

MATERIAL AND EQUIPMENT STANDARD
FOR
METRIC TYPE FASTENERS
(SCREWS, BOLTS, STUDS, NUTS AND WASHERS)

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1. SCOPE

This Standard gives the minimum requirements of metric fasteners (screw threads, screws, bolts, nuts and washers) which are used in oil industries and their dimensions are in SI.

2. REFERENCES

Throughout this Standard, the following standards and codes are referred to. The editions of these standards that are in effect at the time of publication of this Standard shall, to be extent specified herein, form a part of this Standard, the applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Vendor.

ISO	(INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)
ISO 68, 1973	"ISO General Purpose Screw Threads-Basic Profile"
ISO 225, 1983	"Fasteners-Bolts, Screws, Studs and Nuts Symbols and Designations of Dimensions"
ISO 261, 1973	"ISO General Purpose Metric Screw Threads-General Plan"
ISO 262, 1973	"ISO General Purpose Metric Screw Threads-Selected Sizes for Screws, Bolts and Nuts"
ISO 288, 1988 Parts 1, 2	"ISO System of Limits and Fits"
ISO 724, 1978	"ISO Metric Screw Threads-Basic Dimensions"
ISO 895, Parts 1, 2, 5 and 6	"Mechanical Properties of Fasteners"
ISO 965 Parts 1, 2 and 3	"ISO General Purpose Metric Screw Threads- Tolerances"
ISO 1207, 1983	"Slotted Cheese Head Screws-Product Grade A"
ISO 1456, 1988	"Metallic Coatings-Electrodeposited Coatings of Nickel Plus Chromium and of Copper Plus Nickel Plus Chromium"
ISO 1458, 1988	"Metallic Coatings-Electrodeposited Coatings of Nickel"
ISO 1478, 1983	"Tapping Screws Threads"
ISO 1479, 1983	"Hexagon Head Tapping Screws"
ISO 1481, 1983	"Slotted Pan Head Tapping Screws"
ISO 1482, 1983	"Slotted Countersunk (Flat) Head Tapping Screws (Common Head Style)"
ISO 1483, 1983	"Slotted Raised Countersunk (Oval) Head Tapping Screws (Common Head Style)"
ISO/R 1501, 1970	"ISO Miniature Screw Threads"
ISO 1502, 1978	"ISO General Purpose Metric Screw Threads-Gauging"
ISO 1580, 1983	"Slotted Pan Head Screws-Product Grade A"

ISO 1891, 1979	"Bolts, Screws, Nuts and Accessories-Terminology and Nomenclature"
ISO 2009, 1983	"Slotted Countersunk Head Screws (Common Head Style)-Product Grade A"
ISO 2010, 1983	"Slotted Raised Countersunk Head Screws (Common Head Style) Product Grade A"
ISO 2081, 1986	"Metallic Coatings-Electroplated Coatings of Zinc on Iron or Steel"
ISO 2702, 1974	"Head Treated Steel Tapping Screws-Mechanical Properties"
ISO 2901, 1977	"ISO Metric Trapezoidal Screw Threads-Basic Profile and Maximum Material Profiles"
ISO 2902, 1977	"ISO Metric Trapezoidal Screw Thread-General Plan"
ISO 2903, 1977	"ISO Metric Trapezoidal Screw Threads Tolerances"
ISO 2904, 1977	"ISO Metric Trapezoidal Screw Threads-Basic Dimensions"
ISO 3269, 1988	"Fasteners-Acceptance Inspection"
ISO 3506, 1979	"Corrosion-Resistant Stainless Steel Fasteners-Specifications"
ISO 4014, 1988	"Hexagon Head Bolts-Product Grade A and B"
ISO 4015, 1979	"Hexagon Head Bolts-Product Grade B-Reduced Shank (Shank Diameter=Pitch Diameter)"
ISO 4016, 1988	"Hexagon Head Bolts-Product Grade C"
ISO 4017, 1988	"Hexagon Head Screws-Product Grade A and B"
ISO 4018, 1988	"Hexagon Head Screws- Product Grade C"
ISO 4026, 1977	"Hexagon Socket Set Screws With Flat Point"
ISO 4027, 1977	"Hexagon Socket Set Screws With Cone Point"
ISO 4028, 1977	"Hexagon Socket Set Screws with Dog Point"
ISO 4029, 1977	"Hexagon Socket Set Screws With Cup Point"
ISO 4032, 1986	"Hexagon Nuts, Style 1-Product Grades A and B"
ISO 4033, 1979	"Hexagon Nuts, Style 2-Product Grades A and B"
ISO 4034, 1986	"Hexagon Nuts-Product Grade C"
ISO 4035, 1986	"Hexagon Thin Nuts (Chamfered) - Product Grades A and B"
ISO 4036, 1979	"Hexagon Thin Nuts - Product Grade B (Unchamfered)"
ISO 4042, 1989	"Threaded Components-Electroplated Coatings"
ISO 4161, 1983	"Hexagon Nuts With Flange-Product Grade A"
ISO 4166, 1979	"Hexagon Nuts for Fine Mechanics Product Grade F"
ISO 4759/1, 1978	"Tolerances for Fasteners-Part 1-Bolts, Screws and Nuts With Thread Diameters Between 1.6 mm (Inclusive) and 150 mm (Inclusive) and Product Grade A, B and C"

ISO 4759/2, 1979	"Tolerances for Fasteners - Part 2 Bolts, Screws and Nuts with Thread Diameter From 1 up to 3 mm (Inclusive) and Product Grade F for Fine Mechanics"
ISO 4762, 1977	"Hexagon Socket Head Cap Screws-Product Grade A"
ISO 4766, 1983	"Slotted Set Screws With Flat Point"
ISO 5408, 1983	"Cylindrical Screw Threads-Vocabulary"
ISO 6157-1, 1988	"Fasteners-Surface Discontinuities- Part 1: Bolts, Screws and Studs for General Requirements"
ISO 6157-3, 1988	"Fasteners-Surface Discontinuities- Part 3: Bolts, Screws and Studs for Special Requirements"
ISO 7040, 1983	"Prevailing Torque Type Hexagon Nuts (With Non-Metallic Insert) Style 1 - Property Classes 5,8 and 10"
ISO 7041, 1983	"Prevailing Torque Type Hexagon Nuts (With Non-Metallic Insert), Style 2- Property Classes 9 and 12"
ISO 7042, 1983	"Prevailing Torque Type All-Metal Hexagon Nuts, Style 2 - Property Classes 5,8,10 and 12"
ISO 7043, 1983	"Prevailing Torque Type Hexagon Nuts (With Non-Metallic Insert)"
ISO 7044, 1983	"Prevailing Torque Type All-Metal Hexagon Nuts With Flange"
ISO 7045, 1983	"Cross Recessed Pan Head Screws-Product Grade A"
ISO 7046, 1983	"Cross Recessed Countersunk Flat Head Screws (Common Head Style) Product Grade A and Property Class 4.8 Only"
ISO 7049, 1983	"Cross Recessed Pan Head Tapping Screws"
ISO 7050, 1983	"Cross Recessed Countersunk (Flat) Head Tapping Screws (Common Head Style)"
ISO 7089, 1983	"Plain Washers - Normal Series - Product Grade A"
ISO 7090, 1983	"Plain Washers, Chamfered - Normal Series-Product Grade A"
ISO 7091, 1983	"Plain Washers-Normal Series Product Grade C"
ISO 7092, 1983	"Plain Washers-Small Series Product Grade A"
ISO 7378, 1983	"Fasteners-Bolts, Screws and Studs-Split Pin Holes and Wire Holes"
ISO 7379, 1983	"Hexagon Socket Head Shoulder Screws"
ISO 7380, 1983	"Hexagon Socket Button Head Screws-Metric Series"
ISO 7411, 1984	"Hexagon Bolts for High-Strength Structural Bolting With Large Width Across Flats (Thread Lengths According to ISO 888)-Product Grade C Property Classes 8.8 and 10.9"
ISO 7412, 1984	"Hexagon Bolts for High-Strength Structural Bolting With Large Width Across Flats (Short Thread Length) - Product Grade C-Property Class 8.8 and 10.9"

ISO 7413, 1984	"Hexagon Nuts for Structural Boltings, Style 1 Hot-Dip Galvanized (Over Size Tapped) - Product Grades A and B- Property Classes 5, 6 and 8"
ISO 7414, 1984	"Hexagon Nuts for Structural Bolting With Large Width Across Flats, Style 1- Product Grade B- Property Class 10"
ISO 7417, 1984	"Hexagon Nuts for Structural Bolting-Style 2, Hot-Dip Galvanized (Oversize Tapped)-Product Grade A- Property Class 9"
ISO 7434, 1983	"Slotted Set Screws With Cone Point"
ISO 7435, 1983	"Slotted Set Screws With Long Dog Point"
ISO 7436, 1983	"Slotted Set screws With Cup Point"
ISO 7719, 1983	"Prevailing Torque Type All-Metal Hexagon Nuts, Style 1- Property Class 5, 8 and 10"
ISO 8673, 1988	"Hexagon Nuts, Style 1, With Metric Fine Pitch Thread- Product Grades A and B"
ISO 8674, 1988	"Hexagon Nuts - Style 2, With Metric Fine Pitch Thread- Product Grades A and B"
ISO 8475, 1988	"Hexagon Thin Nuts With Metric Fine Pitch Thread- Product Grades A and B"
ISO 8676, 1988	"Hexagon Head Screws With Metric Fine Pitch Thread- Product Grades A and B"
ISO 8677, 1986	"Cup Head Square Neck Bolts With Large Head- Product Grade C"

DIN (DEUTSCHES INSTITUTE FUR NORMUNG)

DIN 93 1974	"Tab Washers With Long Tab"
DIN 128 1987	"Curved and Wave Spring Lock Washers"
DIN 137 1987	"Curved and Wave Spring Washers"
DIN 267-2 1973	"Round Screw Thread with Clearance and Steep Flank with Pitch 7 mm, Limiting Dimensions of Screw Threads and Allowances Permissible Deviations and Permissible Wear of Screw Thread Gage"
DIN 267-10 1988	"Fasteners; Technical Delivery Conditions, Hot Dip Galvanized Parts"
DIN 432 1983	"External Tab Washers (Locking Tab Washers)"
DIN 463	"Tab Washers With Long and Short Tab at Right Angles"
DIN 478 1985	"Square Head Bolts With Collar"
DIN 479 1985	"Square Head Bolts With Short Dog Point"
DIN 480 1985	"Square Head Bolts With Collar and Oval Half Dog Point"
DIN 546 1986	"Slotted Round Nuts"
DIN 548 1986	"Round Nuts With Set Pin Holes in Side"

DIN 557 1985	"Square Nuts; Product Grade C"
DIN 561 1985	"Hexagon Head Set Screws With Small Hexagon and Full Dog Point"
DIN 562 1987	"Square Thin Nuts; Product Grade B"
DIN 564 1985	"Hexagon Head Set Screws With Small Hexagon and Coned Half Dog Point"
DIN 609 1984	"Hexagon Fit Bolts With Long Threaded Dog Point"
DIN 610 1984	"Hexagon Fit Bolts With Short Threaded Dog Point"
DIN 928 1983	"Square Weld Nuts"
DIN 929 1987	"Hexagon Weld Nuts"
DIN 935 1987	"Hexagon Slotted Nuts and Castle Nuts With Part 1 Metric Coarse and Fine Pitch Thread; Product Grades A and B"
DIN 935 1987	"Hexagon Slotted Nuts With Metric Coarse Part 3 Pitch Thread; Product Grade C"
DIN 6796 1987	"Conical Spring Washers for Bolted Connections"
DIN 6797 1971	"Toothed Lock Washers"
DIN 6798 1971	"Serrated Lock Washers"
DIN 6904 1972	"Curved Spring Washers for Screw Assemblies"
DIN 6905 1972	"Spring Washers for Screw Assemblies"
DIN 6906 1972	"Lock Washers for Screw Assemblies"
DIN 6912 1985	"Hexagon Socket Thin Head Cap Screws with Pilot Recess for Wrench"
DIN 6913 1987	"Spring Lock Washers With Safety Ring"
DIN 6914 1979	"Hexagon Bolts With Large Width Across"
DIN 6916 1979	"Washers for High-Tensile Bolting in Steel Structures"
DIN 6917 1979	"Washers, Square, for High-Tensile Bolting of I Sections in Steel"
DIN 7984 1985	"Hexagon Socket Thin Head Cap Screws"

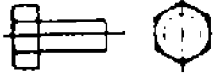
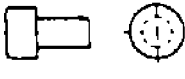
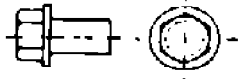
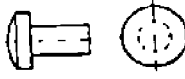

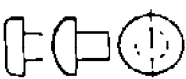
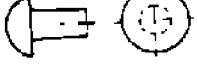
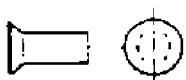
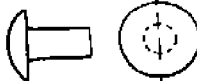

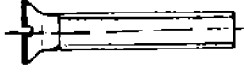

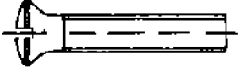
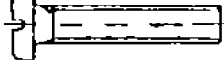
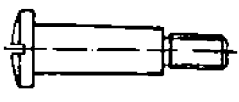

3. DEFINITIONS AND TERMINOLOGY

Terms and definitions given below apply to this Standard.

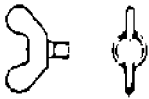
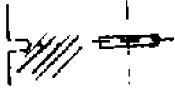

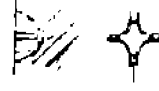
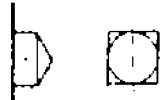
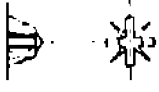
3.1 Terms and definitions cited in ISO 5408 and ISO 1891.

3.2 Terms and Nomenclatures as Hereunder

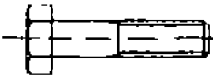
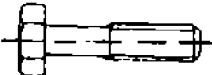
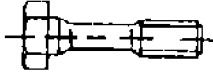
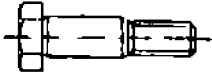

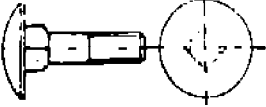
3.2.1 Shape of heads

 <p>HEXAGON HEAD</p>	 <p>CHEESE HEAD</p>
 <p>HEXAGON HEAD WITH COLLAR</p>	 <p>RAISED CHEESE HEAD</p>
 <p>HEXAGON HEAD WITH FLANGE</p>	 <p>PAN HEAD</p>
 <p>ROUND HEAD</p>	 <p>COUNTERSUNK HEAD</p>
 <p>MUSHROOM HEAD</p>	 <p>UNDERCUT COUNTERSUNK HEAD</p>
 <p>SLOTTED COUNTERSUNK (FLAT) HEAD SCREW</p>	 <p>SLOTTED CHEESE HEAD SCREW</p>
 <p>SLOTTED RAISED COUNTERSUNK (OVAL) HEAD SCREW</p>	 <p>SLOTTED PAN HEAD SCREW</p>
 <p>SLOTTED RAISED CHEESE HEAD FIT SCREW (SHOULDER SCREW)</p>	 <p>SLOTTED ROUND HEAD SCREW</p>











3.2.2 Driving features

 <p>WING</p>	 <p>SLOT</p>
 <p>HEXAGON SOCKET</p>	 <p>CROSS RECESS (PHILLIPS)</p>
 <p>SQUARE SOCKET</p>	 <p>CROSS RECESS</p>







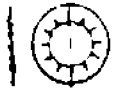

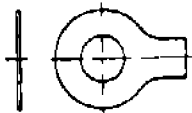

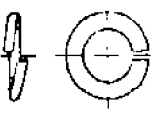
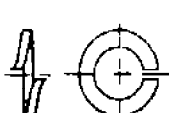
3.2.3 Form of shank

 <p>NORMAL SHANK (NOMINAL SHANK DIAMETER = NOMINAL THREAD DIAMETER)</p>	 <p>REDUCED SHANK (SHANK DIAMETER \approx EFFECTIVE PITCH DIAMETER)</p>
 <p>WAISTED SHANK (SHANK DIAMETER < MINOR DIAMETER)</p>	 <p>INCREASED SHANK (SHANK DIAMETER > THREAD DIAMETER)</p>
 <p>SHOULDER</p>	 <p>SQUARE NECK</p>

3.2.4 Nomenclature of nuts

 <p>KNURLED NUT</p>	 <p>ROUND NUT WITH DRILLED HOLES IN ONE FACE</p>
 <p>SLOTTED ROUND NUT</p>	 <p>PREVAILING TORQUE TYPE ALL METAL HEXAGON NUT</p>
 <p>ROUND NUT WITH SET PIN HOLES</p>	 <p>PREVAILING TORQUE TYPE HEXAGON NUT WITH NYLON INSERT</p>
 <p>HEXAGON SLOTTED NUT</p>	 <p>ACORN NUT (DOMED CAP NUT)</p>
 <p>HEXAGON CASTLE NUT</p>	 <p>CAP NUT</p>

3.2.5 Nomenclature of washers

 <p>PLAIN WASHERS</p>	 <p>SERRATED LOCK WASHER EXTERNAL TEETH</p>
 <p>LOCK WASHER INTERNAL TEETH</p>	 <p>COUNTERSUNK EXTERNAL TOOTHED LOCK WASHER</p>
 <p>LOCK WASHER EXTERNAL TEETH</p>	 <p>EXTERNAL TAB WASHER</p>
 <p>SERRATED LOCK WASHER INTERNAL TEETH</p>	 <p>INTERNAL TAB WASHER</p>
 <p>TAB WASHER WITH LONG TAB</p>	 <p>TAB WASHER WITH LONG TAB AND WING</p>
 <p>SINGLE COIL SPRING LOCK WASHER WITH SQUARE ENDS</p>	 <p>SINGLE COIL SPRING LOCK WASHER WITH TANG ENDS</p>

4. UNITS

This Standard is based on International System of Units (SI), except where otherwise specified.

5. SPECIFIC REQUIREMENTS

5.1 General Requirements

5.1.1 Products shall have intact surfaces and edges and shall be free of any burr which influences the performance of the product or would be a safety hazard when handled.

Unless otherwise specified limits for surface discontinuities of bolts, screws and studs shall conform with ISO 6157-1.

Trimming burrs beyond the bearing face of bolts , screws, nut, studs and washers is not permissible.

Center holes for bolts and screws are permissible, unless otherwise specified.

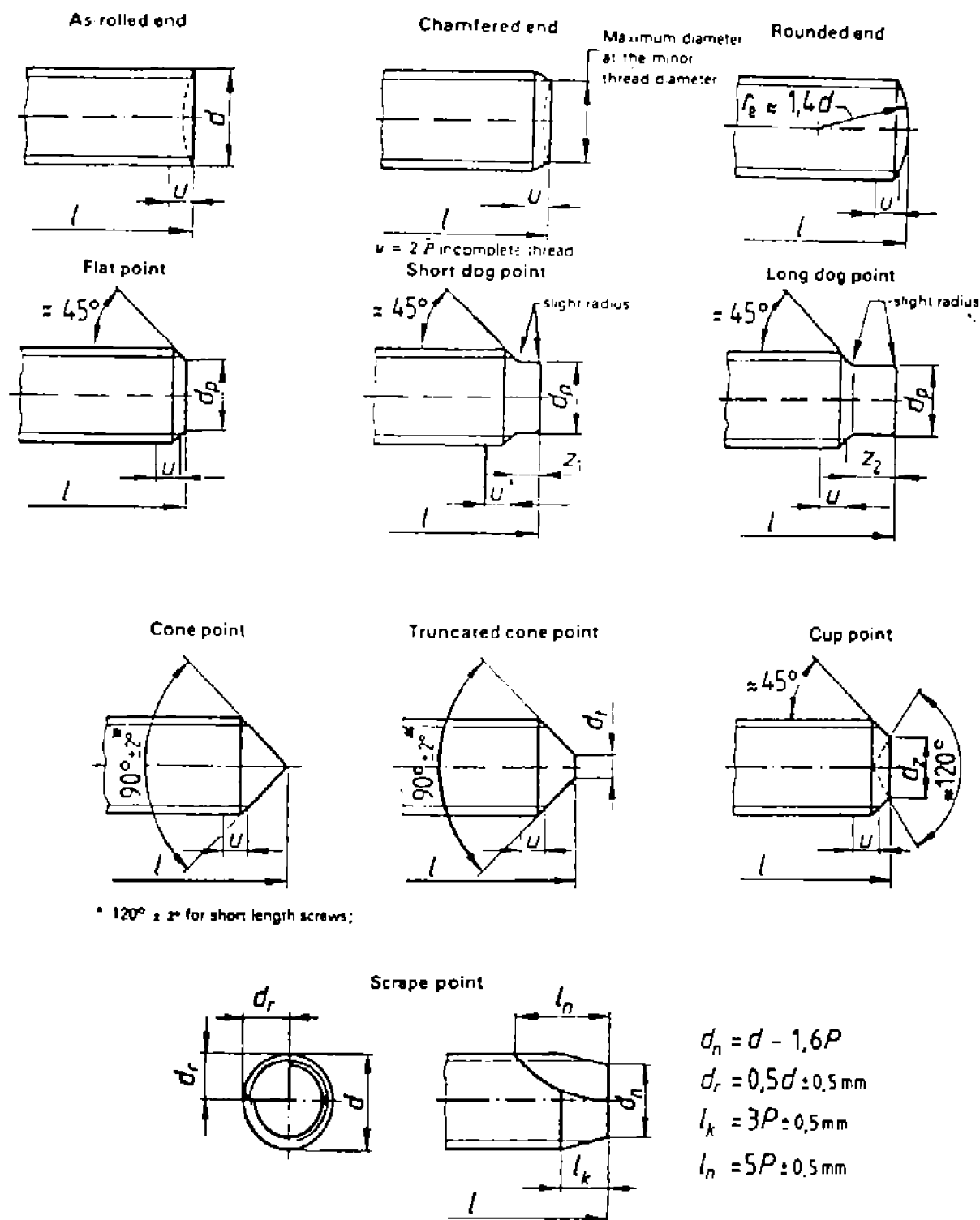
The finish (surface) of the products shall be;

- As processed for steel products not quenched and tempered;
- In general, black oxide for quenched and tempered steel products;
- Plain for products made of stainless steel or nonferrous metal.

