BRITISH STANDARD

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Flanges and their joints — Bolting

Part 4: Selection of bolting for equipment subject to the Pressure Equipment Directive 97/23/EC

ICS 21.060.10; 21.060.20; 23.040.60

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 1515-4:2009.

The UK participation in its preparation was entrusted to Technical Committee PSE/15, Flanges.

A list of organizations represented on this committee can be obtained on request to its secretary.

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

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Foreword

This document (EN 1515-4:2009) has been prepared by Technical Committee CEN/TC 74 “Flanges and their joints”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2010, and conflicting national standards shall be withdrawn at the latest by June 2010.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

EN 1515, *Flanges and their joints — Bolting*, consists of the following parts:

— *Part 1: Selection of bolting*

— *Part 2: Classification of bolt materials for steel flanges, PN designated*

— *Part 3: Classification of bolt materials for steel flanges, class designated*

— *Part 4: Selection of bolting for equipment subject to the Pressure Equipment Directive 97/23/EC*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard is applicable to the selection of bolting for equipment subject to the Pressure Equipment Directive 97/23/EC.

It specifies standards and additional requirements for dimensions, materials and technical conditions of delivery for bolting.

The bolting selection covered by this European Standard is regarded to be used for combination with flanges according to the series EN 1092 (PN designated flanges) and the series EN 1759 (Class designated flanges).

The selection is based on commonly used materials, bolts and nuts. It covers temperature ranges of the general service of standard flanges (based on PN or Class).

NOTE 1 The bolting selection given may be used in combination with non-standard flanges too provided that the range of application of the equipment for which the bolting is intended to be used is covered. It is the purchaser's option to decide on this.

When selecting bolting according to this European Standard it is essential to take into account other parameters such as type of fluids, corrosion hazards and relaxation at elevated temperatures.

The purpose of this European Standard is to provide a selection of most commonly used bolting types and bolting material combinations as well a tool for easy selection of suitable bolting for equipment.

It is not the intention to specify all possible applications but to give guidance on the most commonly applications. According to this, e.g. application limits for material in the creep range are not explicitly covered in this European Standard but some bolting materials listed (see Table 3, footnote h) are suitable to be used in this temperature range. Wherever the starting material standard provides mechanical properties for this temperature range respective reference is made in Table 3.

NOTE 2 Special services and ambient conditions may require the application of coatings. It is the purchaser's option to decide on this. Depending on the coating used, a verification of the temperature ranges given in Table 3 may be required.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 764-5:2002, *Pressure Equipment — Part 5: Compliance and Inspection Documentation of Materials*

EN 1092-1:2007, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 1759-1:2004, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, Class designated — Part 1: Steel flanges, NPS 1/2 to 24*

EN 10204:2004, *Metallic products — Types of inspection documents*

EN 10269:1999, *Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties*

EN 13445-3:2009, *Unfired pressure vessels — Part 3: Design*

EN 13480-3:2002, *Metallic industrial piping — Part 3: Design and calculation*

EN 20898-2,:1993 *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values — Coarse thread (ISO 898-2:1992)*

EN ISO 898-1:2009, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread (ISO 898-1:2009)*

EN ISO 3506-1:1997, *Mechanical properties of corrosion-resistant stainless-steel fasteners — Part 1: Bolts, screws and studs (ISO 3506-1:1997)*

EN ISO 3506-2:1997, *Mechanical properties of corrosion-resistant stainless-steel fasteners — Part 2: Nuts (ISO 3506-2:1997)*

EN ISO 4014:2000, *Hexagon head bolts — Product grades A and B (ISO 4014:1999)*

EN ISO 4017:2000, *Hexagon head screws — Product grades A and B (ISO 4017:1999)*

EN ISO 4032:2000, *Hexagon nuts, style 1 — Product grades A and B (ISO 4032:1999)*

EN ISO 4033:2000, *Hexagon nuts, style 2 — Product grades A and B (ISO 4033:1999)*

EN ISO 16426:2002, *Fasteners — Quality assurance system (ISO 16426:2002)*

ISO 261, *ISO general purpose metric screw threads — General plan*

ISO 965-2:1998, *ISO general purpose metric screw threads — Tolerances — Part 2: Limits of sizes for general purpose external and internal screw threads — Medium quality*

3 Terms and definitions, symbols and units

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
bolting
type of fastener such as a bolt, screw, stud, tie-rod, reduced shank bolt (also named as necked-down bolt) and nut

NOTE Also defined as fasteners (see EN ISO 16426).

