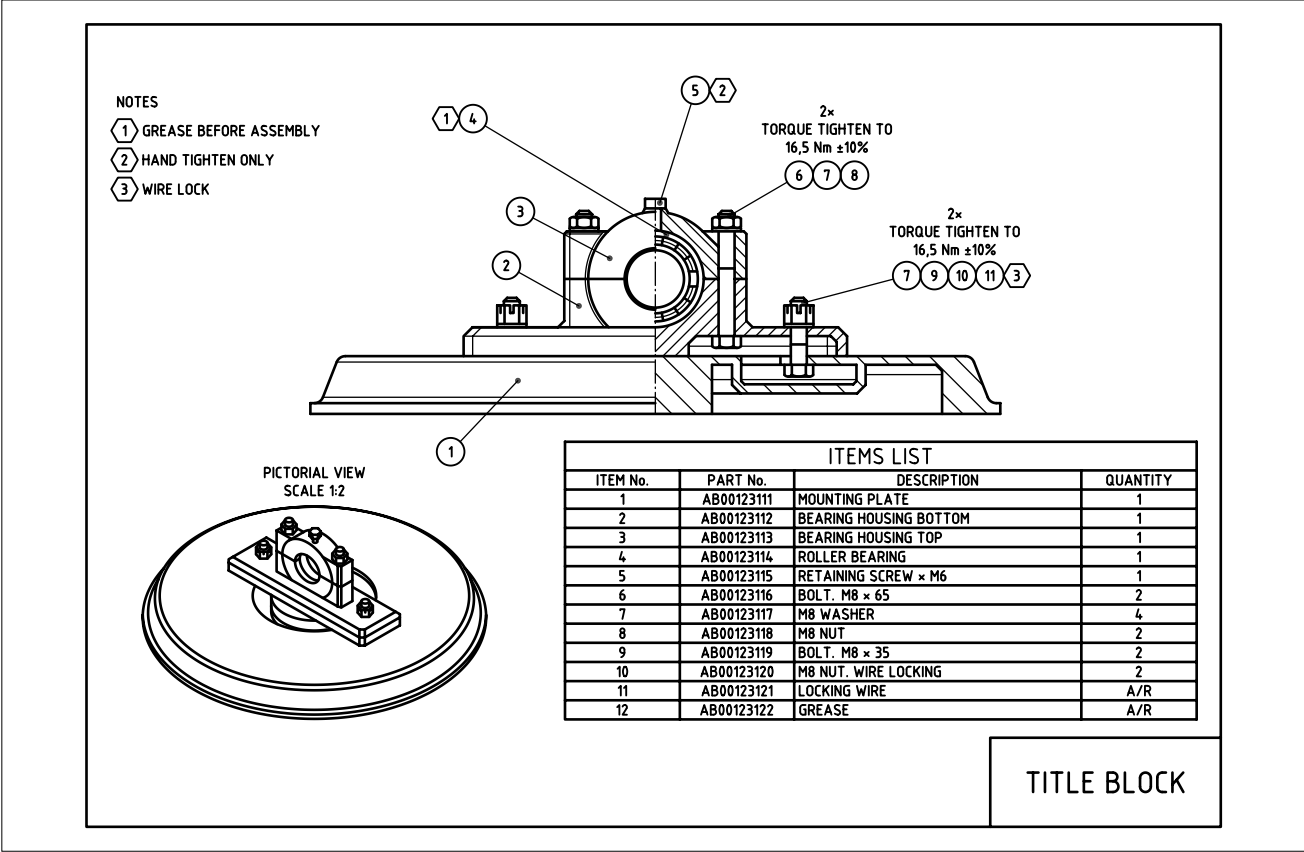


Figure 14 — Example of part drawing

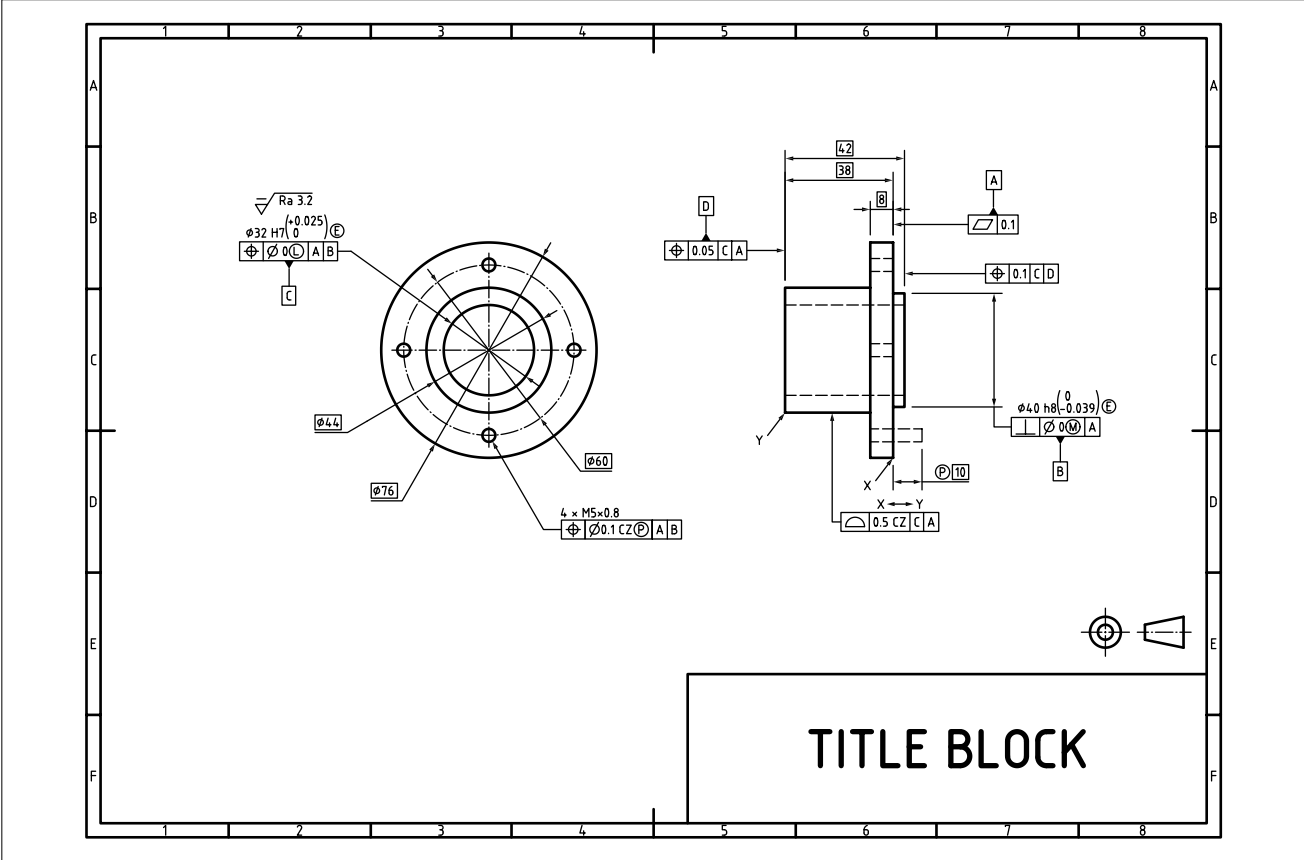
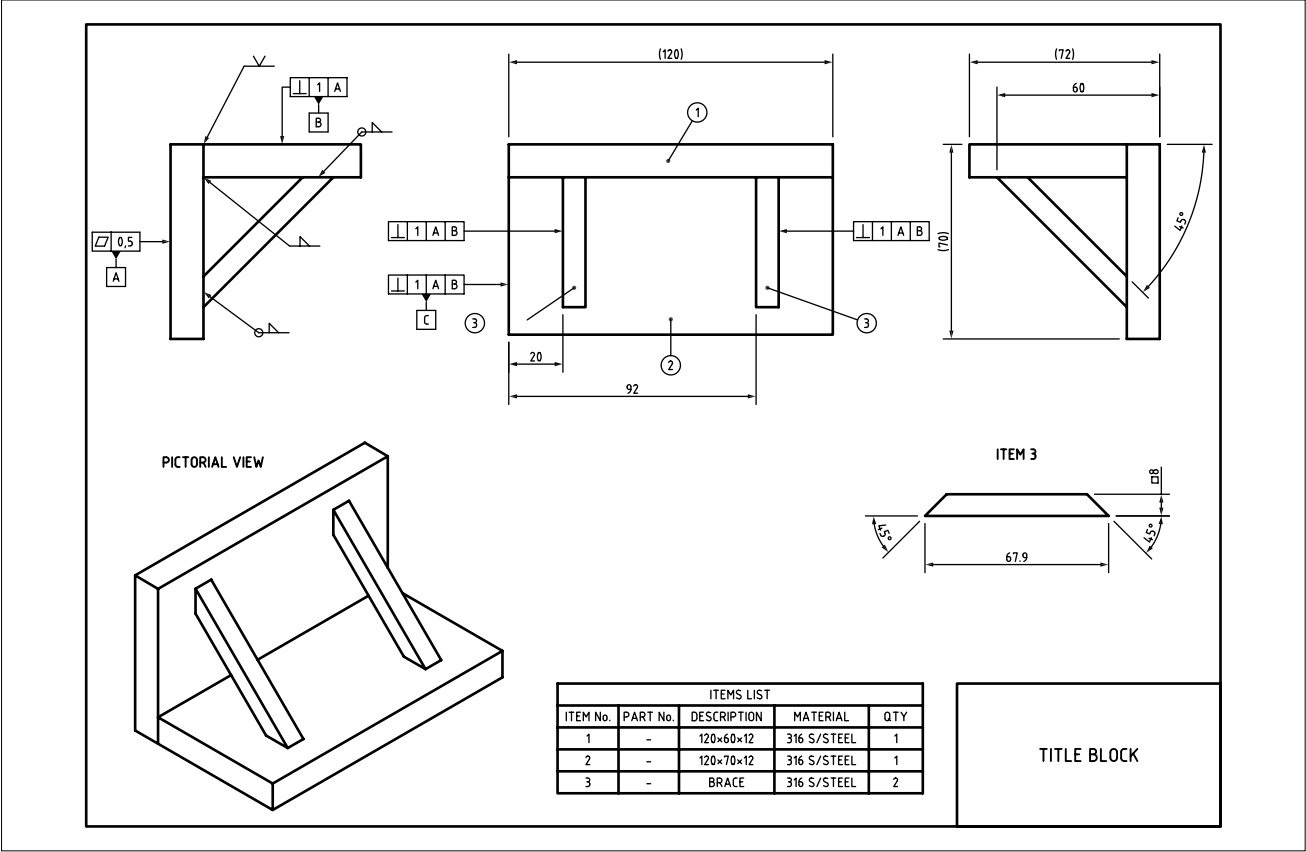


Figure 15 — Example of fabrication drawing with title block



6.4 Graphical representation and annotation of 3D data (3D modelling output)

Graphical representation and annotation of 3D models shall conform to the following standard:

BS ISO 16792, Technical product documentation – Digital product definition data practices.

NOTE See Clause 5.

6.5 Drawing sheets

COMMENTARY ON 6.5

The complete drawing sheet comprises the drawing space, title block, border and frame.

6.5.1 General

The drawing sheet shall conform to BS EN ISO 5457 and BS EN ISO 7200.

6.5.2 Sizes

In accordance with BS EN ISO 5457, the original drawing shall be made on the smallest sheet permitting the necessary clarity and resolution.

NOTE 1 The preferred sizes of the trimmed and untrimmed sheets, as well as the drawing space, are given in Table 4.

NOTE 2 The range of sheet sizes chosen could be rationalized through the use of scales (see 6.7).