Bolts, screws, studs and nuts shall be delivered in a clean condition and lightly oiled.

5.1.2 General dimensions of ends of metric threads for external threaded products are given in Table 1.

Fig. 1 gives an illustration of different forms and symbols of different parts of these forms.



* $120^\circ \pm 2^\circ$ for short length screws;

ENDS OF PARTS WITH EXTERNAL METRIC THREADS
Fig. 1

Note:

1) The 45° angle applies only to the portion of the point below the root diameter of the thread.

**TABLE 1 - GENERAL DIMENSIONS OF ENDS OF METRIC THREADS
FOR EXTERNAL THREADED PRODUCTS**

THREAD DIAMETER d	dp h 14	d_t¹⁾ h 16	d_z h 14	z₁ + IT 14 0	z₂ + IT 14 0
1	0.5	0.1	-	-	-
1.2	0.6	0.12	-	-	-
1.4	0.7	0.14	0.7	0.35	0.7
1.6	0.8	0.16	0.8	0.4	0.8
1.8	0.9	0.18	0.9	0.45	0.9
2	1	0.2	1	0.5	1
2.2	1.2	0.22	1.1	0.55	1.1
2.5	1.5	0.25	1.2	0.63	1.25
3	2	0.3	1.4	0.75	1.5
3.5	2.2	0.35	1.7	0.88	1.75
4	2.5	0.4	2	1	2
4.5	3	0.45	2.2	1.12	2.25
5	3.5	0.5	2.5	1.25	2.5
6	4	1.5	3	1.5	3
7	5	2	4	1.75	3.5
8	5.5	2	5	2	4
10	7	2.5	6	2.5	5
12	8.5	3	7	3	6
14	10	4	8.5	3.5	7
16	12	4	10	4	8
18	13	5	11	4.5	9
20	15	5	13	5	10
22	17	6	15	5.5	11
24	18	6	16	6	12
27	21	8	-	6.7	13.5
30	23	8	-	7.5	15
33	26	10	-	8.2	16.5
36	28	10	-	9	18
39	30	12	-	9.7	19.5
42	32	12	-	10.5	21
45	35	14	-	11.2	22.5
48	38	14	-	12	24
52	42	16	-	13	26

¹⁾ ≤ M5 no flat part on the cone required; the point may be slightly rounded.

Notes:

1) For tolerance values see ISO 4759.

2) For indicated notations see Fig 1.

5.1.3 Dimensions of split pin holes and wire holes of external threaded products "if any" shall conform with ISO 7378.

5.2 Metallurgical and Mechanical Requirements

5.2.1 Metallurgical and mechanical properties and chemical composition limits of fasteners made of carbon steel and alloy steel "according to their property class" if not otherwise specified in data-sheet and or pertinent workpiece requirement, shall comply with ISO 898.

5.2.2 Composition range of corrosion resistant stainless steel fasteners for different grades of austenitic, martensitic and ferritic groups shall comply with Table 2 of ISO 3506.

5.2.8 Compliance of properties shall be verified by the procedures denoted in the above mentioned standards.

D	=	basic major diameter of internal thread (nominal diameter)
d	=	basic major diameter of external thread (nominal diameter)
D₂	=	basic pitch diameter of internal thread
d₂	=	basic pitch diameter of external thread
D₁	=	basic minor diameter of internal thread
d₁	=	basic minor diameter of external thread
H	=	height of fundamental triangle
p	=	pitch

The values of D₂, d₂, D₁ and d₁ have been calculated from the following formulas and rounded, in the next coming tables, to the third decimal place:

$$D_2 = D - 2 \times \frac{3}{8} H = D - 0.6495 P$$

$$d_2 = d - 2 \times \frac{3}{8} H = d - 0.6495 P$$

$$D_1 = D - 2 \times \frac{5}{8} H = D - 1.0822 P$$

$$d_1 = d - 2 \times \frac{5}{8} H = d - 1.0825 P$$

5.3.1.2 Dimensions

Dimensions of different parts shall conform with Table 2, additionally the height of the fundamental triangle of thread shall comply with the below equation:

$$H = \sqrt{3} / 2P = 0.866 025P$$

TABLE 2 - DIMENSIONS OF GENERAL PURPOSE METRIC SCREW THREADS

NOMINAL DIAMETER = MAJOR DIAMETER D, d	PITCH p	PITCH DIAMETER D₂, d₂	MINOR DIAMETER D₁, d₁	APPLICATION CLASS
1.4	0.3	1.205	1.075	Coarse
	0.2	1.270	1.183	Fine
1.6	0.35	1.373	1.221	Coarse
	0.2	1.470	1.383	Fine
1.8	0.35	1.573	1.421	Coarse
	0.2	1.670	1.583	Fine
2	0.4	1.740	1.567	Coarse
	0.25	1.838	1.729	Fine
2.2	0.45	1.907	1.713	Coarse
	0.25	2.038	1.929	Fine
2.5	0.45	2.207	2.013	Coarse
	0.35	2.273	2.121	Fine
3	0.5	2.675	2.459	Coarse
	0.35	2.773	2.621	Fine
3.5	0.6	3.110	2.850	Coarse
	0.35	3.273	3.121	Fine
4	0.7	3.545	3.242	Coarse
	0.5	3.675	3.459	Fine
4.5	0.75	4.013	3.688	Coarse
	0.5	4.175	3.959	Fine
5	0.8	4.480	4.134	Coarse
	0.5	4.675	4.459	Fine
5.5	0.5	5.175	4.959	Fine
6	1	5.350	4.917	Coarse
	0.75	5.513	5.188	Fine

(to be continued)

TABLE 2 (continued)

NOMINAL DIAMETER = MAJOR DIAMETER D, d	PITCH p	PITCH DIAMETER D₂, d₂	MINOR DIAMETER D₁, d₁	APPLICATION CLASS
7	1	6.350	5.917	Coarse
	0.75	6.513	6.188	Fine
8	1.25	7.188	6.647	Coarse
	1	7.350	6.917	Fine
9	1.25	8.188	7.647	Coarse
	1	8.350	7.917	Fine
10	1.5	9.026	8.376	Coarse
	1.25	9.188	8.647	Fine
12	1.75	10.863	10.106	Coarse
	1.25	11.188	10.647	Fine
14	2	12.701	11.835	Coarse
	1.5	13.026	12.376	Fine
16	2	14.701	13.835	Coarse
	1.5	15.026	14.376	Fine
18	2.5	16.376	15.294	Coarse
	1.5	17.026	16.376	Fine
20	2.5	18.376	17.294	Coarse
	1.5	19.026	18.376	Fine
22	2.5	20.376	19.294	Coarse
	1.5	21.026	20.376	Fine
24	3	22.051	20.752	Coarse
	2	22.701	21.835	Fine
26	1.5	25.026	24.376	Fine
27	3	25.051	23.752	Coarse
	2	25.701	24.835	Fine
30	3.5	27.727	26.211	Coarse
	2	28.701	27.835	Fine
33	3.5	30.727	29.211	Coarse
	2	31.701	30.835	Fine
36	4	33.402	31.670	Coarse
	2	34.701	33.835	Fine
39	4	36.402	34.670	Coarse
	2	37.701	36.835	Fine
42	4.5	39.077	37.129	Coarse
45	4.5	42.077	40.129	Coarse
48	5	44.752	42.587	Coarse
52	5	48.752	47.587	Coarse
56	5.5	52.428	50.046	Coarse
60	5.5	56.428	54.046	Coarse
64	6	60.103	57.505	Coarse
68	6	64.103	61.505	Coarse

Note:

Dimensions other than those mentioned in Table 2 "if required" will be selected from ISO 724.

5.3.1.3 Tolerances

5.3.1.3.1 Tolerance grades

For each of the two main elements, pitch diameter and crest diameter, a number of tolerance grades have been established. Related values for each grades are given in Tables 3, 4 , 5 and 6. In most cases the tolerance grade and tolerance position for two main element are the same which in such cases only one of them will be mentioned.

As a general grade 6 shall be used for tolerance quality medium and normal length of thread engagement. The grades below 6 are intended for tolerance quality fine and/or short length of engagement. The grades above 6 are intended for tolerance quality of coarse thread and/or long length of thread engagement. Length of thread engagements are given in Table 8.

5.3.1.3.2 Tolerance positions for required workpieces shall be as below:

- For nuts shall be either G with positive fundamental deviation or H with zero fundamental deviation. (see Table 7); Valves shall be in accordance with ISO 965/1.
- for bolts shall be either e, f or g with negative fundamental deviation or h with zero fundamental deviation (see Table 7). Valves shall be in accordance with ISO 965/1.

Note:

Deviations for constructional threads in respect to different tolerance grades shall be in accordance with ISO 965/3 and more over for nut threads as well as bolt threads, the actual root contours shall not in any point transgress the basic profile.

**TABLE 3 - MINOR DIAMETER TOLERANCES OF NUT THREAD (T_{D1})
(CREST TOLERANCE OF NUT)**

PITCH P	TOLERANCE GRADES	
	5	6
mm	μm	μm
0.25	56	—
0.35	80	100
0.4	90	112
0.45	100	125
0.5	112	140
0.6	125	160
0.7	140	180
0.75	150	190
0.8	160	200
1	190	236
1.25	212	265
1.5	236	300
1.75	265	335
2	300	375
2.5	355	450
3	400	500
3.5	450	560
4	475	600
4.5	530	670
5	560	710
5.5	600	750
6	630	800

**TABLE 4 - MAJOR DIAMETER TOLERANCE OF BOLT THREAD (T_d)
(CREST TOLERANCE OF BOLT)**

PITCH P	TOLERANCE GRADE (6)
mm	μm
0.25	67
0.35	85
0.4	95
0.45	100
0.5	106
0.6	125
0.7	140
0.75	140
0.8	150
1	180
1.25	212
1.5	236
1.75	265
2	280
2.5	335
3	375
3.5	425
4	475
4.5	500
5	530
5.5	560
6	600

TABLE 5 - PITCH DIAMETER TOLERANCE OF NUT THREAD (T_{D2})

BASIC MAJOR DIAMETER d		PITCH P	TOLERANCE GRADE (5)
Over	Up to and incl.		
mm	mm	mm	μm
1.4	2.8	0.2	—
		0.25	60
		0.35	67
		0.4	71
		0.45	75
2.8	5.6	0.35	71
		0.5	80
		0.6	90
		0.7	95
		0.75	95
		0.8	100
		0.75	106
5.6	11.2	1	118
		1.25	125
		1.5	140
11.2	22.4	1	125
		1.25	140
		1.5	150
		1.75	160
		2	170
		2.5	180
		1	132
22.4	45	1.5	160
		2	180
		3	212
		3.5	224
		4	236
		4.5	250
45	90	1.5	170
		2	190
		3	224
		4	250
		5	265
		5.5	280
		6	300

TABLE 6 - PITCH DIAMETER TOLERANCE OF BOLT THREAD (T_{d2})

BASIC MAJOR DIAMETER d		PITCH P	TOLERANCE GRADE (6)
Over	Up to and incl.		
mm	mm	mm	μm
1.4	2.8	0.2	50
		0.25	56
		0.35	63
		0.4	67
		0.45	71
2.8	5.6	0.35	67
		0.5	75
		0.6	85
		0.7	90
		0.75	90
		0.8	95
		0.75	100
5.6	11.2	1	112
		1.25	118
		1.5	132
		1	118
11.2	22.4	1.25	132
		1.5	140
		1.75	150
		2	160
		2.5	170
		1	125
		1.5	150
22.4	45	2	170
		3	200
		3.5	212
		4	224
		4.5	236
		1.5	160
		2	180
45	90	3	212
		4	236
		5	250
		5.5	265
		6	280

TABLE 7 - FUNDAMENTAL DEVIATIONS FOR NUT THREADS AND BOLT THREADS

PITCH P	FUNDAMENTAL DEVIATION			
	NUT THREAD D ₂ , D ₁	BOLT THREAD d, d ₂		
	G EI	e es	f es	g es
mm	μm	μm	μm	μm
0.2	+17			-17
0.25	+18			-18
0.3	+18			-18
0.35	+19		-34	-19
0.4	+19		-34	-19
0.45	+20		-35	-20
0.5	+20	-50	-36	-20
0.6	+21	-53	-36	-21
0.7	+22	-56	-38	-22
0.75	+22	-56	-38	-22
0.8	+24	-60	-38	-24
1	+26	-60	-40	-26
1.25	+28	-63	-42	-28
1.5	+32	-67	-45	-32
1.75	+34	-71	-48	-34
2	+38	-71	-52	-38
2.5	+42	-80	-58	-42
3	+48	-85	-63	-48
3.5	+53	-90	-70	-53
4	+60	-95	-75	-60
4.5	+63	-100	-80	-63
5	+71	-106	-85	-71
5.5	+75	-112	-90	-75
6	+80	-118	-95	-80

TABLE 8 - LENGTHS OF THREAD ENGAGEMENT

BASIC MAJOR DIAMETER d		PITCH P	LENGTH OF THREAD ENGAGEMENT			
Over	Up to and incl.		S	N		L
			Up to and incl.	Over	Up to and incl.	Over
1.4	2.8	0.2	0.5	0.5	1.5	1.5
		0.25	0.6	0.6	1.9	1.9
		0.35	0.8	0.8	2.6	2.6
		0.4	1	1	3	3
		0.45	1.3	1.3	3.8	3.8
2.8	5.6	0.35	1	1	3	3
		0.5	1.5	1.5	4.5	4.5
		0.6	1.7	1.7	5	5
		0.7	2	2	6	6
		0.75	2.2	2.2	6.7	6.7
5.6	11.2	0.8	2.5	2.5	7.5	7.5
		0.75	2.4	2.4	7.1	7.1
		1	3	3	9	9
		1.25	4	4	12	12
		1.5	5	5	15	15
11.2	22.4	1	3.8	3.8	11	11
		1.25	4.5	4.5	13	13
		1.5	5.6	5.6	16	16
		1.75	6	6	18	18
		2	8	8	24	24
22.4	45	2.5	10	10	30	30
		1	4	4	12	12
		1.5	6.3	6.3	19	19
		2	8.5	8.5	25	25
		3	12	12	36	36
45	90	3.5	15	15	45	45
		4	18	18	53	53
		4.5	21	21	63	63
		1.5	7.5	7.5	22	22
		2	9.5	9.5	28	28
90	180	3	15	15	45	45
		4	19	19	56	56
		5	24	24	71	71
		5.5	28	28	85	85
		6	32	32	95	95
180	355	2	12	12	36	36
		3	18	18	53	53
		4	24	24	71	71
		6	36	36	106	106
		3	20	20	60	60
		4	26	26	80	80
		6	40	40	118	118

Note:

The length of thread engagement is classified into one of three groups. S, N, L, in accordance with table 7.

- S** : for short engagement
- N** : for normal engagement
- L** : for long engagement

TABLE 9 - MINIMUM ROOT RADII OF BOLTS

PITCH P	R min
mm	μm
0.2	25
0.25	31
0.3	38
0.35	44
0.4	50
0.45	56
0.5	63
0.6	75
0.7	88
0.75	94
0.8	100
1	125
1.25	156
1.5	188
1.75	219
2	250
2.5	313
3	375
3.5	438
4	500
4.5	563
5	625
5.5	688
6	750

5.3.1.4 Compliance

The supplier/manufacturer shall not deliver any workpiece that the actual thread size (for example the pitch diameter) of which lies outside the specified limits. Compliance with specified limits shall be verified according to ISO 1502.

5.3.1.5 Designation

General purpose metric screw threads are designated in accordance with ISO 965/1.

5.3.2 Specification of nuts and/or bolts with miniature screw thread

If nuts and/or bolts with miniature screw thread required, the requirements shall conform, to ISO/R 1501.

5.3.3 Specification of nuts and/or bolts with metric trapezoidal screw threads**5.3.3.1 Basic profile**

The basic profile of metric trapezoidal screw threads "if required" shall conform to ISO 2901.

5.3.3.2 Basic dimensions

The basic dimensions of nuts and/or bolts with trapezoidal screw threads shall conform to ISO 2904.

5.3.3.3 Tolerance classes

5.3.3.3.1 Tolerance classes for single start threads

The tolerance class of required workpiece shall be the denoted class in data-sheet and/or the relevant workpiece specification which may be selected from Table 10 for nut threads and Table 11 for bolt threads;

TABLE 10 - TOLERANCE CLASSES FOR NUT THREADS

TOLERANCE QUALITY	TOLERANCES FOR THE PITCH DIAMETER
Medium	7H
Coarse	8H

Note:

In Table 10 Figs 7 and 8 denote to the tolerance classes and H denotes to the fundamental deviation.

TABLE 11 - TOLERANCE CLASSES FOR BOLT THREADS

TOLERANCE QUALITY	TOLERANCES FOR THE PITCH DIAMETER
Medium	7e
Coarse	8c

Note:

In Table 11 Figs 7 and 8 denote to the tolerance classes and e and c denote to the fundamental deviation.

The numerical values of each class shall be selected accordingly from Tables 3, 4, 5, 6 and 7 of ISO 2903.

5.3.3.3.2 Tolerance values for multiple-start threads

Tolerance values of multiple-start threads shall comply with ISO 2903.

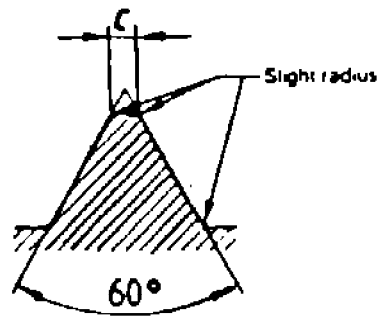
5.3.3.4 Designation

Metric trapezoidal threads shall be designated in accordance with ISO 2902 and ISO 2903.

5.3.4 Specification for tapping screw threads

5.3.4.1 Thread profile

The profile of tapping screw threads shall be in accordance with Fig. 3.



THREAD PROFILE
Fig. 3

5.3.4.2 Dimensions

Dimensions of tapping screws thread referred to Fig. 3 and Fig. 4 and Fig. 5 shall comply with Table 12.