3.1.2
purchaser
person or organization that orders products in accordance with this European Standard

NOTE The purchaser is not necessarily, but may be, a manufacturer of equipment in accordance with the EU Directive listed in Annex ZA. Where a purchaser has responsibilities under this EU Directive, this European Standard will provide a presumption of conformity with the essential requirements of the Directive so identified in Annex ZA.

3.1.3
bolting manufacturer
person or organization that is responsible for the compliance of the bolting with the requirements of this European Standard and the referenced standards given for bolting and materials agreed with the purchaser

3.1.4
manufacturing lot
quantity of fasteners of a single designation including product grade, property class and sizes, manufactured from bar, wire, rod or flat product from a single cast, processed through the same or similar steps at the same time or over a continuous time period through the same heat treatment and/or coating, if any

NOTE 1 Same heat treatment or coating means:

— for a continuous process, the same treatment cycle without any setting modification;

— for a discontinuous process, the same treatment cycle for identical consecutive loads (batches).

NOTE 2 The manufacturing lot may be split into several manufacturing batches for processing purposes and then reassembled into the same manufacturing lot.

3.1.5
manufacturing lot number
unique number assigned by the bolting manufacturer and which allows full traceability from the finished product back through all previous steps of the manufacturing operations to a given cast number of the starting material of manufacture

3.2 Symbols and units

The symbols and respective units used in this European Standard are defined in Table 1.

Table 1 — Symbols and units

Symbol	Designation	Unit
KV	Impact rupture energy	J
t_{KV}	Material impact test temperature	°C
t_M	Minimum metal temperature	°C

4 Selection of bolting types and materials

4.1 General

The selection of bolting types and bolting material combinations for a certain application shall comprise beside the requirements covered by this European Standard, the range of application of the equipment for which the bolting is intended to be used. That is all service conditions such as maximum/minimum allowable temperature, stresses, type of fluids, corrosion hazards and if applicable type and material of gasket.

Furthermore it shall be regarded that flanged joints shall remain tight under the expected operating conditions. Other properties like residual magnetism and relaxation properties shall be evaluated by the purchaser.

For selection of bolting types and bolting material combinations other than those listed in Table 2 and Table 3 according to commonly used national standards, see Annex B.

Requirements for combination of bolting and flange materials as given in some European Standards such as EN 13480-3 or EN 13445-3 shall be observed by the user of this standard.

Requirements concerning the strength category for bolting as given in EN 1092-1:2007, Annex E, EN 1759-1:2004, Annex B and EN 13480-3:2002, Annex D shall be observed by the user of this European Standard.

4.2 Selection of bolting types

Selection of bolting types according to Table 2.

Table 2 — Types of bolting

Dimensional standard		Remarks
Bolts/Studs	Nuts	
EN ISO 4014	EN ISO 4032 EN ISO 4033[a]	Hexagon head bolt
EN ISO 4017	EN ISO 4032 EN ISO 4033[a]	Hexagon head bolt, threaded full length
Annex A	EN ISO 4032 EN ISO 4033[a]	Stud bolt, threaded full length

[a] Nuts in accordance with EN ISO 4033 are normally used for industrial plants. For sizes ≥ M39 nuts with $m = d$ are recommended.

4.3 Selection of bolting material combinations

A selection of commonly used bolting material combinations and their suitable temperature ranges, based on PN or Class, is shown in Table 3. Combination of bolting materials other than the combinations shown may reduce the given temperature limits. Conditions to determine the permissible minimum temperature: see 6.2.

Starting material for bolting according to EN 20898-2, EN ISO 898-1, EN ISO 3506-1 and EN ISO 3506-2 shall comply with EN 10269.

NOTE 1 Requirement for starting material has been derived from EN 13445-2.

NOTE 2 Upper suitable temperatures listed in Table 3 correspond with the highest temperature for which minimum 0,2 % proof strength values are given in EN 10269 and the limits given in EN ISO 898-1, EN ISO 3506-1 and EN ISO 3506-2. Wherever material combinations are listed upper suitable temperature is chosen to comply with the lowest permissible of one of them. For some materials mechanical properties at higher temperature exist, e.g. creep values to be taken into consideration as appropriate.

NOTE 3 For determination of strength category of bolting, see EN 1515-2.