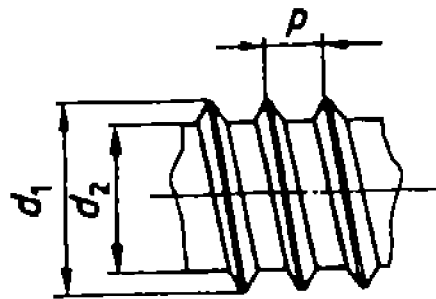
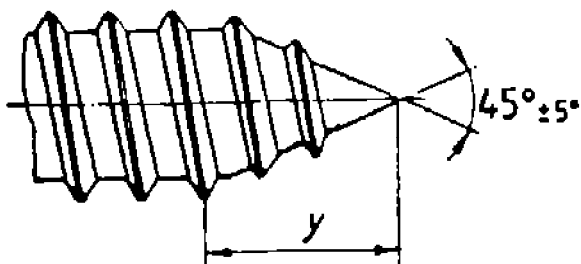
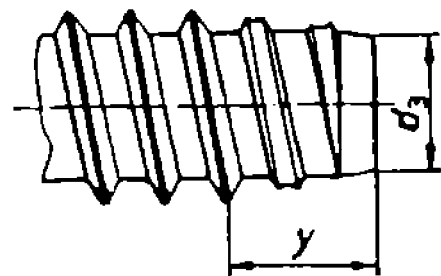


Fig. 4



TYPE C CONE AND
(PREVIOUSLY TYPE AB)



TYPE F FLAT END
(PREVIOUSLY TYPE B)

THREAD ENDS
Fig. 5

TABLE 12 - DIMENSIONS

Dimensions in mm

THREAD SIZE		ST 1.5	ST 1.9	ST 2.2	ST 2.6	ST 2.9	ST 3.3	ST 3.5	ST 3.9	ST 4.2	ST 4.8	ST 5.5	ST 6.3	ST 8	ST 9.5
P	≈	0.5	0.6	0.8	0.9	1.1	1.3	1.3	1.3	1.4	1.6	1.8	1.8	2.1	2.1
d ₁	max.	1.52	1.90	2.24	2.57	2.9	3.3	3.53	3.91	4.22	4.8	5.46	6.25	8	9.65
	min.	1.38	1.76	2.1	2.43	2.76	3.12	3.35	3.73	4.04	4.62	5.28	6.03	7.78	9.43
d ₂	max.	0.91	1.24	1.63	1.90	2.18	2.39	2.64	2.92	3.10	3.58	4.17	4.88	6.20	7.85
	min.	0.84	1.17	1.52	1.80	2.08	2.29	2.51	2.77	2.96	3.43	3.99	4.70	5.99	7.59
d ₃	max.	0.79	1.12	1.47	1.73	2.01	2.21	2.41	2.67	2.84	3.30	3.86	4.55	5.84	7.44
	min.	0.69	1.02	1.37	1.60	1.88	2.08	2.26	2.51	2.69	3.12	3.68	4.34	5.64	7.24
c	max.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.15	0.15	0.15	0.15	0.15
y	Type C	1.4	1.6	2	2.3	2.6	3	3.2	3.5	3.7	4.3	5	6	7.5	8
	Type F	1.1	1.2	1.6	1.8	2.1	2.5	2.5	2.7	2.8	3.2	3.6	3.6	4.2	4.2

5.3.4.3 Designation

Tapping screw threads shall be designated with "ST" followed by the nominal value of the thread diameter. For example ST 3.5.

5.3.4.4 Compliance

The supplier/manufacturer shall not deliver any workpiece that the actual thread size of which lies outside the specified values.

5.4 Specific Requirements for Screws

5.4.1 Slotted and/or cross recessed screws

5.4.1.1 Specification for raised countersunk (oval) head tapping screws which may be ordered with thread size of either ST 2.2, ST 3.5, ST 4.2, ST 4.8, ST 5.5, ST 6.3, ST 8 and ST 9.5 shall be as given in Table 13 and the dimensions of required screws "as data sheet" shall comply with ISO 1483 "if screws are slotted" and with ISO 7051 "if the screws are cross recessed type".

TABLE 13 - SPECIFICATION FOR RAISED COUNTERSUNK (OVAL) HEAD TAPPING SCREWS

MATERIAL	STEEL, ACCORDING TO ISO 2702
Thread	According to Clause 5.3.4
Mechanical properties	According to ISO 2702
Tolerances Product grade Reference standard	A ¹⁾ ISO 4759/1
Finish	Plain Requirements for electroplating are covered in ISO 4042
Acceptability	Acceptance procedure shall be in accordance with ISO 3269

¹⁾ As denoted in ISO 4759/1 the product grades refer to the quality of the product and to the size of the tolerances, where grade A is the most precise and grade C is the less precise.

5.4.1.2 Specification for countersunk (flat) head tapping screws which may be ordered with thread size of either ST 2.2, ST 3.5, ST 4.2, ST 4.8, ST 5.5, ST 6.3, ST 8, and ST 9.5 shall be as given in Table 14 and the dimensions of required screws "as data sheet" shall comply with ISO 1482 "if the screws are slotted and with ISO 7050" if the screw are cross recessed type.

TABLE 14 - SPECIFICATION FOR COUNTERSUNK (FLAT) HEAD TAPPING SCREWS

MATERIAL	STEEL
Thread	According to Clause 5.3.4
Mechanical properties	According to ISO 2702
Tolerances $\frac{\text{Product grade}}{\text{Reference standard}}$	$\frac{\text{A}}{\text{ISO 4759/1}}$
Finish	Plain Requirements for electroplating are covered in ISO 4042
Acceptability	Acceptance procedure shall be in accordance with ISO 3269

5.4.1.3 Specification for countersunk flat head screws (common head style) which may be ordered with thread size of either M1.6, M2, M3, M4, M5, M6, M8 and M10, shall be as given in Table 15 and dimensions of required screws "as data sheet" shall comply with ISO 2009 "if the screw is slotted" and with ISO 7046 "if the screw is cross recessed type".

Note:

Cross recessed screws may be of Z or H type "as denoted in data sheet".

TABLE 15 - SPECIFICATION FOR COUNTERSUNK HEAD SCREWS

MATERIAL	STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread $\frac{\text{Tolerance class}}{\text{Tolerance values}}$	$\frac{6g}{\text{According to Clauses 5.3.1.2 and 5.3.1.3}}$		
Mechanical properties $\frac{\text{Property class}}{\text{Reference standard}}$	$\frac{4.8^1}{5.8^1 \text{ and } 2)} \frac{(\text{According to data sheet})}{\text{ISO 898/1}}$	$\frac{\text{A2-70, A2-50}}{(\text{According to data sheet}) \text{ ISO 3506}}$	In accordance with ISO 8839
Tolerances $\frac{\text{Product grade}}{\text{Reference standard}}$	$\frac{\text{A}}{\text{ISO 4759/1}}$		
Finish	Plain Requirements for electroplating are covered in ISO 4042		
Acceptability	Acceptance procedure shall be in accordance with ISO 3269		

¹⁾ Max. hardness 255 HV permissible.

²⁾ This property class is for slotted type only and not for cross recessed types.

5.4.1.4 Specification for raised countersunk head screw (common head style) which may be ordered with thread size of either M1.6, M2, M3, M4, M5, M6, M8 or M10 shall be as given in Table 16 and dimensions of required screws "as data sheet" shall comply with ISO 2010 "if the screw is slotted type" and with ISO 7047 "if the screw is cross recessed type".

Note:

Cross recessed screws may be of H or Z type as denoted in data sheet.

TABLE 16 - SPECIFICATION FOR RAISED COUNTERSUNK HEAD SCREWS

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	4.8 ¹⁾ 5.8 ^{1) and 2)} (According to data sheet) ISO 898/1	A2-70, A2-50 (According to data sheet) ISO 3506	In accordance with ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4759/1		
Finish		Plain Requirements for electroplating are covered in ISO 4042		
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

¹⁾ Max. hardness 255 HV permissible.

²⁾ This property class is for slotted types and not for cross recessed types.

5.4.1.5 Specification for pan head screws (slotted or cross recessed type) which may be ordered with thread size of either M1.6, M2, M2.5, M3, M4, M5, M6, M8 and M10 shall be as given in Table 17 and dimensions of required screws "as data sheet" shall comply with ISO 1580 "if the screw is slotted pan head type" and with ISO 7045 "if the screw is cross recessed pan head type".

Note:

Cross recessed screws may be of Z type or H type as denoted in data sheet".

TABLE 17 - SPECIFICATION FOR PAN HEAD SCREWS

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	4.8 ¹⁾ 5.8 ^{1) and 2)} (According to data sheet) ISO 898/1	A2-70, A2-50 (According to data sheet) ISO 3506	In accordance with ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4759/1		
Finish		Plain Requirements for electroplating are covered in ISO 4042		
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

¹⁾ Max. hardness 255 HV permissible.

²⁾ This property class is applicable only for slotted pan head and shall not be applied for cross recessed pan head screws.

5.4.1.6 Specification for slotted cheese head screws which may be ordered with thread size either M4, M5, M6, M8 and shall be as given in Table 18 and dimensions of required screws "as data sheet" shall comply with ISO 1207.

TABLE 18 - SPECIFICATIONS FOR SLOTTED CHEESE HEAD SCREWS

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> Tolerance values	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> Reference standard	4.8 ¹⁾ 5.8 ^{1) and 2)} (According to data sheet) ISO 898/1	A2-70, A2-50 (According to data sheet) ISO 3506	In accordance with ISO 8839
Tolerances	<u>Product grade</u> Reference standard	A ISO 4759/1		
Finish		Plain Requirements for electroplating are covered in ISO 4042		
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

¹⁾ Max. hardness 255 HV permissible.

5.4.1.7 Specification for pan head tapping screws which may be ordered with thread size of either ST2.2, ST2.9, ST3.5, ST4.2, ST4.8, ST5.5, ST6.3, ST8 and ST9.5 shall be as given in Table 19 and dimensions of required screws "as data sheet" shall comply with ISO 1481 "if the screw is slotted" and with ISO 7049 "if the screw is cross recessed type".

TABLE 19 - SPECIFICATION FOR SLOTTED PAN HEAD TAPPING SCREWS

MATERIAL	STEEL, ACCORDING TO ISO 2702
Thread	According to Clause 5.3.4
Mechanical properties	According to ISO 2702
Tolerances <u>Product grade</u> Reference standard	A ISO 4759/1
Finish	Plain Requirements for electroplating are covered in ISO 4042
Acceptability	Acceptance procedure shall be in accordance with ISO 3269

5.4.1.8 Specification for slotted set screws with cone point which may be ordered with thread size of either M1.2, M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10 and M12 shall be as given in Table 20 and dimensions of required screw "as data sheet" shall comply with ISO 7434.

TABLE 20 - SPECIFICATION FOR SLOTTED SET SCREWS WITH CONE POINT

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	14 H, 22 H (In according with data sheet) ISO 898/5	A1-50 ISO 3506	In accordance with ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4759/1		
Finish		Plain Requirements for electroplating are covered in ISO 4042		
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

5.4.1.9 Specification for slotted set screws with long dog point which may be ordered with thread size of either M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, and M12 shall be as given in Table 21 and dimensions of required screws "as data sheet" shall comply with ISO 7435.

TABLE 21 - SPECIFICATIONS FOR SLOTTED SET SCREWS WITH LONG DOG POINT

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	14 H, 22 H (In according with data sheet) ISO 898/5	A1-50 ISO 3506	In accordance with ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4759/1		
Finish		Plain Requirements for electroplating are covered in ISO 4042		
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

5.4.1.10 Specification for slotted set screws with flat point which may be ordered with thread size of either M1.2, M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, and M12 shall be as given in Table 22 and dimensions of required screws "as data sheet" shall comply with ISO 4766.

TABLE 22 - SPECIFICATIONS FOR SLOTTED SET SCREWS WITH FLAT POINT

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	14 H, 22 H (In according with data sheet) ISO 898/5	A1-50 ISO 3506	In accordance with ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4759/1		
Finish		Plain Requirements for electroplating are covered in ISO 4042		
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

5.4.1.11 Specification for slotted set screws with cup point which may be ordered with thread size of either M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, or M12 shall be as given in Table 23 and dimensions of required screws "as data sheet" shall comply with ISO 4766.

TABLE 23 - SPECIFICATIONS FOR SLOTTED SET SCREWS WITH CUP POINT

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	14 H, 22 H (In according with data sheet) ISO 898/5	A1-50 ISO 3506	In accordance with ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4759/1		
Finish		Plain Requirements for electroplating are covered in ISO 4042		
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

5.4.2 Hexagon screws

5.4.2.1 Specification for hexagon head screws-Grades A and B

5.4.2.1.1 Hexagon head screws with thread size of either M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16, M20 and M24 and/or nominal lengths up to and including 10d or 150 mm "whichever is shorter" shall be grade A and with thread size of either M30, M36, M42, M48, M56 or M64 and /or nominal length over 10d or 150 mm "which ever is shorter" shall be Grade B.

5.4.2.1.2 Dimensions of required screws "as indicated in data sheet" shall comply with ISO 4017.

5.4.2.1.3 If fine pitch thread are required, dimensions shall conform with ISO 8676.

5.4.2.1.4 Other requirement shall comply with Table 24.

TABLE 24 - SPECIFICATION FOR HEXAGON HEAD SCREWS-GRADES A AND B

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> Tolerance values	<u>6g</u> According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> Reference standard	d < 3 mm: as agreed or denoted in data sheet 3 mm ≤ d ≤ 39 mm: 5.6, 8.8, 10.9 (in accordance with data sheet) d > 39 mm: as agreed or denoted in data sheet d ≤ 39 mm: ISO 898-1 d < 3 mm and d > 39 mm: as agreed or denoted in data sheet	d ≤ 20 mm: A 2-70 20 mm < d ≤ 39 mm: A2-50 d > 39 mm: as agreed or denoted in data sheet d ≤ 39 mm: ISO 3506 d > 39 mm: as agreed	ISO 8839
Tolerances	<u>Product grade</u> Reference standard	For d ≤ 24 mm and l ≤ 10 d or 150 mm ¹⁾ : A For d 24 mm or l > 10 d or 150 mm: B ISO 4759/1		
Finish		As processed Requirements for electroplating are covered in ISO 4042 Limits for surface discontinuities are covered in ISO 6157-1 and ISO 6157-3	Plain	Plain
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

¹⁾ **Whichever is shorter.**

5.4.2.2 Specification for hexagon head screws-Grade C shall be as given in Table 25 and dimensions of required screws "as data sheet" shall comply with ISO 4018.

Note:

Grade C hexagon head screws shall only be supplied with threads size of either M5, M6, M8, M10, M16, M20, M24, M30, M36, M42, M48, M56, and M64 and unless otherwise specified in data sheet. Non-Preferred Threads which are mentioned in ISO 4018 shall not be supplied.

TABLE 25 - SPECIFICATION FOR HEXAGON HEAD SCREWS - GRADE C

MATERIAL		STEEL
Thread	<u>Tolerance class</u> Tolerance values	<u>8g</u> According to Clauses 5.3.1.2 and 5.3.1.3
Mechanical properties	<u>Property class</u> Reference standard	d ≤ 39 mm: 3.6, 4.6, 4.8 d > 39 mm: as agreed or denoted in data sheet d ≤ 39 mm: ISO 898-1
Tolerances	<u>Product grade</u> Reference standard	<u>C</u> ISO 4759/1
Finish		As processed Requirements for electroplating are covered in ISO 4042
Acceptability		Acceptance procedure shall be in accordance with ISO 3269

5.4.2.3 Specification for Hexagon socket set screws with flat point which may be ordered with thread size of either M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16, M20 and M24, shall be as given in Table 26 and dimensions of required screws "as data sheet" shall comply with ISO 4026.

TABLE 26 - SPECIFICATIONS FOR HEXAGON SOCKET SET SCREWS WITH FLAT POINT

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	45 H ISO 898/V	A1-50 ISO 3506	In accordance with ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4759/I		
Finish		Black oxide (Thermal or chemical) Requirements for electroplating are covered in ISO 4042	Plain	Plain
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

5.4.2.4 Specification for Hexagon socket set screws with cone point which may be ordered with thread size of either M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16, M20 and M24, shall be as given in Table 27 and dimensions of required screws "according to data sheet" shall conform with ISO 4027.

TABLE 27 - SPECIFICATIONS FOR HEXAGON SOCKET SET SCREWS WITH CONE POINT

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	45 H ISO 898/V	A1-50 ISO 3506	In accordance with ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4759/I		
Finish		Black oxide (Thermal or chemical) Requirements for electroplating are covered in ISO 4042	Plain	Plain
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

5.4.2.5 Specification for Hexagon socket set screws with dog point which may be ordered with thread size of either M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16, M20 and M24, shall be as given in Table 28 and dimensions of required screws "according to data sheet" shall comply with ISO 4028.

TABLE 28 - SPECIFICATIONS FOR HEXAGON SOCKET SET SCREWS WITH DOG POINT

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	45 H ISO 898/V	A1-50 ISO 3506	In accordance with ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4759/1		
Finish		Black oxide (Thermal or chemical) Requirements for electroplating are covered in ISO 4042	Plain	Plain
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

5.4.2.6 Specification for Hexagon socket set screws with cup point which may be ordered with thread size of either M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16, M20 and M24, shall be as given in Table 29 and dimensions of required screws "according to data sheet" shall comply with ISO 4029.

TABLE 29 - SPECIFICATIONS FOR HEXAGON SOCKET SET SCREWS WITH CUP POINT

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	45 H ISO 898/V	A1-50 ISO 3506	In accordance with ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4759/1		
Finish		Black oxide (Thermal or chemical) Requirements for electroplating are covered in ISO 4042	Plain	Plain
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

5.4.2.7 Specification for Hexagon socket head cap screws-product grade A which may be ordered with thread size of either M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16, M20, M24, M30 or M36, shall be as given in Table 30 and dimensions of required screws "according to data sheet" shall comply with ISO 4762.

TABLE 30 - SPECIFICATIONS FOR HEXAGON SOCKET HEAD CAP SCREWS-PRODUCT GRADE A

MATERIAL		STEEL ¹⁾	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	8.8, 12.9 as specified in data sheet ISO 898-1 ²⁾	d ≤ 20 mm: - A2 - 70 d > 20 mm: - A2 - 50 ISO 3506	In accordance with ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4759/1		
Finish		Black oxide (Thermal or chemical) Requirements for electroplating are covered in ISO 4042	Plain	Plain
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

¹⁾ Alloy steel is mandatory as the material for screws of property class 12.9.

²⁾ For screws unsuitable for tensile testing, the hardness requirements shall be complied with, throughout the section of the screw.

5.4.2.8 Specification for hexagon socket head shoulder screws which may be ordered with shoulder diameters of either 6.5, 8, 10, 13, 16, 20 and 25 shall be as given in Table 31 and dimensions of required screws "according to data sheet" shall comply with ISO 7379.

TABLE 31 - SPECIFICATION FOR HEXAGON SOCKET HEAD SHOULDER SCREWS

MATERIAL		STEEL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	12.9 ¹⁾ ISO 898-1
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4759/1
Finish	<u>Shoulder</u> <u>Other features</u>	To surface roughness of Ra value = 0.8 µm in accordance with ISO 1302. Tolerances only apply before electroplating Black oxide (Thermal or chemical) Requirements for electroplating are covered in ISO 4042
Acceptability		Acceptance procedure shall be in accordance with ISO 3269

¹⁾ Because of their configuration these screws cannot be subjected to tensile testing. They are nevertheless required to meet all the other material and property requirements for property class 12.9.

5.4.2.9 Specification for hexagon socket button head Screws which may be ordered with thread size of either M3, M4, M5, M6, M8, M10, M12 and M16 shall be as given in Table 32 and dimensions of required screws "according to data sheet" shall comply with ISO 7380.

TABLE 32 - SPECIFICATION FOR HEXAGON SOCKET BUTTON HEAD SCREWS

MATERIAL		STEEL
Thread	$\frac{\text{Tolerance class}}{\text{Tolerance values}}$	$\frac{6g}{\text{According to Clauses 5.3.1.2 and 5.3.1.3}}$
Mechanical properties	$\frac{\text{Property class}}{\text{Reference standard}}$	$\frac{12.9^{1)}}{\text{ISO 898-1}}$
Tolerances	$\frac{\text{Product grade}}{\text{Reference standard}}$	$\frac{A}{\text{ISO 4759/1}}$
Finish		Black oxide (Thermal or chemical) Requirements for electroplating are covered in ISO 4042
Acceptability		Acceptance procedure shall be in accordance with ISO 3269

¹⁾ Because of their head configurations, these screws may not meet the minimum ultimate tensile load for property Class 12.9, specified in ISO 898/1, Table 6, when tested in accordance with test program B.

They are nevertheless required to meet the other material and property requirements for property Class 12.9 in ISO 898/1.

In addition, when normally loaded with the head supported on a parallel collar using the type of testing fixture illustrated in ISO 898/1, Fig. 2, they shall withstand the following loads without fracture:

THREAD SIZE d	M 3	M 4	M 5	M 6	M 8	M 10	M 12	M 16
Test load, kN	5.2	9.1	14.8	20.9	38.1	60.3	87.7	63

If tested to failure, the fracture may occur in the threaded section, the head or at the head-shank junction.

5.4.2.10 Specification for hexagon head tapping screws which may be ordered with thread size of either ST2.2, ST2.9, ST3.5, ST4.2, ST4.8, ST5.5, ST6.3, ST8 and ST9.5 shall be as given in Table 33 and dimensions of required screws "according to data sheet" shall comply with ISO 1479.

TABLE 33 - SPECIFICATION FOR HEXAGON HEAD TAPPING SCREWS

MATERIAL		STEEL, ACCORDING TO ISO 2702
Thread		According to Table 17
Tolerances	$\frac{\text{Product grade}}{\text{Reference standard}}$	$\frac{A}{\text{ISO 4759/1}}$
Finish		Plain Requirements for electroplating are covered in ISO 4042
Acceptability		Acceptance procedure shall be in accordance with ISO 3269

5.4.2.11 Specification for hexagon set screws with small hexagon and full dog point which may be ordered with thread sizes of either M6, M8, M10, M12, M20, M24, M30, M36, M42, M48 and M56 shall comply with Table 34 and dimensions of required screw according to data sheet shall be in accordance with DIN 561.

TABLE 34 - SPECIFICATION FOR HEXAGON SET SCREWS WITH SMALL HEXAGON AND FULL DOG POINT

MATERIAL		STEEL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	<u>6g</u> <u>According to Clauses 5.3.1.2 and 5.3.1.3</u>
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	<u>5.6 5.8 8.8 In accordance with data sheet</u> <u>ISO 898 Part 1</u>
Tolerances	<u>Product grade</u> <u>Reference standard</u>	<u>A</u> <u>ISO 4759/1 Part 1</u>
Finish		As processed Property class 8.8 screws: (thermally or chemically) blackened. DIN 267 part 2 shall apply with regard to surface roughness. ISO 6157-1 shall apply with regard to permissible surface discontinuities. ISO 4042 shall apply with regard to electroplating. DIN 267 part 10 shall apply with regard to hot dip galvanizing.
Acceptability		ISO 3269 shall apply with regard to the acceptance inspection.

5.4.2.12 Specification for hexagon head set screws with small hexagon and coned half dog point which may be ordered with thread sizes of either M6, M8, M12, M16, M20, M24, M30, or M36, shall comply with Table 35 and dimensions of required screw as denoted in data sheet shall be in accordance with DIN 561.

TABLE 35 - SPECIFICATION FOR HEXAGON HEAD SET SCREWS WITH SMALL HEXAGON AND CONED HALF DOG POINT

MATERIAL		STEEL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	<u>6g</u> <u>According to Clauses 5.3.1.2 and 5.3.1.3</u>
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	<u>5.6 5.8 8.8 In accordance with data sheet</u> <u>ISO 898 Part 1</u>
Tolerances	<u>Product grade</u> <u>Reference standard</u>	<u>A</u> <u>ISO 4759/1 Part 1</u>
Finish		As processed Property class 8.8 screws: (thermally or chemically) blackened. DIN 267 part 2 shall apply with regard to surface roughness. ISO 6157-1 shall apply with regard to permissible surface discontinuities. ISO 4042 shall apply with regard to electroplating. DIN 267 part 10 shall apply with regard to hot dip galvanizing.
Acceptability		ISO 3269 shall apply with regard to the acceptance inspection.

5.4.2.13 Specification of hexagon socket thin head cap screws with pilot recess for wrench key which may be ordered with thread sizes of either M4, M5, M6, M8, M10, M12, M16, M20, M24, M30 and M36 shall comply with Table 36 and dimensions of required size "as denoted in data sheet" shall be in accordance with DIN 6912. If hexagon socket thin head cap screws without pilot recess for wrench are required, the dimensions of required size may be either M3, M4, M5, M6, M8, M10, M12, M16, M20 or M24, shall comply with DIN 7984. Other specifications shall be in accordance with above mentioned table.

**TABLE 36 - SPECIFICATION OF HEXAGON SOCKET THIN HEAD CAP SCREWS
WITH PILOT RECESS FOR WRENCH KEY**

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	8.8 ISO 898 ¹⁾ Part 1	≤ M20 : - A2 - 70 > M20 : - A2 - 50 ISO 3506	CuZn = copper-zinc alloy ²⁾ ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4759/1 Part 1		
Finish		(Thermally or chemically) blackened DIN 267 part 2 shall apply with regard to surface roughness. ISO 6157-1 shall apply with regard to permissible surface discontinuities. ISO 4042 shall apply with regard to electroplating.	Bright	Bright
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

¹⁾ The acceptance inspection shall include hardness testing of property class 8.8 screws, with hardness values of HV 250 to 320 for sizes up to and including M:6 and HV 255 to 335 for sizes greater than M16.

²⁾ Preferably CU2 or CU3, at the manufacturer's discretion

5.5 Specific Requirements for Bolts

The thread lengths shown in Table 38 apply to bolts of metric sizes. Table 37 contains the formulas on which the calculation of the thread lengths indicated in Table 38 was based.

For dimensioning of thread lengths, see ISO 225.

TABLE 37 - FORMULAS FOR CALCULATION OF THREAD LENGTH

mm		
NOMINAL LENGTH		FORMULAE FOR THREAD LENGTHS
Over	To	
—	125	2d + 6
125	200	2d + 12
200	—	2d + 25

**TABLE 38 - ALLOCATION OF THE THREAD LENGTHS TO THE BOLT
DIAMETERS DIMENSIONS IN MILLIMETERS**

THREAD DIAMETER d		1.6	2	2.5	3	4	5	6	7	8	10	12	14	16	18	20
Thread length b	1 ≤ 125	9	10	11	12	14	16	18	20	22	26	30	34	38	42	46
	125 < 1 ≤ 200	—	—	—	—	—	—	—	—	28	32	36	40	44	48	52
	1 > 200	—	—	—	—	—	—	—	—	—	—	—	—	57	61	65

THREAD DIAMETER d		22	24	27	30	33	36	39	42	45	48	52	56			
Thread length b	1 ≤ 125	50	54	60	66	72	78	84	90	96	102	—	—	—	—	—
	125 < 1 ≤ 200	56	60	66	72	78	84	90	96	102	108	116	124	132	140	148
	1 > 200	69	73	79	85	91	97	103	109	115	121	129	137	145	153	164

Note:

b: denotes to the thread length and, **l:** denotes to the nominal length. For more information see ISO 225.

5.5.1 Specification of hexagon head bolts-Grades A & B

5.5.1.1 Hexagonal head bolts of grades A or B with threads of either M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16, M20 or M24 and nominal length up to and including 10 d or 150 mm "whichever is shorter" shall be grade A and with threads of either M30, M36, M42, M48, M56, M64 and nominal length over 10d or 150 mm (whichever is shorter) shall be Grade B.

5.5.1.2 Dimensions of required bolts "as indicated in data sheet" shall comply with ISO 4014 and non-preferred threads in the mentioned standard shall not be supplied.

5.5.1.3 Other requirements shall conform with Table 39.

Note:

If reduced shank diameter is required, dimensions and other requirements shall comply with ISO 4015.

TABLE 39 - SPECIFICATION FOR HEXAGON HEAD BOLTS-GRADES A AND B

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> Tolerance values	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> Reference standard	d < 3 mm: as agreed or specified in data sheet 3 mm ≤ d ≤ 39 mm: 5.6 ¹⁾ , 8.8 ²⁾ , 10.9 ³⁾ (see data sheet) d > 39 mm: as agreed or denoted in data sheet 3 mm ≤ d ≤ 39 mm: ISO 8998-1 d < 3 mm and d > 39 mm as agreed	d ≤ 20 mm: A2-70 20 mm < d ≤ 39 mm: A2-50 d > 39 mm: as agreed or denoted in data sheet d ≤ 39 mm: ISO 3506 d > 39 mm: as agreed	ISO 8839
Tolerances	<u>Product grade</u> Reference standard	For d ≤ 24 mm and l ≤ 10 d or 150 mm ⁴⁾ : A For d > 24 mm or l > 10 d or 150 mm ⁴⁾ : B ISO 4759/1		
Finish		As processed Requirements for electroplating are covered in ISO 4042 Limits for surface discontinuities are covered in ISO 6157-1 and ISO 6157-3	Plain	Plain
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

¹⁾ For bolts with property class of 5.6 with all diameter range, the mating nuts with nominal height range of ≥ 0.8D shall have the property class of at least 5.

²⁾ Property class of mating nuts with nominal height range of ≥ 0.8D shall be 8.

³⁾ Property class of mating nuts with nominal height range of ≥ 0.8D shall be at least 10.

⁴⁾ Whichever is shorter.

5.5.2 Specification for hexagon head bolts-Grade C shall be as given in Table 40 and dimensions of required bolts "as denoted in data sheet" shall comply with ISO 4016.

Notes:

- 1) Grade C hexagon head bolts are not in prime consider and shall only be supplied if ordered in special cases otherwise bolts mentioned in 5.5.1 shall be supplied.
- 2) Grade C hexagon head bolts shall only be supplied with threads of either M5, M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56 and M64.
- 3) Unless otherwise specified in data sheet, non-preferred threads given in ISO 4016 shall not be supplied.
- 4) If metric hexagon bolts for high-strength structural bolting with large width across flats are required the requirements shall comply with ISO 7411.
- 5) If metric hexagon bolts for high-strength structural bolting with large width across flats but with short thread length is required "shorter than those mentioned in ISO 4016 the requirements shall comply with ISO 7412.

TABLE 40 - SPECIFICATION FOR HEXAGON HEAD BOLTS-GRADE C

MATERIAL		STEEL
Thread	<u>Tolerance class</u> Tolerance values	<u>8g</u> According to Clauses 5.3.1.2 and 5.3.1.3
Mechanical properties	<u>Property class</u> Reference standard	d ≤ 39 mm: 3.6 ¹⁾ , 4.6 ¹⁾ , 4.8 ¹⁾ according with data sheet d > 39 mm: as agreed or denoted in data sheet d ≤ 39 mm: ISO 898-1 d > 39 mm: as agreed
Tolerances	<u>Product grade</u> Reference standard	<u>C</u> ISO 4759/1
Finish		As processed Requirements for electroplating are covered in ISO 4042
Acceptability		For acceptance procedure, see ISO 3269

¹⁾ Property class of mating nut with nominal height of $\geq 0.8D$ "if required" shall be at least 4 if the diameter range of bolts are more than 16 mm and shall be at least 5 if the diameter range of bolts are equal to M16 and/or less than that.

5.5.3 Specification for cup head square neck bolts with large head-Grade C shall be as given in Table 41 and dimensions of required bolts "as denoted in data sheet" which may be ordered with thread size of either M5, M6, M8, M10, M12, M16 and M20 shall comply with ISO 8677.

**TABLE 41 - SPECIFICATION FOR CUP HEAD SQUARE NECK BOLTS
WITH LARGE HEAD-GRADE C**

MATERIAL		STEEL
Thread	<u>Tolerance class</u> Tolerance values	<u>6g</u> According to Clauses 5.3.1.2 and 5.3.1.3
Mechanical properties	<u>Property class</u> Reference standard	<u>8.8 ²⁾</u> (In accordance with data sheet) ISO 898/1
Tolerances	<u>Product grade</u> Reference standard	<u>C</u> ISO 4759-1
Finish		As processed Black oxide (thermic or chemical) for product class 8.8 Requirements for electroplating are covered in ISO 4042. For hot dip galvanizing, see ISO 1461.
Acceptability		For acceptance procedure, see ISO 3269.

¹⁾ Property class of mating nut with nominal height of $\geq 0.8D$ "if required" shall be at least 4 if the diameter range of bolts are more than 16 mm and shall be at least 5 if the diameter range of bolts are equal to M16 and or less than that.

²⁾ Property class of mating nut with nominal height of $\geq 0.8D$ shall be 8.

5.5.4 Specification for cup head square neck bolts with small head and short neck-grade B.

5.5.4.1 This bolts may be ordered with thread size of either M6, M8, M10, M12, M16 and M20.

5.5.4.2 Dimensions of this kind of bolts shall comply with ISO 8678 and other specifications shall be in accordance with Table 42.

**TABLE 42 - SPECIFICATIONS FOR CUP HEAD SQUARE NECK BOLTS WITH
SMALL HEAD AND SHORT NECK-GRADE B**

MATERIAL		STEEL
Thread	<u>Tolerance class</u> Tolerance values	<u>6g</u> According to Clauses 5.3.1.2 and 5.3.1.3
Mechanical properties	<u>Property class</u> Reference standard	<u>4, 8 ¹⁾, 8.8 ²⁾, 10.9 ³⁾</u> ISO 898-1
Tolerances	<u>Product grade</u> Reference standard	<u>B</u> ISO 4759-1
Finish		As processed Requirements for electroplating are covered in ISO 4042. Limits for surface discontinuities are covered in ISO 6157-1 and ISO 6157-3. For hot dip galvanizing, see ISO 1461.
Acceptability		Acceptance procedure, shall be in accordance with ISO 3269.

¹⁾ For bolts with diameter range of $> M_{16}$ the property class of mating nut with the nominal height of $\geq 0.8D$ shall be at least 4 and for bolts with diameter range of $\leq 16M$ the property class of mating nut with the nominal height of $\geq 0.8D$ shall be at least 5.

²⁾ The mating nut with the nominal height of $\geq 0.8D$ shall have the property class of at least 8.

³⁾ The mating nut with the nominal height of $\geq 0.8D$ shall have the property class of at least 10.

5.5.5 Specification for hexagon flange bolts-Small series, which may be ordered with threads of either M5, M6, M8, M10, M12 and M16 with property classes of either 8.8 to 10.9 "according to ISO 898-1 or A2-70" according to ISO 3506 shall be as given in Table 43.

Dimensions of required bolts "according to data sheet" shall comply with ISO 4162.

TABLE 43 - SPECIFICATION FOR HEXAGON FLANGE BOLTS-SMALL SERIES

MATERIAL		STEEL	
Thread	Tolerance class Tolerance values	6g According to Clauses 5.3.1.2 and 5.3.1.3	
Mechanical properties	Property class Reference standard	8.8 ¹⁾ , 9.8 ²⁾ , 10.9 ³⁾ in accordance with data sheet ISO 898-1	A2-70 ISO 3506
Tolerances	Product grade Reference standard	A ISO 4759-1	
Finish		Black oxide (Thermic or chemical) Plain Requirements for electroplating are covered in ISO 4042. Limits for surface discontinuities are covered in ISO 6157-1 and ISO 6157-3.	
Acceptability		Acceptance procedure, shall be in accordance with ISO 3269.	

¹⁾ Property class of mating nuts with nominal heights of $\geq 0.8D$ shall be at least 8.

²⁾ Property class of mating nuts with nominal heights of $\geq 0.8D$ shall be at least 9.

³⁾ Property class of mating nuts with nominal heights of $\geq 0.8D$ shall be at least 10.

5.5.6 Specification for hexagon head bolts with metric fine pitch thread-Grades A and B.

5.5.6.1 This kind of bolts may be ordered with nominal thread diameter, d , from 8 to 64 mm. Product grade A may have nominal thread diameter, d , of either 8, 10, 12, 16, 20 and 24 mm and nominal length, l , up to and including $10d$ or 150 mm, whichever is shorter. Product grade B may have nominal thread diameters of either 30, 36, 42, 48, 56 and 64 mm and nominal length over $10d$ or 150 mm, whichever is shorter.

5.5.6.2 Dimensions of required bolts "according to data sheet" shall comply with ISO 8765. Unless otherwise specified in data sheet, non preferred threads in the above mentioned standard shall not be supplied.

5.5.6.3 Other specifications shall be as given in Table 44.

**TABLE 44 - SPECIFICATION FOR HEXAGON HEAD BOLTS WITH METRIC FINE PITCH
THREAD-GRADES A AND B**

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	d < 39 mm: 5.6 ¹⁾ , 8.8 ²⁾ , 10.9 ³⁾ as specified in data sheet d > 39 mm: as agreed or denoted in data sheet d ≤ 39 mm: ISO 8998-1 d > 39 mm as agreed	d ≤ 20 mm: A2-70 20 mm < d ≤ 39 mm: A2-50 d > 39 mm: as agreed or denoted in data sheet d ≤ 39 mm: ISO 3506 d > 39 mm: as agreed	ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	For d ≤ 24 mm and l ≤ 10 d or 150 mm: A For d > 24 mm or l > 10 d or 150 mm: B ISO 4759/1		
Finish		As processed Plain Plain Requirements for electroplating are covered in ISO 4042 If different electroplating requirements are desired or if requirements are needed for other finishes, they should be agreed between company and supplier. Limits for surface discontinuities are covered in ISO 6157-1 and ISO 6157-3		
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

¹⁾ The property class of mating nuts with nominal heights of ≥ 0.8D shall be at least 5.

²⁾ The property class of mating nuts with nominal heights of ≥ 0.8D shall be at least 8.

³⁾ The property class of mating nuts with nominal heights of ≥ 0.8D shall be at least 10.

5.5.7 Specification for hexagon fit bolts with short threaded dog point which may be ordered with thread size of either M8, M10, M12, M16, M20, M24, M30, M36, M42 and M48 shall comply with Table 45 and dimensions of required bolt "as denoted in data sheet" shall be in accordance with DIN 610.

**TABLE 45 - SPECIFICATION FOR HEXAGON FIT BOLTS WITH
SHORT THREADED DOG POINT**

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class ¹⁾</u> <u>Reference standard</u>	≤ M39 : 8.8 ²⁾ > M39 : subject to agreement if not denoted in data sheet ISO 898 Part 1	≤ M20 : A2-70; M20 < M39 : A2-50; > M39 : subject to agreement if not denoted in data sheet ISO 3506	e.g. CU2, CU3 ISO 8839
Tolerances	<u>Product grade ³⁾</u> <u>Reference standard</u>	≤ M10 : A > M12 : B ISO 4759/1		
Finish		Blackened ⁴⁾ Bright Bright (Thermally or chemically) Fit shank: bright DIN 267 part 2 shall apply with regard to surface roughness. ISO 6157-1 shall apply with regard to permissible surface discontinuities. ISO 4042 shall apply with regard to electroplating. DIN 267 part 10 shall apply with regard to hot-dip galvanizing.		
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

¹⁾ Where, for special purposes, the bolts are to meet requirements differing from those specified, e.g., in respect of property class or material, the specifications of the relevant standards shall be complied with.

²⁾ Property class of mating nuts with nominal height of $> 0.8D$ shall be at least 8 or any higher classes.

³⁾ If product grade A is required for sizes from M12 upwards, this shall be incorporated in the designation, e.g.:

Fit bolt DIN 610 - M20 \times 100 - 8.8 - A

in this case, the appropriate tolerances as specified in ISO 4759 Part 1 shall apply. This does not apply however to the diameter of the fit shank.

⁴⁾ Different surfaces are the standard for different property classes or materials, as appropriate, e.g., "as rolled", i.e. without additional surface treatment, for property class 5.6.

5.5.8 Specification of hexagon fit bolts with long threaded dog point which may be ordered with thread sizes of either M8, M10, M12, M16, M20, M24, M30, M36, M42 and M48 shall comply with Table 46 and dimensions of required size as denoted in data sheet shall be in accordance with DIN 609.

**TABLE 46 - SPECIFICATION OF HEXAGON FIT BOLTS WITH LONG
THREADED DOG POINT**

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	$\frac{\text{Tolerance class}}{\text{Tolerance values}}$	$\frac{6g}{\text{According to Clauses 5.3.1.2 and 5.3.1.3}}$		
Mechanical properties	$\frac{\text{Property class } ^1)}{\text{Reference standard}}$	$\leq M39 : 8.8$ ²⁾ $> M39 : \text{subject to agreement}$ if not denoted in data sheet <hr/> ISO 898 Part 1	$\leq M20 : A2-70; M20$ $< M20 \leq M39 : A2-50;$ $> M39 : \text{subject to agreement}$ if not denoted in data sheet <hr/> ISO 8839 or DIN 267 part 18	e.g. CU2, CU3 <hr/> ISO 8839 or DIN 267 part 18
Tolerances	$\frac{\text{Product grade } ^3)}{\text{Reference standard}}$	$\frac{\leq M10 : A}{\geq M12 : B}$ <hr/> ISO 4759 part 1		
Finish		$\frac{\text{Blackened } ^4)}{\text{Bright}}$ (Thermally or chemically) Fit shank: bright DIN 267 part 2 shall apply with regard to surface roughness. ISO 6157-1 and ISO 6157-3 shall apply with regard to permissible surface discontinuities. ISO 4042 shall apply with regard to electroplating. DIN 267 part 10 shall apply with regard to hot-dip galvanizing.		
Acceptability		ISO 3269 shall apply with regard to acceptance inspection.		