Table 3 — Selection of bolting material combinations with suitable temperatures ranges

Line No	PN Class	Suitable temperature range	Type of bolting and description of material groups		Steel designation name or property class Steel designation number Material standard	
	up to	°C	Bolts, screws, studs	Nuts	Bolts, screws, studs	Nuts
1	PN 40[a] Cl. 300	- 10 to 300	C-St	C-St	5.6[g] — EN ISO 898-1	5[e] — EN 20898-2
2	PN 40[a] Cl. 300	- 10 to 300	C-St	C-St	8.8[g] — EN ISO 898-1	8 — EN 20898-2
3	all	- 10 to 400	0,25C-1Cr-Mo	C-St elev. temp.	25CrMo4 1.7218 EN 10269	C35E 1.1181 EN 10269
4	all	- 10 to 350	0,42C-1Cr-Mo	C-St elev. temp.	42CrMo4 1.7225 EN 10269	C45E 1.1191 EN 10269
5	all	- 60 to 400	0,25C-1Cr-Mo	18Cr-9Ni	25CrMo4 1.7218 EN 10269	A2-50, A2-70 [g] — EN ISO 3506-2
6	all	- 60 to 500	0,25C-1Cr-Mo	0,25C-1Cr-Mo	25CrMo4[h] 1.7218 EN 10269	25CrMo4 1.7218 EN 10269
7	all	- 100 to 500	0,42C-1Cr-Mo	0,42C-1Cr-Mo	42CrMo4[h] 1.7225 EN 10269	42CrMo4 1.7225 EN 10269
8	all	- 10 to 500	0,42C-1,3Cr-0,6Mo	0,42C-1Cr-Mo	42CrMo5-6[h] 1.7233 EN 10269	42CrMo4 1.7225 EN 10269
9	all	- 10 to 500	0,40C-1Cr-0,6Mo-V	0,42C-1Cr-Mo	40CrMoV4-6[h] 1.7711 EN 10269	42CrMo4 1.7225 EN 10269
10	all[c]	- 10 to 500	0,21C-1,3Cr-0,7Mo-V	0,21C-1,3Cr-0,7Mo-V	21CrMoV5-7[h] 1.7709 EN 10269	21CrMoV5-7 1.7709 EN 10269
11	all	- 10 to 500	0,2C-1Cr-1Mo-V-Ti-B	0,2C-1Cr-1Mo-V-Ti-B	20CrMoVTiB4-10[h] 1.7729 EN 10269	20CrMoVTiB4-10 1.7729 EN 10269
12	all[c]	- 196[j] to 650	25Ni-15Cr-0,2Ti-Mo-V-B	25Ni-15Cr-0,2Ti-Mo-V-B	X6NiCrTiMoVB[h] 25-15-2 1.4980 EN 10269	X6NiCrTiMoVB 25-15-2 1.4980 EN 10269

Table 3 (*continued*)

Line No	PN Class up to	Suitable temperature range °C	Type of bolting and description of material groups		Steel designation name or property class Steel designation number Material standard	
			Bolts, screws, studs	Nuts	Bolts, screws, studs	Nuts
13	all[c]	- 10 to 500	12Cr-1Mo-V	12Cr-1Mo-V	X22CrMoV12-1[h] 1.4923 EN 10269	X22CrMoV12-1 1.4923 EN 10269
14	all	- 10 to 650	16Cr-16Ni-Mo-B-Nb	16Cr-16Ni-Mo-B-Nb	X7CrNiMoBNb16-16[h] 1.4986 EN 10269	X7CrNiMoBNb16-16 1.4986 EN 10269
15	PN 40[d] Cl. 300	- 196 to 400	18Cr-9Ni	18Cr-9Ni	A2-50[g] — EN ISO 3506-1	A2-50[g] — EN ISO 3506-2
16	PN 100 Cl. 600	- 196 to 400	18Cr-9Ni	18Cr-9Ni	A2-70[g] — EN ISO 3506-1	A2-70[g] — EN ISO 3506-2
17	PN 40[d] Cl. 300	- 60[f] to 400	18Cr-9Ni-Mo	18Cr-9Ni-Mo	A4-50[g] — EN ISO 3506-1	A4-50[g] — EN ISO 3506-2
18	PN 100 Cl. 600	- 60[f] to 400	18Cr-9Ni-Mo	18Cr-9Ni-Mo	A4-70[g] — EN ISO 3506-1	A4-70[g] — EN ISO 3506-2
19	PN 40[d] Cl. 300	- 196 to 550	17Cr-12Ni-2Mo	17Cr-12Ni-2Mo	X5CrNiMo17-12-2 AT 1.4401 EN 10269	X5CrNiMo17-12-2 1.4401 EN 10269
20	PN 100 Cl. 600	- 196 to 200[b]	17Cr-12Ni-2Mo AT+C	17Cr-12Ni-2Mo	X5CrNiMo17-12-2 AT+C 1.4401 EN 10269	X5CrNiMo17-12-2 1.4401 EN 10269
21	PN 40[d] Cl. 300	- 196 to 550	18Cr-10Ni	18Cr-10Ni	X5CrNi18-10 1.4301 EN 10269	X5CrNi18-10 1.4301 EN 10269
22	PN 100 Cl. 600	- 196 to 200[b]	18Cr-10Ni AT+C	18Cr-10Ni	X5CrNi18-10 AT+C 1.4301 EN 10269	X5CrNi18-10 1.4301 EN 10269

[a] Up to PN 63 for temperature up to 120 °C.

[b] Allowable stresses for elevated temperatures may be taken from the material in AT condition, as no stresses exist for the cold worked condition.

[c] Commonly used for PN 160 up to PN 400.

[d] Is limited to be used for max. PN 40/Cl. 300 (low strength bolting).

[e] The use of free-cutting steel is not permitted.

[f] – 196 °C for studs.

[g] Starting material shall comply with EN 10269 (see 6.1).

[h] May be used in the creep range. For maximum suitable temperature see EN 10269.

[j] When intended to be used down to – 273 °C, for additional requirements see Table 5, footnote a.

5 Manufacturing

5.1 General

All bolting shall meet the requirements of EN 10269 in the delivered condition.

NOTE 1 Final heat treatment is not necessary for bolting which are machined from adequate pre-treated bars. Kind of pre-treatment of bars is at the responsibility of the bolting manufacturer.

NOTE 2 Generally cold forming except rolling of external threads requires a subsequent heat treatment. Cold working is just necessary and therefore permitted for austenitic stainless steel bolting in accordance to property class 70 and for nuts in accordance to property classes 5 and 8. Nuts should be obtained, preferably, by forging. The internal thread of the nut will usually be machined.

5.2 Coating

The type of coating shall be specified in the purchase order (see Clause 8). The coating process is under the responsibility of the bolting manufacturer and shall take into consideration achievement of the mechanical properties of bolting, as appropriate.

The purchaser shall ensure that the coating to be used for the bolting is appropriate for the foreseen service conditions.

NOTE 1 In general, bolting will be delivered:

- with a primary manufacture finish (slightly greased); or
- with an electrolytic coating in compliance with EN ISO 4042; or
- hot galvanized in compliance with EN ISO 10684;
- passivated according to EN ISO 16048 (applicable for corrosion-resistant stainless-steel bolting only).

NOTE 2 For additional requirements regarding hot dip galvanized carbon steel bolting see Annex C.

NOTE 3 Other coatings may be agreed between purchaser and bolting manufacturer (see Clause 8).

6 Technical conditions of delivery

6.1 General

The technical conditions of delivery and the marking requirements are included in the referenced standards given for bolting and materials.

Starting material shall comply with EN 10269. The use of free-cutting steel is not permitted.

6.2 Requirements for prevention of brittle fracture at low temperatures

Requirements are given in Table 4, Table 5 and Table 6.

For other bolting than given in Table 4 specified impact energy of minimum 40 J is required at t_{KV} = RT for $t_M \geq$ - 10 °C.

If t_M is lower than - 10 °C, specified impact energy of minimum 40 J is required at $t_{KV} \leq t_M$.

Except bolting material made from austenitic stainless steel as listed in Table 5 and Table 6, bolting material with a design temperature below - 160 °C shall be impact tested at - 196 °C.

NOTE Data in the tables are derived from EN 13445-2. InTable 4, footnote a (reference to EN 10045-1) is added to clarify testing requirements.

Some bolting materials listed in Tables 4 and 5 are not covered by Table 3, but t_M is given in addition.

Table 4 — Requirements for prevention of brittle fracture with reference thickness for nuts and bolts for $t_M \geq -10$ °C

Standard	Type of material/ property class	Thickness limitation	Impact test[a]	Test temperature/ value [*KV*]
EN 10269	All steels	According to EN 10269	According to EN 10269:1999, Table 4	As specified in EN 10269:1999, Table 4
EN ISO 898-1	5.6	M ≤ 39	M ≥ 16	+ 20 °C / 40 J
	8.8			+ 20 °C / 52 J
EN 20898-2	5	M ≤ 39	None	—
	8			
[a] Testing requirements according to EN 10045-1.				