¹⁾ Where, for special purposes, the bolts are to meet requirements differing from those specified, e.g., in respect of property class or material, the specifications of the relevant standards shall be complied with.

²⁾ Property class of mating nuts with nominal height of $\geq 0.8D$ shall be at least 8.

³⁾ If product grade A is required for sizes from M 12 upwards, this shall be incorporated in the designation, e.g.:

Fit bolt DIN 609 - M20 \times 100 - 8.8 - A

in this case, the appropriate tolerances as specified in ISO 4759 Part 1 shall apply. This does not apply however to the diameter of the fit shank.

⁴⁾ Different surfaces are the standard for different property classes or materials, as appropriate, e.g., "as rolled", i.e. without additional surface treatment, for property class 5.6.

⁵⁾ The supply of electroplated fit bolts with bright shank is permitted.

5.5.9 Specification of hexagon bolt with large width across flat

5.5.9.1 Dimensions of these bolts which are intended for use in high-tensile bolting in steel structure may be ordered with thread sizes of either M12, M16, M20, M22, M24, M27, M30 or M36.

5.5.9.2 Dimensions of required size shall conform with DIN 6914.

5.5.9.3 General requirements shall be as given in sub-clause 5.3.1 and technical conditions of delivery shall comply with the above-mentioned standard if nuts and washers are required to be supplied for use with these bolts, the nuts shall comply with DIN 6915 and washers with DIN 6916 and DIN 6917.

5.5.10 Specification of high strength hexagon fit bolts with large width across flats

These bolts which are intended for use in structural steel bolting may be ordered with thread sizes of either M12, M16, M20, M22, M24, M27 or M30.

5.5.10.1 Dimensions of required size shall conform with DIN 7999 and general requirements of these bolts shall comply with sub-clause 5.3.1 and technical conditions of delivery shall be in accordance with the above mentioned standard.

In the case that nuts and washers are required to be supplied for use with these bolts, the nuts shall comply with requirements of DIN 6915 and the washers shall comply with DIN 6916 and DIN 6917.

5.5.11 Specification of square head bolts shall comply with Table 47

5.5.11.1 Dimensions of square head bolts with collar which may be ordered with thread size of either M5, M6, M8, M10, M12, M16, M20 and M24 (in accordance with data-sheet) shall conform with DIN 478.

5.5.11.2 Dimensions of square head bolts with short dog point which may be ordered with thread size of either M5, M6, M8, M10, M12, M16, M20, or M24 (according to data-sheet) shall comply with DIN 479.

5.5.11.3 Dimensions of square head bolts with collar and oval half dog point which may be ordered with thread size of either M8, M10, M12, M16, M20 and M24 (in accordance with data-sheet) shall conform with DIN 480.

TABLE 47 - SPECIFICATION FOR SQUARE HEAD BOLTS

MATERIAL		STEEL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	<u>6g</u> According to Clauses 5.3.1.2 and 5.3.1.3
Mechanical properties	<u>Property class (material)</u> <u>Reference standard</u>	<u>5.6¹⁾, 5.8¹⁾, 8.8²⁾</u> ISO 898 part 1
Tolerances	<u>Product grade</u> <u>Reference standard</u>	<u>A</u> ISO 4759 part 1
Finish		As processed Property class 8.8 bolts: (thermally or chemically) blackened. DIN 267 part 2 shall apply with regard to surface roughness. ISO 6157-1 and ISO 6157-3 shall apply with regard to permissible surface discontinuities. ISO 4042 shall apply with regard to electroplating. DIN 267 part 10 shall apply with regard to hot-dip galvanizing.
Acceptability		ISO 3269 shall apply with regard to the acceptance inspection.

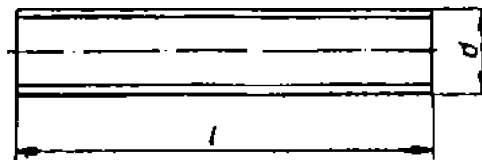
¹⁾ Property class of mating nuts with nominal height of $\geq 0.8D$ shall be at least 5.

²⁾ Property class of mating nuts with nominal height of $\geq 0.8D$ shall be at least 8.

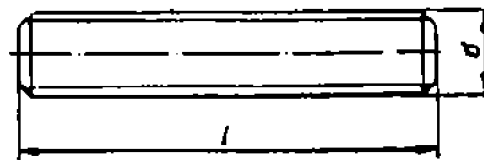
5.6 Specific Requirements for Studs

5.6.1 Specification for various purpose stud bolts

5.6.1.1 Various purpose stud bolts which may be ordered either with as-rolled ends (type A) or with chamfered ends (type B)" shall be supplied with tolerance class of 6g "see figure in below".



TYPE A, WITH AS-ROLLED END



TYPE B, WITH DIN 78-K THREAD ENDS (CHAMFERED ENDS)

These studs may be required with thread sizes of either M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56 and M64. Length of stud bolts shall conform with data-sheet which will be selected from DIN 976. Specifications of these studs shall comply with Table 48.

TABLE 48 - SPECIFICATION OF VARIOUS PURPOSE STUD BOLTS

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6g According to Clauses 5.3.1.2 and 5.3.1.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	4.6, 5.6, 5.8 ¹⁾ according to data sheet ISO 898 Part 1	A2: A4 ISO 3506	CuZn = copper-zinc alloy ²⁾ ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4759 Part 1		
Finish		As processed DIN 267 part 2 shall apply with regard to surface roughness. ISO 6157 shall apply with regard to permissible surface discontinuities. ISO 4042 shall apply with regard to electroplating. DIN 267 part 10 shall apply with regard to hot-dip galvanizing.		
Acceptability		ISO 3269 shall apply with regard to acceptance inspection.		

¹⁾ The property class of mating nuts with nominal height of > 0.8D shall be at least 5.

²⁾ CuZn=CU2 or CU3 (as specified in DIN 267 part 18), at the manufacturer's discretion.

5.7 Specific Requirements for Nuts

Geometrical and mechanical properties of nuts are designed to provide for a high degree of resistance to stripping, so that the nut of an assembly shall have the

capability of being tightened to the bolt proof load without thread stripping occurring.

However, should tightening beyond bolt proof load take place, the nut design is intended to ensure at least 10% of the over-tightened assemblies fail through bolt breakage in order to warn the user that his installation practice is not appropriate.

Nuts shall be made of steel conforming to the chemical composition limits specified in Table 49.

TABLE 49 - LIMITS OF CHEMICAL COMPOSITION

PROPERTY CLASS		CHEMICAL COMPOSITION LIMITS (CHECK ANALYSIS), %			
		C max.	Mn min.	P max.	S max.
4 ¹⁾ 5 ¹⁾ 6 ¹⁾	—	0.50	—	0.110	0.150
8 9	04 ¹⁾	0.58	0.25	0.060	0.150
10 ²⁾	05 ²⁾	0.58	0.30	0.048	0.058
12 ²⁾	—	0.58	0.45	0.048	0.058

¹⁾ Nuts of these property classes may be manufactured from free-cutting steel unless otherwise specified in data-sheet. In such cases the following maximum sulphur, phosphorus and lead contents are permissible:

Sulphur 0.34% phosphorus 0.12%; lead 0.35%

²⁾ Alloying elements may be added if necessary to develop the mechanical properties of the nuts.

Nuts of property classes 05.8 (style 1> M16), 10 and 12 shall be hardened and tempered.

Mechanical properties of nuts with coarse threads shall at least comply with Table 50 when tested in accordance with Clause 8 of ISO 898/2.

TABLE 50 - MECHANICAL PROPERTIES (COARSE THREAD)

NOMINAL SIZE (thread diameter) mm		PROPERTY CLASS 8.4				PROPERTY CLASS 8.6				PROPERTY CLASS 4				
		Proof stress S_p N/mm ²	Vickers hardness HV	Rockwell Hardness HRC	Proof stress S_p N/mm ²	Vickers hardness HV	Rockwell hardness HRC	Proof stress S_p N/mm ²	Vickers hardness HV	Rockwell hardness HRC	Proof stress S_p N/mm ²	Vickers hardness HV	Rockwell hardness HRC	
over	to		min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
-	4													
4	7	380	188	302	-	30	500	272	353	27.8	36			
7	10													
10	16													
16	39													
39	100	-					-			117	302	-		30

NOMINAL SIZE (thread diameter) mm		PROPERTY CLASS 8.5				PROPERTY CLASS 6				PROPERTY CLASS 8				
		Proof stress S_p N/mm ²	Vickers hardness HV	Rockwell Hardness HRC	Proof stress S_p N/mm ²	Vickers hardness HV	Rockwell hardness HRC	Proof stress S_p N/mm ²	Vickers hardness HV	Rockwell hardness HRC	Proof stress S_p N/mm ²	Vickers hardness HV	Rockwell hardness HRC	
over	to		min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
-	4	520					600							
4	7	580	130				670							
7	10	590					680	150	302					
10	16	610				30	700			30				30
16	39	630	146				720	170						
39	100	-	128				-	142						38

NOMINAL SIZE (thread diameter) mm		PROPERTY CLASS 9				PROPERTY CLASS 10				PROPERTY CLASS 12				
		Proof stress S_p N/mm ²	Vickers hardness HV	Rockwell Hardness HRC	Proof stress S_p N/mm ²	Vickers hardness HV	Rockwell hardness HRC	Proof stress S_p N/mm ²	Vickers hardness HV	Rockwell hardness HRC	Proof stress S_p N/mm ²	Vickers hardness HV	Rockwell hardness HRC	
over	to		min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
-	4	900	170				1040							
4	7	915					1040							
7	10	940		302			1040							
10	16	940	188			30	1050	272	353	28	38	295 ¹⁰	272	535
16	39	920					1060							38
39	100	-					-							

Note:

Minimum hardness is mandatory only for heat-treated nuts and nuts too large to be proof-load tested. For all other nuts, minimum hardness is provided for guidance only. Hardness values for nominal sizes (thread diameters) over 39 up to and including 100 mm are to be used for information and guidance only.

If prevailing torque type steel hexagon nuts ¹⁾ are required, mechanical properties of such nuts "which may be ordered with thread sizes M3 to M39 inclusive" shall comply with Table 51.

**TABLE 51 - MECHANICAL PROPERTIES OF PREVAILING TORQUE
TYPE STEEL HEXAGON NUTS**

THREAD SIZE mm		PROPERTY CLASS 5						PROPERTY CLASS 8						PROPERTY CLASS 9					
		Proof stress S_p N/mm ²		Vickers hardness HV		Rockwell Hardness HRC		Proof stress S_p N/mm ²		Vickers hardness HV		Rockwell hardness HRC		Proof stress S_p N/mm ²		Vickers hardness HV		Rockwell hardness HRC	
		min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
-	4	520						800	170			-		930	170			-	
4	7	580		130				810		302		30		915					
7	10	590			302		30	830	183			-		940			302		30
10	16	610						840						950	188			-	
16	39	630	146			-		920	233	353		36		920					

THREAD SIZE mm		PROPERTY CLASS 10						PROPERTY CLASS 12					
		Proof stress S_p N/mm ²		Vickers hardness HV		Rockwell Hardness HRC		Proof stress S_p N/mm ²		Vickers hardness HV		Rockwell hardness HRC	
		min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
-	4	1040						1150					
4	7	1040						1150	295	353	29	36	
7	10	1040		272	353	28	36	1160					
10	16	1050						1190					
16	39	1060						1200	-	-	-	-	

¹⁾ Prevailing torque type nut: A nut which is frictionally resistant to rotation due to a self-contained prevailing torque feature, and not because of a compressive load developed against the bearing surface of the nut.

5.7.1 Specific requirements for hexagon nuts style 1- Grade A and B shall be as given in Table 52 and dimensions of required nuts "as denoted in data sheet" shall comply with ISO 4032.

These nuts will be ordered with thread size of either M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56 and M64. If fine pitch thread is required, the dimensions shall comply with ISO 8673 which will be ordered with thread size of either M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56 and M64.

Unless otherwise specified in data sheet style 1 hexagon nuts are not in prime consider and non-preferred sizes given in the above mentioned standards shall not be supplied.

It is better to consider that style 1 hexagon nuts are thinner than style 2 hexagon nuts for the same thread sizes.

TABLE 52 - SPECIFICATION FOR HEXAGON NUTS STYLE 1 GRADES A AND B

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> Tolerance values	6g According to Clauses 5.3.1.2 and 5.3.1.3 and for fine pitch threads ISO 261 and ISO 965-2		
Mechanical properties	<u>Property class</u> Reference standard	d < M3 as agreed or denoted in data sheet M3 ≤ d ≤ M39: 6 ¹⁾ , 8 ²⁾ , 10 ³⁾ d > M39 as agreed for fine-pitch threads d ≤ M39: 04, 05 d < M39 as agreed or denoted in data sheet M3 ≤ d ≤ M39 see 5.6 d < M3 and d > M39 as agreed or denoted in data sheet and for fine-pitch threads d ≤ M39: ISO 898-6 d > M39: as agreed or denoted in data sheet	d ≤ M20: A2-70 ⁴⁾ M20 < d ≤ M39: A2-50 d > M39: as agreed or denoted in data sheet d ≤ M39: ISO 3506 d > M39: as agreed or denoted in data sheet	ISO 8839
Tolerances	<u>Product grade</u> Reference standard	d ≤ M16: A d > M16: B ISO 4759 part 1		
Finish		As processed Requirements for electroplating are covered in ISO 4042	Plain	Plain
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

¹⁾ The property class of mating bolt shall be 6.8 or any other class that the assembly have the capability of being tightened to the bolt proof load without thread stripping occurring.

²⁾ The property class of mating bolt shall be 8.8 or any other class that the assembly have the capability of being tightened to the bolt proof load without thread stripping occurring.

³⁾ The property class of mating bolt shall be 10.9 or any other class that the assembly have the capability of being tightened to the bolt proof load without thread stripping occurring.

⁴⁾ Mating bolts shall have the same property class of nuts.

5.7.2 Specification for hexagon nuts, style 2, Grades A and B shall be as given in Table 53 and dimensions of required nuts "as specified in data sheet" shall comply with ISO 4033. These nuts will be ordered with thread size of either M5, M6, M8, M10, M12, M16, M20, M24, M30 and M36. Dimensions of fine pitch thread, which may be ordered with thread size of either M8, M10, M12, M16, M20, M24, M30 and M36, shall comply with ISO 8674. Style 1 hexagon nuts are not in prime consider and shall only be supplied if ordered in special cases otherwise hexagon nuts of style 2 shall be supplied.

Non-preferred sizes given in the above mentioned standards shall not be supplied unless otherwise specified in data sheet.

TABLE 53 - SPECIFICATION OF HEXAGON NUTS, STYLE 2 GRADES A AND B

MATERIAL		STEEL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	<u>6g</u> According to Clauses 5.3.1.2 and 5.3.1.3 and for fine pitch threads ISO 261, ISO 965-2
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	9 - 12 ²⁾ For fine pitch threads d ≤ 16 mm: 8 ³⁾ , 12 ²⁾ d ≤ 39 mm: 10 ⁴⁾ in accordance with data sheet Subclause 5.7 and for fine pitch threads ISO 898-6
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A for products with d ≤ M16 B for products with d > M16 ISO 4759-1
Finish		As processed Requirements for electroplating are covered in ISO 4042.
Acceptability		Acceptance procedure, shall be in accordance with ISO 3269.

¹⁾ The property class of mating bolt shall be 8.8 or any other class that the assembly have the capability of being tightened to the bolt proof load without thread stripping occurring.

²⁾ The property class of mating bolt shall be 12.9 or any other class that the assembly have the capability of being tightened to the bolt proof load without thread stripping occurring.

³⁾ The property class of mating bolt shall be 10.9 or any other class that the assembly have the capability of being tightened to the bolt proof load without thread stripping occurring.

⁴⁾ The property class of mating bolt shall be 12.9 or any other class that the assembly have the capability of being tightened to the bolt proof load without thread stripping occurring.

5.7.3 Specification for hexagon nuts-Grade C shall be as given in Table 54 and dimensions of required nuts "as denoted in data-sheet" which may either be M5, M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56 and M64 shall comply with ISO 4034. Unless otherwise specified in data sheet the non-preferred thread size with related dimensions shall not be supplied.

TABLE 54 - SPECIFICATION FOR HEXAGON NUTS-GRADE C

MATERIAL		STEEL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	<u>7H</u> According to Clauses 5.3.1.2 and 5.3.1.3
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	d ≤ M16: 5 ¹⁾ M16 < d ≤ M39: 4 ¹⁾ , 5 (in accordance with data sheet) d > M39: as agreed or as denoted in data sheet d ≤ M39: see subclause 5.7 d > M39: as agreed
Tolerances	<u>Product grade</u> <u>Reference standard</u>	<u>C</u> ISO 4769/1
Finish		As processed Requirements for electroplating are covered in ISO 4042.
Acceptability		Acceptance procedure, shall be in accordance with ISO 3269.

¹⁾ The property class of mating bolt shall be 3.6 or any other class that the assembly have the capability of being tightened to the bolt proof load without thread stripping occurring

5.7.4 Hexagon nuts with flange - Grade A

Specification for these nuts which may be ordered with thread size of either M5, M6, M8, M10, M12, M16 and M20 shall comply with Table 55 and dimensions of required nuts "as denoted in data sheet" shall be as given in ISO 4161.

TABLE 55 - SPECIFICATION FOR HEXAGON NUTS WITH FLANGE-GRADE A

MATERIAL		STEEL	STAINLESS STEEL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6H According to Clauses 5.3.1.2 and 5.3.1.3	
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	8, 9, 10 and 12 ¹⁾ In accordance to data sheet See 5.3.1 and 5.7	A2-70 ISO 3506
Tolerances	<u>Product grade</u> <u>Reference standard</u>	A ISO 4769-1	
Finish		As processed Requirements for electroplating are covered in ISO 4042.	Plain
Acceptability		Acceptance procedure, shall be in accordance with ISO 3269.	

¹⁾ For nuts with property classes of 8 or 9 the mating bolt shall have the property class of 8.8. For nuts with property class of 10 the mating bolt shall have the property class of 10.9. For nuts with property class of 12 the mating bolt shall have the property class of 12.9. Instead of above mentioned property classes any bolts with any property class may be supplied "if required" but the assembly shall have the capability of being tightened to the bolt proof load without thread stripping occurring.

5.7.5 Hexagon thin nuts (chamfered) - Grades A and B

Specification for these nuts which may be ordered with thread size of either M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56, M64 shall be as given in Table 56 and the dimensions of required nuts "denoted in data sheet" shall comply with ISO 4035. Non preferred sizes which are given in the above mentioned standard shall not be supplied "unless otherwise stated in data sheet".

TABLE 56 - SPECIFICATIONS OF HEXAGON THIN NUTS-GRADES A AND B

MATERIAL		STEEL	STAINLESS STEEL	NON-FERROUS METAL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6H In Accordance with 5.3.1.2 and 5.3.1.3.3		
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	d < M3: 14H M3 ≤ d ≤ M39: 04 ¹⁾ , 05 ¹⁾ d > M39 as agreed or denoted in data sheet d < M3: ISO 898/5 M3 ≤ d ≤ M39: ISO 898/2 d > M39: as agreed or denoted in data sheet	d ≤ M20: A2-70 ²⁾ M20 < d ≤ M39: A2-50 d > M39: as agreed or denoted in data sheet d ≤ M39: ISO 3506 d > M39: as agreed or denoted in data sheet	ISO 8839
Tolerances	<u>Product grade</u> <u>Reference standard</u>	d ≤ M16: A d > M16: B ISO 4759/1		
Finish		As processed Requirements for electroplating are covered in ISO 4042	Plain	Plain
Acceptability		Acceptance procedure shall be in accordance with ISO 3269		

¹⁾ The property class of mating bolts shall be 6.8 but however the assembly of bolts and nuts shall have the capability of being tightened to mating bolt proof load without thread stripping occurring.

²⁾ Mating bolts shall have the same property class of nuts.

5.7.6 Hexagon nuts for fine mechanics - Grade F

Specification for these nuts "which may be ordered with thread diameters of either M1, M1.2, and M1.4 shall be as given in Table 57 and dimensions of required nuts "denoted in data sheet" shall comply with ISO 4166.