Table 5 — Requirements for prevention of brittle fracture with reference thickness for nuts and bolts with starting material according to EN 10269

Type of material	Thickness limitation	Impact test	t_M	Remark
1.4307, 1.4301, 1.4303, 1.4404, 1.4401, 1.4948, 1.4919, 1.4941, 1.4980[a]	According to EN 10269:1999, Table 7	According to EN 10269:1999, Table 4	- 196 °C	Verification testing required for diameter or thickness > 20 mm
1.4429, 1.4910			- 273 °C	
1.5523, 1.1133 1.6563		According to EN 10269:1999, Table 7	- 20 °C	—
1.7218	$d \leq 60$ mm		- 60 °C	
	60 < $d \leq 100$ mm		- 50 °C	
1.6582, 1.6580, 1.7225	According to EN 10269:1999, Table 7		- 40 °C	
1.5680	$d \leq 45$ mm		- 120 °C	
	45 < $d \leq 75$ mm		- 110 °C	
1.5662	According to EN 10269:1999, Table 7	According to EN 10269:1999, Table 7 at - 196 °C	- 196 °C	
[a] When used at - 273 °C, verification testing at - 196 °C according to EN 10269:1999, Table 7 is required.				

Table 6 — Requirements for prevention of brittle fracture with reference thickness for bolts according to EN ISO 3506-1 and nuts according to EN ISO 3506-2

Standard	Type of material[b]		Thickness limitation	T_M	Impact test
EN ISO 3506-1	A2, A3	50	M ≤ 39	- 196 °C	None
		70	M ≤ 24		
	A4, A5	50	M ≤ 39	- 60 °C[a]	
		70	M ≤ 24		
EN ISO 3506-2	A2, A3, A4, A5	50	M ≤ 39	- 196 °C	
		70	M ≤ 24		

[a] - 196 °C for studs.

[b] Starting material shall comply with EN 10269 (see 4.3 and 6.1).

7 Traceability and inspection documents

7.1 Traceability

Beside the requirements for traceability given in EN ISO 16426, bolting made from alloy steels shall be subjected by the bolting manufacturer to a suitable test to ensure no mixing of materials has occurred. The bolting manufacturer shall apply respective procedures to ensure traceability of material and shall be able to provide respective documentation for the starting material used.

NOTE 1 Alloy steel as defined in EN 10269:1999, 6.1.

NOTE 2 Inspections should be carried out in accordance with EN ISO 3269.

For bolts and studs, the inspection certificate or the test report shall contain at least the following:

a) copy of inspection certificate from the steel furnisher with cast number;

b) number of manufacturing lot;

c) final heat treatment condition (if applicable);

d) minimum impact rupture energy, *KV* (for diameters ≥ M16) (if applicable).

For nuts, the inspection certificate or the test report shall contain at least the following:

e) copy of material certificate from the steel furnisher with cast number;

f) number of manufacturing lot.

7.2 Inspection documents

Under consideration of EN 764-5, the purchaser may require an inspection certificate according to EN 10204, applicable for the respective category of the equipment for which the bolting is intended to be used referring to the following criteria.

When bolting is used as:

a) main pressure bearing part a certificate of specific control is required, i.e. type 3.1 or type 3.2 (unless the item of equipment itself is in Category I);

b) other pressure bearing parts a test report is sufficient, i.e. type 2.2;

c) non pressure bearing parts a certificate of compliance is sufficient, i.e. type 2.1.

NOTE See also the Pressure Equipment Directive 97/23/EC and the product specification, which includes the technical delivery conditions. Concerning the connection between inspection certificate type 3.1, the quality system of the material manufacturer and the ESRs of the Directive, see the third paragraph of section 4.3 of Annex I of Pressure Equipment Directive 97/23/EC.

In addition, the bolting manufacturer shall affirm that the product complies with this standard.

8 Ordering information

With the purchase order the purchaser shall provide the following information:

a) type of bolting, dimensions and designation of thread;

b) order quantity;

c) property class according to EN ISO 898-1 or EN 20898-2, EN ISO 3506-1 or EN ISO 3506-2 or steel grade according to EN 10269;

d) t_M if t_M is below - 10 °C;

NOTE If t_M is not specified by the purchaser the requirements of Table 4 (and Table 6) applies.

e) type of inspection document (test report 2.2 or inspection certificate 3.1 – see 7.2);

f) any other particular specification (see 5.2 and Clause 6).

Annex A
(normative)

Studs threaded full length

Studs shall be threaded full length. The points shall be chamfered or rounded at the bolting manufacturer's option. The height of point shall be a maximum one time the pitch of thread.