TABLE 57 - SPECIFICATION FOR HEXAGON NUTS - GRADE F

MATERIAL		STEEL	STAINLESS STEEL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	5H According to Clauses 5.3.1.2 and 5.3.1.3 or ISO 261 and ISO 965	
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	11 H (Steel min. 110 HV) 14 H (Steel min. 140 HV) ISO 898/5	A1 A4 (In accordance with data sheet) ISO 3506
Tolerances	<u>Product grade</u> <u>Reference standard</u>	F ISO 4769-1	
Finish		Plain Requirements for electroplating are covered in ISO 4042.	
Acceptability		Acceptance procedure, shall be in accordance with ISO 3269.	

5.7.7 Hexagon nuts for structural bolting - Property Classes 5, 6 & 8

Specifications of these nuts "which may be ordered with thread size of either M10, M12, M16, M20, M24, M30 and M36 shall be as given in Table 58 and dimensions of required nuts "denoted in data sheet" shall comply with ISO 7413.

TABLE 58 - SPECIFICATIONS OF HEXAGON NUTS FOR STRUCTURAL BOLTING WITH PROPERTY CLASSES 5 AND 8

MATERIAL		STEEL
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	6AX ¹⁾ ISO 261 and annex of ISO 7413
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	5 - 8 ²⁾ In accordance with data sheet See 5.3.1 and 5.7
Tolerances	<u>Product grade</u> <u>Reference standard</u>	Grade A up to M16, Grade B over M16 ISO 4759/1
Surface finish	<u>Type</u> <u>Reference standard</u>	Hot-dip galvanized ISO 1461
Acceptability		Acceptance procedure, shall be in accordance with ISO 3269.

¹⁾ Proof load and proof stress values of these nuts shall comply with the clause 5 of ISO 7413.

²⁾ For nuts with property class of 5 the mating bolts shall have the property class of 5.6.

For nuts of 8 the mating bolts shall have the property class of 8.8 and/or any bolts with any property class which the assemblies have capability of being tightened to the bolt proof load without thread stripping occurring.

5.7.8 Hexagon nuts for structural bolting - Grad A property Class 9

Specifications for these nuts "which may be ordered with thread diameters of either M10, M12 and M16 shall comply with Table 59 and dimensions of required nuts "as denoted in data sheet" shall be in accordance with ISO 7417.

**TABLE 59 - SPECIFICATION OF HEXAGON NUTS FOR STRUCTURAL BOLTING
GRADE A AND PROPERTY CLASS 9**

MATERIAL		STEEL
Thread	<u>Tolerance class</u> Tolerance values	<u>6AX¹⁾</u> ISO 261 and annex of ISO 7413
Mechanical properties	<u>Property class</u> Reference standard	<u>9²⁾</u> See 5.3.1 and 5.7
Tolerances	<u>Product grade</u> Reference standard	<u>A</u> ISO 4759/1
Surface finish	<u>Type</u> Reference standard	<u>Hot-dip galvanized</u> ISO 1461
Acceptability		Acceptance procedure, shall be in accordance with ISO 3269.

¹⁾ Proof load stress shall in accordance with Clause 5 of ISO 7417.

²⁾ The property class of mating bolts shall be 8.8 or any bolt which the assembly shall have the capability of being tightened to the bolt proof load without thread stripping occurring.

5.7.9 Hexagon nuts for high-strength structural bolting with large width across flats Grade B property classes 8 and 10

Specifications for these nuts which may be ordered with thread sizes of either M16, M20, M24, M30 and M36 shall comply with Table 60 and dimensions of required nuts "as denoted in data sheet" shall be in accordance with ISO 4775. Nuts with thread sizes of M12, M22, M27 with related dimensions are not preferred but shall be supplied if required.

**TABLE 60 - SPECIFICATIONS OF HEXAGON NUTS FOR HIGH - STRENGTH
STRUCTURAL BOLTING WITH LARGE WIDTH ACROSS FLATS**

MATERIAL		STEEL
Thread	<u>Tolerance class</u> Tolerance values	<u>6H or 6AX</u> According to 5.3.1.2 and 5.3.1.3 and Annex A of ISO 4775
Mechanical properties	<u>Property class</u> Reference standard	<u>8¹⁾ or 10^{1, 2)} (In accordance with data sheet)</u> According to 5.3.1 and 5.7
Surface finish	<u>Normal</u> <u>Optional</u>	<u>Black oxide³⁾</u> <u>Zinc electroplated^{2, 5)}</u> <u>Cadmium electroplated²⁾</u> Hot-dip galvanized to ISO 1461
Tolerances	<u>Product grade</u> Reference standard	<u>B except nut height m and c</u> ISO 4759/1 ⁴⁾
Acceptability		For acceptance procedure, see ISO 3269
Associated Bolts		ISO 7411 or ISO 7412
Associated washers		ISO 7415 or ISO 7416

¹⁾ For proof load values, see clause 6 of ISO 4775. For nuts of 8, mating bolts shall have the property class of 8.8 and for nuts of 10, mating bolts shall have the property class of 10.9 but however any bolt with any property class may be mated provided that the assembly shall have the capability of being tightened to the bolt proof load without thread stripping occurring.

²⁾ Precautions to avoid hydrogen embrittlement may be necessary for property class 10.

³⁾ Black oxide means the normal finish resulting from manufacture with a light coating of oil.

⁴⁾ Except tolerance on perpendicularity of bearing face.

⁵⁾ For fasteners with zinc electroplated or hot-dip galvanized coatings the manufacturer shall apply a suitable lubricant coating on the nuts or on the mating bolts to ensure that seizure shall not take place in assembly. Information on a suitable test for the effectiveness of the lubricant coating given in annex B of ISO 4775.

5.7.10 Hexagon nuts for structural bolting with large width across flats Grade B - property Class 10

Specifications for these nut "which may be ordered with thread sizes of either M16, M20, M24, M30 and M36 shall comply with Table 61 and dimensions of required nuts "as denoted in data sheet" shall be in accordance with ISO 4714.

Nuts with thread sizes of M12, M22 and/or M27 with related dimensions are not preferred but shall be supplied if required.

**TABLE 61 - SPECIFICATION OF HEXAGON NUTS FOR STRUCTURAL BOLTING
WITH LARGE WIDTH ACROSS FLATS - GRADE B**

MATERIAL		STEEL
Thread	<u>Tolerance class</u> Tolerance values	<u>6H or 6AZ</u> According to 5.3.1.2 and 5.3.1.3 and Annex A of ISO 7414
Mechanical properties	<u>Property class</u> Reference standard	<u>10 ¹⁾</u> See 5.3.1 and 5.7
Surface finish	<u>Normal</u> <u>Optional</u>	<u>Black oxide ²⁾</u> Zinc electroplated ³⁾ Cadmium electroplated ³⁾ Hot-dip galvanized to ISO 1461
Tolerances	<u>Product grade</u> Reference standard	<u>B</u> ISO 4759/1 ⁴⁾
Acceptability		Acceptance procedure shall be in accordance with ISO 3269
Associated Bolts		ISO 7411 or ISO 7412
Associated washers		ISO 7415 or ISO 7416

Notes:

¹⁾ For proof load values, see clause 6 of ISO 7414. The property class of mating bolts shall be 10.9 or bolts with any property class which the assembly shall have the capability of being tightened to the bolt proof load without thread stripping occurring.

²⁾ Black oxide means the normal finish resulting from manufacture with a light coating of oil.

³⁾ Precautions to avoid hydrogen embrittlement may be necessary for property Class 10.

⁴⁾ Except tolerance of perpendicularity of bearing surface.

5.7.11 Specification for prevailing torque type all-metal hexagon nuts

Style 1 of these nuts may be ordered with property class of either 5,8 or 10 (in accordance with data sheet).

Dimensions of style 1 nuts which may be ordered with thread size of either M5, M6, M8, M10, M12, M16, M20, M24, M30 and M36 shall comply with ISO 7719.

Style 2 of these nuts shall be of property class 9 and Dimensions of Style 2 nuts which may be ordered with thread size of either M5, M6, M8, M10, M12, M16, M20, M24, M30 and M36 shall comply with ISO 7720, normal friction Type (NF)¹⁾ or low friction Type (LF)²⁾ of nuts may be required in both styles. Other specifications of prevailing torque type hexagon nuts shall be as given in Table 62.

Notes:

1) Normal friction nuts usually have zinc electroplated finish plus a chromate or phosphate conversion coating with or without supplementary lubricants to meet the torque tension requirements.

2) Low friction nuts usually have a finish which is either cadmium electroplated with a supplementary EP (Extreme Pressure) lubricant, or phosphate coated (zinc or manganese) with a rust preventive oil containing an EP lubricant to meet the torque tension requirements.

**TABLE 62 - SPECIFICATION FOR PREVAILING TORQUE TYPE
ALL METAL HEXAGON NUTS**

MATERIAL		According to Relevant Requirements on 5.3.1 and 5.7
Thread	<u>Tolerance class</u> Tolerance values	<u>6H</u> According to 5.3.1.2 and 5.3.1.3
Mechanical properties	<u>Property class</u> Reference standard	<u>5, 8, 9¹⁾, 10 (In accordance with data sheet)</u> See Table 51
Torque and other reference requirements		See sub-clause 5.7
Tolerances	<u>Product grade</u> Reference standard	<u>For d ≤ M16: A - For d > M16: B</u> ISO 4759/1
Finish		As processed Requirements for electroplated coating are covered in ISO 4042
Acceptability		Acceptance procedure shall be in accordance with ISO 3269

¹⁾ Property class of mating bolts for nuts of 5 shall be 5.6, for nuts of 8 and 9 shall be 8.8 and for nuts of 10 shall be 10.9 but however the assembly shall have the capability of being tightened to the proof load without thread stripping occurring.

5.7.12 Specification for prevailing torque type all-metal hexagon nuts with flange which may be ordered with thread size of either M5, M6, M8, M10, M12, M16 and M20 shall comply with Table 63. Dimensions of these nuts shall be in accordance with ISO 7044.

TABLE 63 - SPECIFICATION FOR PREVAILING TORQUE TYPE ALL-METAL HEXAGON NUTS WITH FLANGE

Nuts	<u>Types</u> <u>Reference</u>	<u>NF (Normal Friction) and LF (Low Friction)</u> See 4.5.11
Material		According to Relevant Requirements on 5.3.1 and 5.6
Thread	<u>Tolerance class</u> <u>Reference standard</u>	<u>6H</u> According to 5.3.1.2 and 5.3.1.3
Mechanical properties	<u>Property class</u> <u>Reference standard</u>	<u>8, 9, 10, 12 (\leq M16) ¹⁾</u> See Table 30
Torque and other reference requirements ¹⁾		See sub-clause 5.7
Tolerances	<u>Product grade</u> <u>Reference standard</u>	<u>A</u> ISO 4759/1
Finish		As processed Requirements for electroplated coating are covered in ISO 4042
Acceptability		Acceptance procedure shall be in accordance with ISO 3269

Note:

¹⁾ Property class of mating bolts shall be such that the failure of assembly due to over tightening occur as bolt shank fracture rather than thread stripping.

5.7.13 Specification for prevailing torque type nuts with non-metallic insert

Style 1 of these nuts may be ordered with thread size of either M3, M4, M5, M6, M8, M12, M16, M20, M24, M30 and M36. Property class of either 5 or 8 or 10 in accordance with data sheet. Dimensions of style 1 nuts shall comply with ISO 7040. Style 2 of these nuts may be ordered with thread size of M5, M6, M8, M10, M12, M16, M20, M24, M30 or M36 and property class of either 9 or 12 and Dimensions of style 2 nuts shall comply with ISO 7041. Normal friction type (NF) or low friction type (LF) of nuts may be required in both styles. Other specifications of prevailing torque type nuts with non-metallic insert shall be as given in Table 64.

TABLE 64 - SPECIFICATION FOR PREVAILING TORQUE TYPE NUTS WITH NON-METALLIC INSERT

Nuts	<u>Types</u> <u>Reference</u>	<u>NF (Normal Friction) and LF (Low Friction)</u> (According to data sheet) See 5.6.11
Material	<u>Nut body</u> <u>Reference</u> <u>Insert</u> <u>Reference</u>	<u>Steel</u> See 5.7 and Tables 50 and 51 "Unless otherwise specified" Polyamid ISO 2320
Thread	<u>Tolerance class</u> <u>Tolerance values</u>	<u>6H</u> According to 5.3.1.2 and 5.3.1.3
Mechanical properties	<u>Property class</u> <u>Reference</u>	<u>5, 8, 9, 10, 12 (According to data sheet) ¹⁾</u> See Table 51
Torque and other reference requirements		See 5.7
Tolerances	<u>Product grade</u> <u>Reference standard</u>	<u>For d \leq M16: A - For d > M16: B</u> ISO 4759/1
Finish		As processed Requirements for electroplated coating are covered in ISO 4042
Acceptability		Acceptance procedure shall be in accordance with ISO 3269

¹⁾ Property class of mating bolts shall be such that the failure of assembly to overtightening occur as bolt shank fracture rather than thread stripping.

5.7.14 Specification for prevailing torque type hexagon nuts with flange (with non-metallic insert)

Dimensions of these nuts which may be ordered with thread size of either M5, M6, M8, M10, M12, M16 and M20 shall be in accordance with ISO 7043 and the other specifications shall comply with Table 65.

TABLE 65 - SPECIFICATION FOR PREVAILING TORQUE TYPE HEXAGON NUTS WITH FLANGE (WITH NON-METALLIC INSERT)

Nuts	<u>Types</u> Reference	NF (Normal Friction) and LF (Low Friction) (According to data sheet) See 5.6.11
Material	<u>Nut body</u> Reference <u>Insert</u> International standard	Steel See 5.7 and Tables 50 and 51 Polyamid "Unless otherwise specified" ISO 2320
Thread	<u>Tolerance class</u> International standards	6H According to 5.3.1.2 and 5.3.1.3
Mechanical properties	<u>Property class</u> Reference	8, 9, 10 (According to data sheet) ¹⁾ See Table 51
Torque and other reference requirements		See 5.7
Tolerances	<u>Product grade</u> Reference standard	A ISO 4759/1
Finish		As processed Requirements for electroplated coating are covered in ISO 4042
Acceptability		Acceptance procedure shall be in accordance with ISO 3269

¹⁾ Property class of mating bolts shall be such that the failure of assembly due to overtightening occur as bolt shank fracture rather than thread stripping.

5.7.15 Square nuts of grade C which may be ordered with thread size of either M5, M6, M8, M10, M12, M16 and M20 shall comply with DIN 557.

5.7.16 Square thin nuts of grade B which may be ordered with thread size of either M1.6, M2, M2.5, M3, M4, M5, M8 or M10 shall comply with DIN 562.

5.7.17 Square weld nuts which may be ordered with thread size of either M4, M5, M6, M8, M10, M12, M14, or M16 shall comply with DIN 928.

5.7.18 Hexagon slotted nuts and castle nuts with metric coarse and fine pitch thread of grades A and B which may be ordered with thread size of either M4, M5, M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56, M64, M80, M90 and M100 shall comply with DIN 935 Part 1.

5.7.19 Hexagon slotted nuts with metric coarse pitch thread of grade C which may be ordered with thread size of either M12, M16, M20, M24, and M30 shall comply with DIN 935 Part 3.

5.7.20 Hexagon weld nuts which may be ordered with thread size of either M3, M4, M5, M6, M7, M8, M10, M12, M14 and M16 shall comply with DIN 929.

5.7.21 Wing nuts which may be ordered with thread size of either M4, M5, M6, M8, M10, M12, M16, M20 and M24 shall comply with DIN 315.

5.7.22 Slotted round nuts which may be ordered with thread size of either M1, M1.2, M1.4, M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16 and M20 shall comply with DIN 546.

5.7.23 Round nuts with drilled holes in one face which may be ordered with thread size of either M2, M2.5, M3, M4, M5, M6, M8 and M10 shall comply with DIN 547.

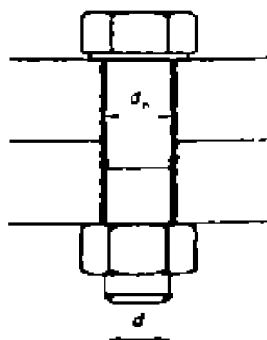
5.7.24 Round nuts with set pin holes in side which may be ordered with threads sizes of M2, M2.5, M3, M4, M5, M6, M8 and M10 shall comply with DIN 548.

5.7.25 Self locking counter nuts which may be ordered with thread size of either M4, M5, M6, M8, M10, M12, M14, M16, M18, M20, M22, M24, M27, M30, M33, M36, M39, M42, M45, M48 and M52 shall comply with DIN 7967.

5.8 Specific Requirements for Washers

5.8.1 Requirements for non percised washers. Non percised washers at least shall have the following specifications.

5.8.1.1 The clearance holes of washers for specified bolts, screws and studs "if required" shall conform with the following Table and if desired sery is not mentioned the values given in medium sery shall be applicable.



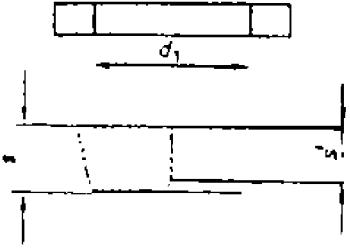
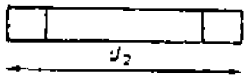
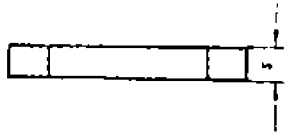
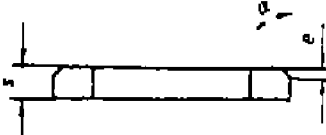
THREAD DIAMETER D	CLEARANCE d_n
1.6	1.8
1.8	2.1
2.0	2.4
2.5	2.9
3.0	3.4
3.5	3.9
4.0	4.5
4.5	5.0
5.0	5.5
6.0	6.6
7.0	7.6
8.0	9.0
10.0	11.0
12.0	13.5
14.0	15.5
16.0	17.5
18.0	20.0
20.0	22.0
22.0	24.0
24.0	26.0
27.0	30.0
30.0	33.0
33.0	36.0
36.0	39.0
39.0	42.0
42.0	45.0
45.0	48.0
48.0	52.0
52.0	56.0
56.0	62.0
60.0	66.0
64.0	70.0
68.0	74.0

5.8.1.2 The outside diameter of washers shall comply with data-sheet which is selected from the following series in mm; 2,6, 3, 3,6, 4, 4,5, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 18, 20, 22, 24, 28, 30, 34, 37, 39, 44, 50, 56, 60, 66, 72, 78, 80, 85, 92 and 98.

5.8.1.3 The thicknesses of washers shall comply with data-sheet which is selected from the following series in mm; 0,3, 0,5, 0,8, 1, 1,2, 1,6, 2, 2,5, 3, 4, 5, 6, 8, 10, 12, 14, 16, 18.

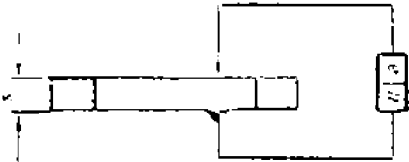
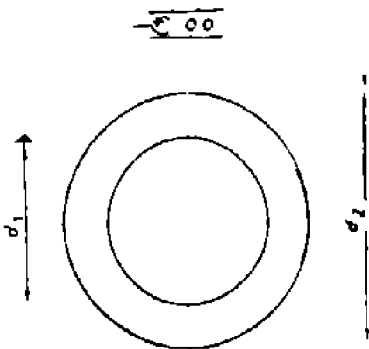
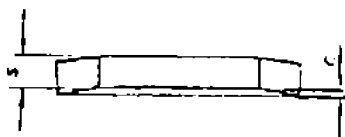
5.8.1.4 Tolerances for washers shall be in accordance with Table 66.

TABLE 66 - TOLERANCES FOR WASHERS

FEATURE	TOLERANCES			
	Product grade A		Product grade C	
Clearance holes 	s mm	d ₁	s mm	d ₁ tol.
	≤ 4 > 4	H13 H14	≤ 4 > 4	H14 H15
	s mm	s' min.	s mm	s' min.
	≤ 4 > 4	0.5 s _{nom} 0.3 s _{nom}	≤ 4 > 4	0.5 s _{nom} 0.3 s _{nom}
Outside diameter 	s mm	d ₂ tol.	d ₂ tol.	
	≤ 4 > 4	h14 ¹⁾ h15	h16	
Thickness 	s mm	tol. mm	s mm	tol. mm
	≤ 0.5 > 0.5 ≤ 1	±0.05 ±0.1	≤ 1 > 1 ≤ 2.5	±0.2 ±0.3
	> 1 ≤ 2.5	±0.2	> 2.5 ≤ 4	±0.6
	> 2.5 ≤ 4	±0.3	> 4 ≤ 6	±1
	> 4 ≤ 6	±0.6	> 6 ≤ 10	±1.2
	> 6 ≤ 10	±1	> 10 ≤ 20	±1.6
	> 10 ≤ 20	±1.2		
Chamfer 	$\alpha \approx 30 \text{ to } 45^\circ$ $e_{\min} = 0.25 s$ $e_{\max} = 0.5 s$			

1) See ISO 286.

Table 66 (continued)

FEATURE	TOLERANCES			
	Product grade A		Product grade C	
Tolerances for form and position parallelism 	s mm	a mm	s mm	a mm
	≤ 0.5 $> 0.5 \leq 1$ $> 1 \leq 2.5$ $> 2.5 \leq 4$ $> 4 \leq 6$ $> 6 \leq 10$ $> 10 \leq 20$	0.025 0.05 0.1 0.15 0.2 0.3 0.4	≤ 1 $> 1 \leq 2.5$ $> 2.5 \leq 4$ $> 4 \leq 6$ $> 6 \leq 10$ $> 10 \leq 20$	0.2 0.2 0.3 0.5 0.6 1
Note: The tolerance for parallelism is valid if the washer is in flat position.				
Concentricity (coaxiality) 	d_1 mm	b	d_2 mm	b
	≤ 50 > 50	2 IT 12 ¹⁾ 2 IT 13 ¹⁾	≤ 50 > 50	2 IT 15 2 IT 16
Note: Tolerance based on dimension d_2				
Flatness 	s mm	$C^{2)}$ mm	s mm	$C^{2)}$ mm
	$\leq .5$ $> 0.5 \leq 1$ $> 1 \leq 2.5$ $> 2.5 \leq 4$ $> 4 \leq 6$ $> 6 \leq 10$ $> 10 \leq 20$	0.1 0.15 0.2 0.3 0.4 0.6 1	≤ 1 $> 1 \leq 2.5$ $> 2.5 \leq 4$ $> 4 \leq 6$ $> 6 \leq 10$ $> 10 \leq 20$	0.25 0.5 0.8 1.2 1.8 3
Note: Tolerance C always independent of thickness tolerance for s.				

1) See ISO 286

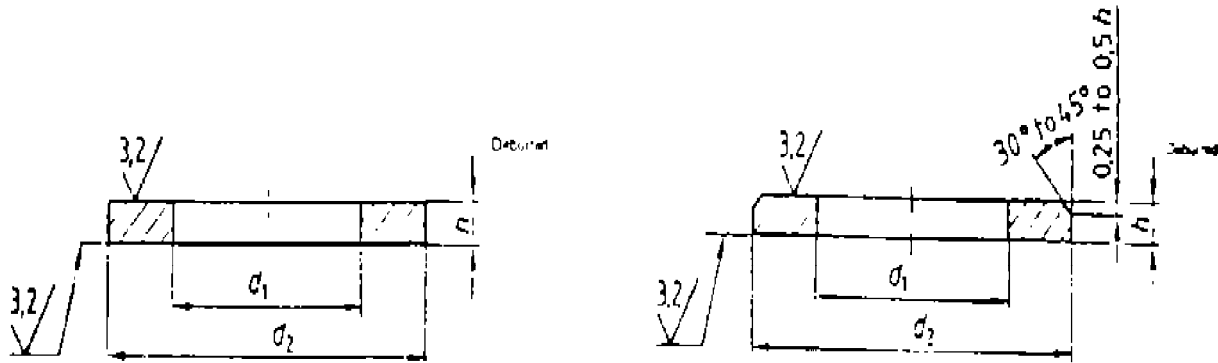
1) See ISO 286

2) For washers made from stainless steel the maximum permissible unflatness is Z_c .

5.8.2 Specification for normal series of plain washers - product Grade A

Dimensions shall conform with Table 67 and other properties shall comply with Table 68.

Washers with nominal size of 5 and over may be chamfered "if required". Dimensions and other properties of chamfered washers shall comply with Tables 67 and 68.



(CHAMFERED WASHERS)

TABLE 67 - DIMENSIONS OF PLAIN WASHERS - NORMAL SERIES - GRADE A

NOMINAL SIZE (thread size, d)	CLEARANCE HOLE d_1		OUTSIDE DIAMETER d_2		THICKNESS h		
	nom.(min.)	max.	nom.(max.)	min.	nom.	max.	min.
1.6	1.7	1.84	4	3.7	0.3	0.35	0.25
2	2.2	2.34	5	4.7	0.3	0.35	0.25
2.5	2.7	2.84	6	5.7	0.5	0.55	0.45
3	3.2	3.38	7	6.64	0.5	0.55	0.45
3.5	3.7	3.88	8	7.64	0.5	0.55	0.45
4	4.3	4.48	9	8.64	0.8	0.9	0.7
5	5.3	5.48	10	9.64	1	1.1	0.9
6	6.4	6.62	12	11.57	1.6	1.8	1.4
8	8.4	8.62	16	15.57	1.6	1.8	1.4
10	10.5	10.77	20	19.18	2	2.2	1.8
12	13	13.27	24	23.48	2.5	2.7	2.3
14	15	15.27	28	27.48	2.5	2.7	2.3
16	17	17.27	30	29.48	3	3.3	2.7
20	21	21.33	37	36.38	3	3.3	2.7
24	25	25.33	44	43.38	4	4.3	3.7
30	31	31.39	56	55.26	4	4.3	3.7
36	37	37.62	66	64.8	5	5.6	4.4

TABLE 68 - PROPERTIES OF PLAIN WASHERS - NORMAL SERIES - GRADE A

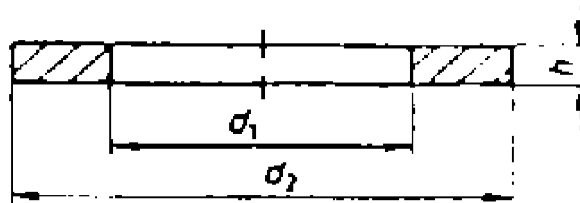
MATERIAL		STEEL			AUSTENITIC STAINLESS STEEL		
Mechanical properties	Classes	140 HV	200 HV	300 HV	A 140	A 200	A 350
	Reference	In accordance with data sheet					
	Hardness HV ¹⁾	140 min.	200 300	300 400	140 min.	200 300	300 400
Tolerances	Product grade Tolerance values	A According to Table 66					
Surface finish		Plain, debarred Requirements for electroplating are given in ISO 1456, ISO 1457, ISO 1458, and ISO 2081					
Acceptability		The acceptance procedure, shall be in accordance with ISO 3269					

¹⁾ Vickers hardness.

5.8.3 Specification for normal series of plain washers - product Grade C

Dimensions shall comply with Table 69 and other properties shall be in accordance with Table 70.

TABLE 69 - DIMENSIONS OF PLAIN WASHERS - NORMAL SERIES - GRADE C



NOMINAL SIZE (thread size, d)	CLEARANCE HOLE d_1		OUTSIDE DIAMETER d_2		THICKNESS h		
	nom.(min.)	max.	nom.(max.)	min.	nom.	max.	min.
5	6.6	6.8	10	9.1	1	1.2	0.8
6	6.8	6.98	12	10.9	1.6	1.9	1.3
8	9	9.36	18	14.9	1.6	1.9	1.3
10	11	11.43	20	18.7	2	2.3	1.7
12	13.6	13.93	24	22.7	2.5	2.8	2.2
14	16.6	16.93	28	26.7	2.5	2.8	2.2
16	17.6	17.93	30	28.7	3	3.6	2.4
20	22	22.62	37	36.4	3	3.6	2.4
24	28	28.62	44	42.4	4	4.6	3.4
30	33	33.62	56	54.1	4	4.6	3.4
36	39	40	66	64.1	5	6	4

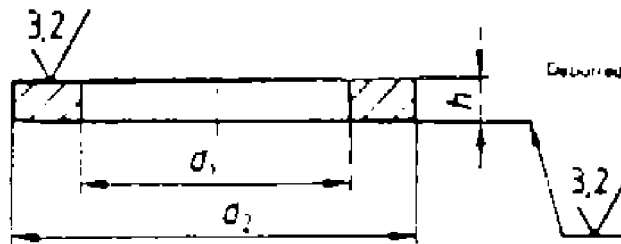
TABLE 70 - PROPERTIES OF PLAIN WASHERS - NORMAL SERIES - GRADE C

MATERIAL		STEEL
Mechanical properties	Class Hardness HV	100 HV 100 min.
Tolerances	Product grade Tolerance values	C According to Table 66
Surface finish		Plain Requirements for electroplating are given in ISO 1456, ISO 1457, ISO 1458, and ISO 2081 Hot dip galvanizing shall be in accordance with ISO 1461
Acceptability		The acceptance procedure, shall be in accordance with ISO 3269

5.8.4 Specification for small series of plain washers product Grade A

Dimensions shall comply with Table 71 and other properties shall comply with Table 72.

TABLE 71 - DIMENSIONS OF PLAIN WASHER - SMALL SERIES - PRODUCT GRADE A



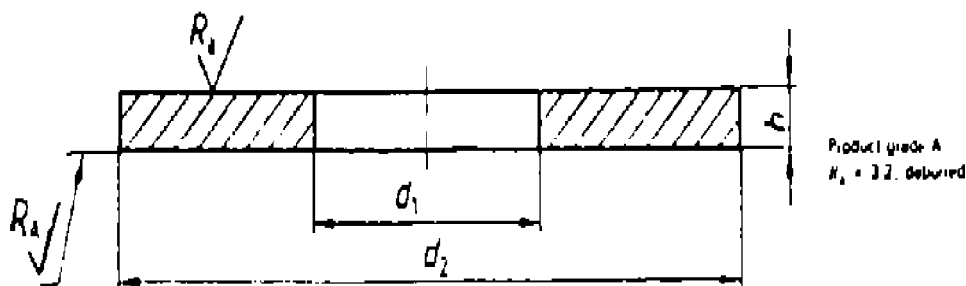
NOMINAL SIZE (thread size, d)	CLEARANCE HOLE d_1		OUTSIDE DIAMETER d_2		THICKNESS h		
	nom.(min.)	max.	nom.(max.)	min.	nom.	max.	min.
1.6	1.7	1.84	3.5	3.2	0.3	0.35	0.25
2	2.2	2.34	4.5	4.2	0.3	0.35	0.25
2.5	2.7	2.84	5	4.7	0.5	0.55	0.45
3	3.2	3.38	6	5.7	0.5	0.55	0.45
3.5	3.7	3.88	7	6.64	0.5	0.55	0.45
4	4.3	4.48	8	7.64	0.5	0.55	0.45
5	5.3	5.48	9	8.64	1	1.1	0.9
6	6.4	6.62	11	10.57	1.6	1.8	1.4
8	8.4	8.62	15	14.57	1.6	1.8	1.4
10	10.5	10.77	18	17.57	1.6	1.8	1.4
12	13	13.27	20	19.48	2	2.2	1.8
14	15	15.27	24	23.48	2.5	2.7	2.3
16	17	17.27	28	27.48	2.5	2.7	2.3
20	21	21.33	34	33.38	3	3.3	2.7
24	25	25.33	39	38.38	4	4.3	3.7
30	31	31.33	50	49.38	4	4.3	3.7
36	37	37.62	60	58.8	5	5.6	4.4

TABLE 72 - PROPERTIES OF PLAIN WASHERS - SMALL SERIES - PRODUCT GRADE A

MATERIAL		STEEL			AUSTENITIC STAINLESS STEEL		
Mechanical properties	Classes	140 HV	200 HV	300 HV	A 140	A 200	A 350
	Reference	According to data sheet					
	Hardness HV	140 min.	200 - 300	300 - 400	140 min.	200 300	300 400
Tolerances	Product grade Tolerance	A According to Table 66					
Surface finish		Plain, debarred Requirements for electroplating are given in ISO 1456, ISO 1457, ISO 1458, and ISO 2081					
Acceptability		The acceptance procedure, shall be in accordance with ISO 3269					

5.8.5 Specification for large series plain washers product grades A and C. The outside diameter of these washers shall be about 3 times of their nominal size. Dimensions shall comply with Table 73. Other properties shall comply with Table 74.

**TABLE 73 - DIMENSIONS OF PLAIN WASHERS - LARGE SERIES
PRODUCT GRADES A AND C**



NOMINAL SIZE (thread size, d)	CLEARANCE HOLE d ₁		OUTSIDE DIAMETER d ₂		THICKNESS h		
	nom.(min.)	max.	nom.(max.)	min.	nom.	max.	min.
3	3.2	3.38	9	8.64	0.8	0.9	0.7
3.5	3.7	3.88	11	10.57	0.8	0.9	0.7
4	4.3	4.48	12	11.57	1	1.1	0.9
5	5.3	5.48	15	14.57	1.2	1.4	1
6	6.4	6.62	18	17.57	1.6	1.8	1.4
8	8.4	8.62	24	23.48	2	2.2	1.8
10	10.5	10.77	30	29.48	2.5	2.7	2.3
12	13	13.27	37	36.38	3	3.3	2.7
14	15	15.27	44	43.38	3	3.3	2.7
16	17	17.27	50	49.38	3	3.3	2.7
20	22	27.52	60	58.1	4	4.6	3.4
24	26	26.84	72	70.1	5	6	4
30	33	34	92	89.8	6	7	5
36	39	40	110	107.8	8	9.2	6.8

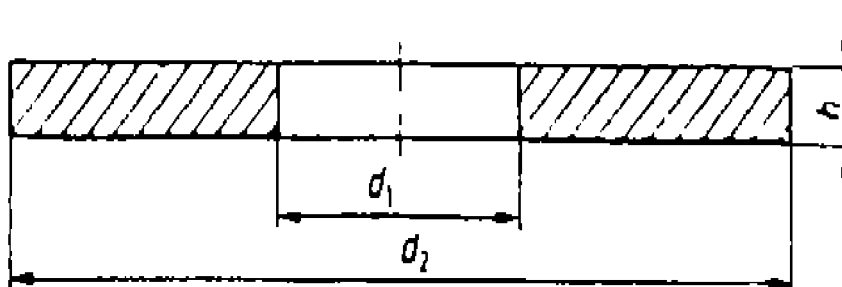
**TABLE 74 - PROPERTIES OF PLAIN WASHERS - LARGE SERIES
PRODUCT GRADES A AND C**

MATERIAL		STEEL	AUSTENITIC STAINLESS STEEL
Mechanical properties	Classes	Grade A: 140 HV	A 140
	Hardness HV	Grade C: 100 HV	
		Grade A: 140 min.	140 min.
		Grade C: 100 min.	
Tolerances	Product grade	A for nominal sizes ≤ 16	A
	Tolerance values	C for nominal sizes >16	
		According to Table 66	According to Table 66
Surface finish		Plain Requirements for electroplating are given in ISO 1456, ISO 1457, ISO 1458, and ISO 2081	
Acceptability		The acceptance procedure, is given in ISO 3269	

5.8.6 Specification for extra large series plain washers - product Grade C

Dimensions of extra large plain washers shall comply with Table 75 and other properties shall comply with Table 76.

TABLE 75 - DIMENSIONS OF EXTRA LARGE PLAIN WASHERS



NOMINAL SIZE (thread size, d)	CLEARANCE HOLE d_1		OUTSIDE DIAMETER d_2		THICKNESS h		
	nom.(min.)	max.	nom.(max.)	min.	nom.	max.	min.
5	5.5	6.8	18	16.9	2	2.3	1.7
6	6.6	6.96	22	20.7	2	2.3	1.7
8	9	9.36	28	26.7	3	3.6	2.4
10	11	11.43	34	32.4	3	3.6	2.4
12	13.5	13.93	44	42.4	4	4.6	3.4
14	15.5	15.93	50	48.4	4	4.6	3.4
16	17.5	18.2	56	54.1	5	6	4
20	22	22.84	72	70.1	6	7	5
24	26	26.84	85	82.8	6	7	5
30	33	34	105	102.8	6	7	5
36	39	40	125	122.5	8	9.2	6.8

TABLE 76 - PROPERTIES OF EXTRA LARGE PLAIN WASHERS

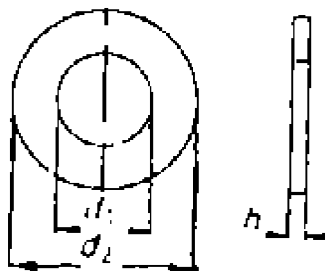
MATERIAL		STEEL
Mechanical properties	Class Hardness HV	100 HV 100 min.
Tolerances	Product grade Tolerance values	C According to Table 66
Surface finish		Plain Requirements for electroplating are given in ISO 1456, ISO 1457, ISO 1458, and ISO 2081 Hot dip galvanizing see ISO 1461
Acceptability		The acceptance procedure, shall be in accordance with ISO 3269

5.8.7 Specifications for hardened and tempered plain washers for high-strength structural bolting

This series is supplied for assembly with large series hexagon high-strength structural bolts and nuts of M12 to M36 inclusive.

Dimensions of these washers shall comply with Table 77 and the other properties shall comply with Table 78, these washers shall be marked or shaped in such a manner so as to differentiate them from other similar products.

TABLE 77 - DIMENSIONS OF PLAIN WASHERS FOR HIGH-STRENGTH STRUCTURAL BOLTING



THREAD SIZE, d, OF ASSOCIATED BOLT		M12	M16	M20	M24	M30	M36
d ₁	min.	14	18	22	26	33	39
	max.	14.43	18.43	22.52	26.52	33.62	39.62
d ₂	min.	25.7	32.4	40.4	48.2	58.1	70.1
	max.	27	34	42	50	60	72
h	min.	3.1	3.1	3.1	3.4	3.4	3.4
	max.	4.6	4.6	4.6	4.6	4.6	4.6

TABLE 78 - PROPERTIES OF PLAIN WASHERS FOR HIGH - STRENGTH STRUCTURAL BOLTING

MATERIAL		STEEL
Mechanical properties	Hardness range (HRC) ¹⁾	35, 45
Tolerances	Product grade Tolerance values	$d_1 : A : h : 2 \text{ IT } 16 \text{ when } d \leq M20$ $d_2 : C : h : \text{ IT } 17 \text{ when } d > M20$ Shall be in accordance with Table 66
Surface finish		Black oxide ²⁾ or zinc electroplated ³⁾ cadmium electroplated ³⁾ hot dip galvanized ³⁾ "as data sheet, if not specified the surface finish shall be black oxide.
Associated nuts		Nuts mentioned in 5.7.9

¹⁾ Minimum hardness for hot dip galvanized washers may be 26 HRC.

²⁾ Black oxide means the normal finish resulting from heat treatment with a residual coating of light oil.

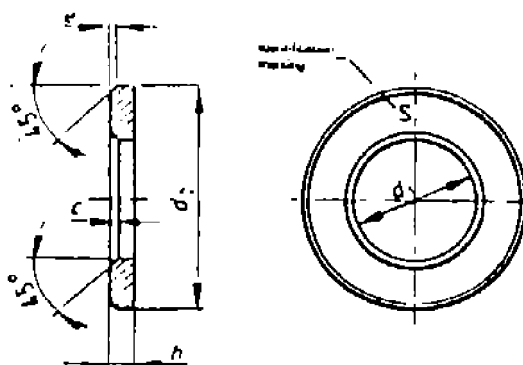
³⁾ Precautions to avoid hydrogen embrittlement is necessary.

5.8.8 Specification for hardened and tempered chamfered plain washers for high-strength structural bolting

This very like as the washers mentioned in sub-subclause 5.8.7 is supplied to be assembled with large hexagon high-strength structural bolts and nuts of M12 to M36 inclusive.

Dimensions of these washers shall comply with Table 79 and the other properties shall be in accordance with Table 80.

TABLE 79 - DIMENSIONS OF CHAMFERED PLAIN WASHERS FOR HIGH-STRENGTH STRUCTURAL BOLTING



THREAD SIZE, d, OF ASSOCIATED BOLT		M12	M16	M20	M24	M30	M36
d_1	min.	13	17	21	25	31	37
	max.	13.2	17.27	21.33	25.33	31.62	37.62
d_2	min.	23.7	31.4	38.4	45.4	54.1	64.1
	max.	25	33	40	47	56	66
h	min.	3.4	3.4	3.4	3.4	4.4	4.4
	max.	4.6	4.6	4.6	4.6	5.6	5.6
e		0.5	1	1	1	1	1
c	min.	1.2	1.2	1.6	1.6	2.0	2.4
	max.	1.6	1.6	2.0	2.0	2.6	2.8

TABLE 80 - PROPERTIES OF CHAMFERED PLAIN WASHERS FOR HIGH-STRENGTH STRUCTURAL BOLTING

MATERIAL		STEEL
Mechanical properties	Hardness range (HRC) ¹⁾	35, 45
Tolerances	Product grade Reference	d_1 : d_2 : C : h : IT 17 ¹⁾ Shall be in accordance with Table 66
Surface finish	Normal Optional	Black oxide ²⁾ or Zinc electroplated ³⁾ or cadmium electroplated ³⁾ or hot dip galvanized ³⁾ "as data sheet" and if not specified in data sheet the surface finish shall be black oxide
Associated bolts "if required"		See 5.3.3.2 / ISO 7411 and ISO 7412
Associated nuts "if required"		Nuts mentioned in 5.7.9 and 5.7.10 or ISO 4775 and ISO 7414

¹⁾ Minimum hardness for hot-dip galvanized washers may be 26 HRC.

²⁾ Black oxide means the normal finish resulting from heat treatment with a light coating of oil.

³⁾ Precautions to avoid hydrogen embrittlement may be necessary.

- See ISO 286

5.8.9 Tab washers with long tap shall comply with DIN 93.

5.8.10 Curved and wave spring lock washers shall conform with DIN 128.

5.8.11 Curved and wave spring washers shall comply with DIN 137.

5.8.12 External tab washers (locking tab washers) shall comply with DIN 432.

5.8.13 Tab washers with long and short tap at right angles shall conform with DIN 463.

5.8.14 Conical spring washers which are used for bolt/nut assemblies shall conform with DIN 6796.

5.8.15 Toothed lock washers shall comply with DIN 6797.

5.8.16 Serrated lock washers shall comply with DIN 6798.

5.8.17 Spring lock washers with safety ring shall comply with DIN 6913.

5.8.18 Curved spring washers shall comply with DIN 6904.

5.8.19 Spring washers shall comply with DIN 6905.

5.8.20 Lock washers shall comply with DIN 6906.

6. MARKING

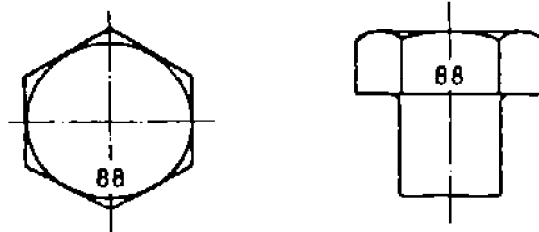
Marking shall be as below. Marking other than that mentioned in this Standard, is applicable by written permission of the Company.

6.1 Marking of bolts, screws and studs made of carbon steel or alloy steel with the exception of set screws and similar threaded fasteners not under tensile stresses.

6.1.1 Hexagon bolts and screws

Hexagon bolts and screws shall be marked with the designation symbol of the property class. The marking is obligatory for all property classes, preferably on the top of the head by indenting or embossing or on the side of the head by indenting.

Examples of marking on hexagon bolts and screws shown below:



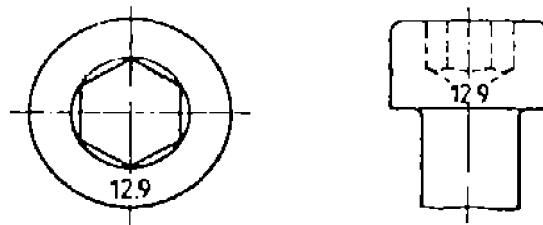
Marking is required for hexagon bolts and screws with nominal diameters $d \geq 5$ mm where the shape of the product allows it, preferably on the head.

6.1.2 Hexagon socket head cap screws

Hexagon socket head cap screws shall be marked with the designation symbol of the property class.

The marking is obligatory for all property classes preferably on the side of the head by indenting or on the top of the head by indenting or embossing.

Examples of marking on hexagon socket head cap screws shown below:



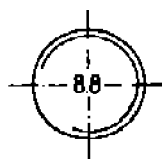
Marking is required for hexagon socket head cap screws with nominal diameters $d \geq 5$ mm where the shape of the product allows it, preferably on the head.

6.1.3 Studs

Studs shall be marked with the designation symbol of the property class.

The marking is obligatory for property classes equal to or higher than 8.8, preferably on the extreme end of the threaded portion by indenting (see figure below). For studs with interference fit, the marking shall be at the nut end.

Marking is required for studs with nominal diameters equal to or greater than 5 mm.



MARKING OF STUD

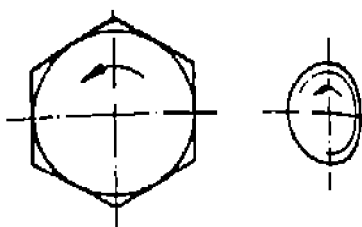
The symbols in the below table are permissible as an non-preferred alternative identification method.

IDENTIFICATION MARKS FOR STUDS

Property class	8.8	9.8	10.9	12.9
Identification mark	○	+	□	△

6.1.4 Marking of left - hand thread

Bolts and screws with left-hand thread shall be marked with the symbol shown below, either on the top of the head or the point.

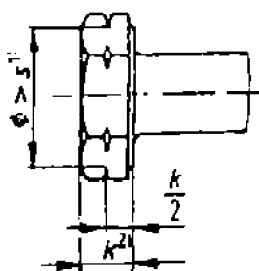


LEFT-HAND THREAD MARKING

Fig. 10

Marking is required for bolts and screws with nominal thread diameters $d \geq 5$ mm.

Alternative marking for left-hand thread may be used for hexagon bolts and screws as shown below:



- 1) s is the width across flats.
- 2) k is the height of the head.

6.2 Marking of Set Screws and Similar

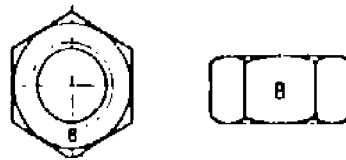
Thread fasteners not under tensile stresses made of carbon steel or alloy steel.

Unless otherwise specified marking of set screws are not obligatory.

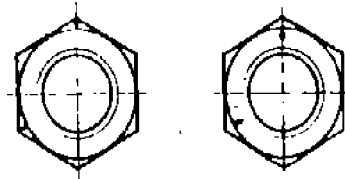
6.3 Marking of Nuts with Specified Proof Load Values Made of Carbon Steel or Alloy Steel

6.3.1 Nuts shall be marked with:

- The property class indenting on the side or bearing surface, or by embossing on the chamfer. See figures below. Embossed marks shall not protrude beyond the bearing surface of the nut.
- The trade (identification) marking of the manufacturer is mandatory on all products covered by the obligatory marking requirements for property classes, provided this is possible for technical reasons. Packages, however, must be marked in any case.



EXAMPLES OF MARKING WITH DESIGNATION SYMBOL



EXAMPLES OF MARKING WITH CODE SYMBOL (CLOCK - FACE SYSTEM)

6.3.2 Marking symbols for different property classes are shown in tables below:

MARKING SYMBOLS FOR NUTS

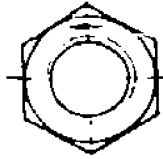
PROPERTY CLASS	4 and 4	6	8	9	10	12
either designation symbol	no marking	6	8	9	10	12
Alternative marking or code symbol (clock-face system)	no marking					

MARKING FOR NUT

PROPERTY CLASS	04	05
Marking	no marking	

6.3.3 Marking of left - hand thread

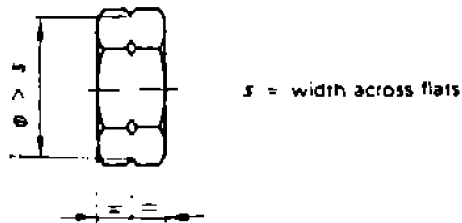
Nuts with left-hand thread shall be marked as shown below on one bearing surface of the nut by indenting.



LEFT - HAND THREAD MARKING

Marking is required for nuts with thread diameters ≥ 6 mm.

Alternative marking for left-hand thread might be used as shown in figure below:



ALTERNATIVE LEFT - HAND THREAD MARKING

6.4 Marking of Nuts with Specified Proof Load with Fine Pitch Thread Made of Carbon Steel or Alloy Steel

Nuts of M5 and larger shall be marked legibly to identify property class and manufacturer trade.

Manufacturer's identification shall be at his option. Marking may be raised or indented at the manufacturer's option, however, raised markings shall not project beyond the specified maximum width or height of nut. Indented marking may be located on any surface, but preferably not on the nut bearing surface; raised marking shall not be on the nut bearing surface.

6.5 Marking of Corrosion - Resistant Stainless Steel Fasteners

6.5.1 Marking of bolts and screws

All hexagon head screws and bolts and socket cap screws of M5 thread diameter and greater shall be clearly marked in accordance with the designation system given in 6.5.5. This marking can be applied to other types of bolts and screws where it is technically possible to do so on the head portion only.

The marking shall include the steel grade and property class and also the manufacturer's identification mark. Additional marking can be applied at the option of the manufacturer or at the specific request of the purchaser. This additional marking should not be liable to cause confusion with any other standardized marking or identification.

6.5.2 Marking of nuts

Nuts shall be marked with the steel grade and property class, if necessary, and with the manufacturer's identification mark in the case of nuts of M5 nominal thread diameter and greater, where this is technically possible for the manufacturer. Marking of one nut face is acceptable and shall be by indentation only when applied to the bearing surface of the nuts. Alternatively, marking on the side of the nuts is permissible. Property class marking and designation of nuts is necessary where the nuts do not meet the minimum proof load stress of the highest property class for the steel grade.

6.5.3 Marking of studs and other fasteners

Marking of washers is not mandatory unless otherwise specified in relevant standard and data-sheet. But however the supplier shall get the written permission of company for marking of studs and other fasteners which are not specified in this Standard.

6.5.4 Packages and containers

Marking of the designation is mandatory on all packages or containers of all sizes.

6.5.5 Designation system

The designation of fasteners is given below. The steel grades and property classes are designated by a four-character identifier consisting of a letter followed by three digits. The letter indicates the general composition groups of steels as follows:

- A** for austenitic steels;
- C** for martensitic steels;
- F** for ferritic steels.

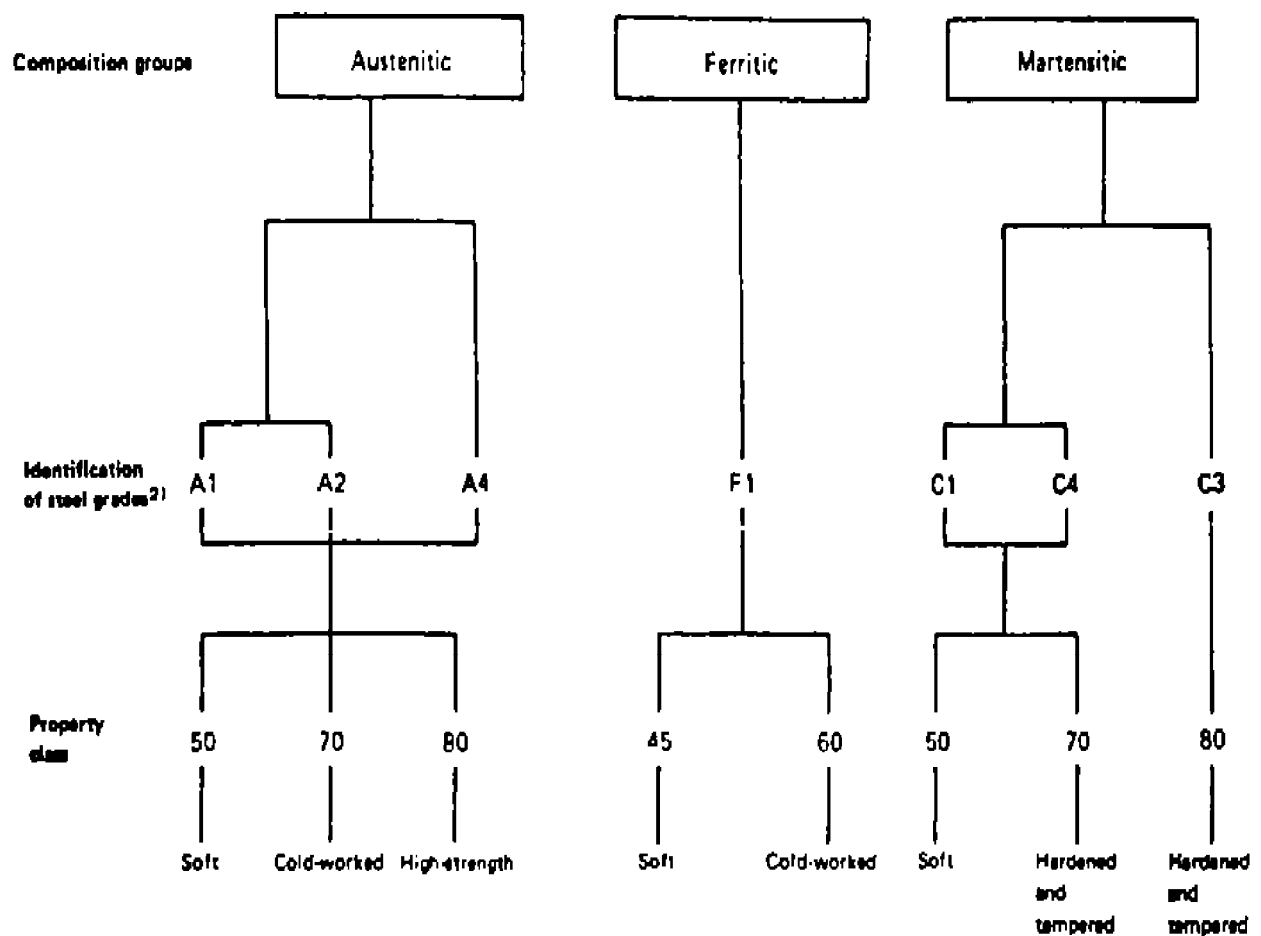
The first digit following the letter indicates the type of alloying elements present for the particular Groups A, C or F. The last two digits indicate the property class (metallurgical condition); for example:

1) A2-70 indicates:

Austenitic steel, cold-worked, minimum 700 N/mm² tensile strength.

2) C4-70 indicates:

Martensitic 12% Cr steel, hardened and tempered, minimum 700 N/mm² tensile strength.



6.6 Marking of Fasteners Made of Non-Ferrous Metals

Bolts, screws, studs and nuts shall be marked as mentioned in 6.5.1 and 6.5.2.

6.6.1 Marking for material

Bolts, screws, studs and nuts where it is technically possible shall be marked with the symbols for material.

The relevant symbols for each material is given in table below; which is in accordance with ISO 8839.

SYMBOLS FOR MATERIALS

SYMBOL	DESIGNATION OF MATERIAL
CU1	Cu-ETP or Cu-FRHC
CU2	CuZn37
CU3	CuZn39Pb3
CU4	CuSn6
CU5	CuNi1Si
CU6	CuZn40Mn1Pb
CU7	CuAl10Ni5Fe4
AL1	AlMg3
AL2	AlMg5
AL3	AlSi1MgMn
AL4	AlCu4MgSi
AL5	AlZnMgCu 0.5
AL6	AlZn5.5MgCu

6.6.2 Marking for identification

The required identification marking is as laid down in 6.1 and 6.3.

7. DOCUMENTS**7.1 At Quotation Stage**

Documents to be submitted by manufacturer/supplier shall give the following as complete:

- report of experience;
- drawings and documents which define the technical data of required commodity (ies);
- list of tests which may be made on his work;
- complaint and compensation policies;
- declaration of any certificate from any impartial laboratory "if any".

7.2 At Ordering Stage

- a copy of test certificate;
- quality assurance certificate;

Note:

All documents shall be in English Language.

8. TESTS

Tests shall be made at the manufacture's work.

The supplier shall maintain appropriate inspection and test records to substantiate conformance with specified requirements.

Test records shall be legible and relevant to the product involved.

Supplier shall submit to purchaser the test records (in..... copies) on completion of tests.

Note:

Blanks to be filled by client.

- 8.1** Bolts, screws and studs made of carbon steel and alloy steel shall be tested in accordance with ISO 898-1.
- 8.2** Set screws and similar threaded fasteners which are not supposed to work under tensile stresses shall be tested in accordance with ISO 898-5.
- 8.3** Nuts with specified proof load made of carbon steel and alloy steel shall be tested in accordance with ISO 898-2.
- 8.4** Nuts with specified proof load values with fine pitch thread shall be tested in accordance with ISO 898-6.
- 8.5** Corrosion-resistant stainless steel fasteners shall be tested in accordance with ISO 3506.
- 8.6** Properties of fasteners made of non ferrous metals shall be verified in accordance with ISO 8839.

9. CONFLICTING REQUIREMENTS

In case of conflict between documents relating to the inquiry or purchase order the following priority of documents shall apply:

- **First priority:** Purchaser order (including attachments) and variations thereon.
- **Second priority:** Data-requisition sheets and drawings.
- **Third priority:** This specification.

10. PACKAGING

- 10.1** Fasteners shall be packaged in a way to fulfill the mentioned requirements of relevant specification.
- 10.2** Fasteners shall be packaged in a way to avoid damage in transit.
- 10.3** Packages shall display the code designations and quantities of fasteners contain and moreover the trade-mark (identification mark) of manufacturer.

11. SHIPMENT

- 11.1** It is desired that the whole commodity is shipped at one batch.
- 11.2** The greatest care must be taken to ensure that shipping and associated documents with exact description for customs release are accompanied with the shipment.

APPENDICES

**APPENDIX A
DATA SHEET FOR FASTENERS**

Details of Required Fastener

			X		X							
Denomination (name of product)												
Referent to appropriate clause number in this IPS Standard and/or Reference to the appropriate International Standard												
Thread size or nominal size (e.g. diameter)												
Further diameters or features												
Nominal length (for bolts, screws, studs if necessary)												
Thread length or shank length (if necessary)												
Type of product (if necessary)												
Property class or hardness or material												
Product grade (if necessary)												
Type of drive (if necessary)												
Surface protection (if necessary)												
Any other details (if required)	<div></div> <div></div> <div></div> <div></div>											

Note:

Blanks to be filled by client. Some examples are given in attachment as a guide for filling the data sheet.

ATTACHMENT

EXAMPLES AS A GUIDE FOR FILLING THE DATA SHEET

Examples

- 1) Example for the designation of a hexagon head bolt ISO 4014 with thread size d=M12, nominal length l=80 mm and property class 8.8.

Hexagon head bolt $\frac{\text{IPS-M-GN-130 - Clause No. 5.5.1}}{\text{ISO 4014}}$ M12 × 80 - 8.8

- 2) Example for the designation of a hexagon head screw ISO 8676 with thread size d=M12, and pitch 1.5, nominal length l=100 mm and property class 10.9.

Hexagon head screw $\frac{\text{IPS-M-GN-130 - Clause No. 5.4.2.1}}{\text{ISO 8676}}$ M12 × 1.5 × 100 - 10.9

- 3) Example for the designation of a hexagon head bolt ISO 4014 with thread size d=M12, nominal length l=80 mm, property class 8.8, electroplated according to ISO 4042, symbol A2P:

Hexagon head bolt $\frac{\text{IPS-M-GN-130 - Clause No. 5.5.1}}{\text{ISO 4014}}$ M12 × 80 - 8.8 - A2P

- 4) Example for the designation of a hexagon nut ISO 4032 with thread size d=M12 and property class 8:

Hexagon nut $\frac{\text{IPS-M-GN-130 - Clause No. 5.6.1}}{\text{ISO 4032}}$ M12 - 8

- 5) Example for the designation of a cross-recessed pan head tapping screw ISO 7049 with thread size ST3, 5, nominal length l=16 mm, cone end type C and recess type Z:

Tapping screw $\frac{\text{IPS-M-GN-130 - Clause No. 5.4.1.7}}{\text{ISO 7049}}$ ST3, 5 × 16 - C - Z

- 6) Example for the designation of a normal series chamfered plain washer ISO 7090 of nominal size 8 mm, made from steel, of mechanical property 140 HV:

Washer $\frac{\text{IPS-M-GN-130 - Clause No. 5.7.2}}{\text{ISO 8676}}$ 8 - 140 HV