The length of studs shall be measured including points. The lengths are stepped by increments of 5 mm for length up to 80 mm, by increments of 10 mm for length above 80 mm and up to 200 mm, and by increments of 20 mm for length above 200 mm.

Thread shall be in accordance with ISO 261, ISO 965-2:1998 tolerance class 6g. The type of thread shall be specified by the purchaser.

NOTE 1 Deviations from increments given may be agreed between purchaser and bolting manufacturer.

NOTE 2 Type of thread is either coarse thread or above M39 fine thread with 4 mm pitch.

Fine thread above M39 is normally used for industrial plants, coarse thread up to and including M64 is normally used for water service.

Annex B
(informative)

Additional bolting types and materials according to commonly used national standards

Additional bolting types and materials according to commonly used national standards which are not listed in Table 2 and Table 3 may be used.

A selection of commonly used national standards for bolting types and materials is listed in Table B.1.

WARNING — Materials used for equipment subject to the Pressure Equipment Directive 97/23/EC in combination with non-harmonized standards require supplementary considerations and measures.

That could be

— material covered by a European Approval of Material (EAM);

— material covered by a Particular Material Appraisal (PMA);

— additional testing to guarantee characteristics of material to comply with Annex I, 7.5, of the Pressure Equipment Directive 97/23/EC (i.e. elongation after rupture and minimum impact energy).

For equipment according to Article 3.3 of the PED, sound engineering practice (SEP) may apply.

Table B.1 — Selection of bolting types according to commonly used national standards

Dimensional standard		Remarks
Bolts, studs	Nuts	
BS 3692	-	ISO Metric Precision Hexagon head bolt
BS 4190	-	ISO Metric Black Hexagon Bolts
NF E29-043		Non Alloy and Alloy Steel Bolting
DIN 976-1	-	Stud bolt, threaded full length, Type B
DIN 2510-3	-	Reduced Shank Bolts[a]
	DIN 2510-5	Hexagon Nuts

[a] Also denominated as necked-down bolts.

Annex C
(informative)

Additional requirements for hot dip galvanized carbon steel bolting

The following additional requirements may be subject of agreement between the purchaser and bolting manufacturer if carbon steel bolting shall be supplied in hot dip galvanized condition.

Hot dipped galvanizing should be performed according to EN ISO 10684.

Thread tolerances should be according to ISO 965 and EN ISO 10684:2004, Clause 6.

As defined in EN ISO 10684:2004, 5.7, the threading of the nuts shall be performed after the hot dipped galvanization process. A threading before galvanization followed by a re-tapping step should be avoided due to the risk of "double-threads".

It is recommended that these kinds of bolts and nuts should be delivered as matching assemblies. Checking of the proper fitting of the threads while assembling the bolts and nuts is recommended.

NOTE It is the purchaser's option to require a supply in assembled condition.

Annex ZA
(normative)

Relationship between this European Standard and the Essential Requirements of Directive 97/23/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 97/23/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this European Standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 97/23/EC

Clause(s)/ subclause(s) of this European Standard	Essential Requirements (ERs) of Directive 97/23/EC, Annex I		Qualifying remarks/ Notes
4 and 6	Section 4.1 a)	Materials for pressurized parts to have appropriate properties for all operating and test conditions: — to be sufficiently ductile and tough; — characteristics of material to comply with ERs at 7.5; — to be selected in order to prevent brittle-type fracture, or appropriate measures to be taken.	[a]
7.1	Section 3.1.5	Traceability: Materials making up bolting to be identified by suitable means from receipt, through production, up to final test.	—
7.2	Section 4.3	Conformity of materials and inspection documents	—

[a] In the case of a harmonized supporting standard for materials, presumption of conformity to the ERs is limited to technical data of materials in the standard and does not presume adequacy of the material to a specific item of equipment. Consequently the technical data stated in the material standard shall be assessed against the design requirements of this specific item of equipment to verify that the ERs of the PED are satisfied.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] EN 1092-2, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 2: Cast iron flanges*

[2] EN 1092-3, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 3: Copper alloy flanges*

[3] EN 1092-4, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 4: Aluminium alloy flanges*

[4] EN 1515-1, *Flanges and their joints — Bolting — Part 1: Selection of bolting*

[5] EN 1515-2, *Flanges and their joints — Bolting — Part 2: Classification of bolt materials for steel flanges, PN designated*

[6] EN 1515-3, *Flanges and their joints — Bolting — Part 3: Classification of bolt materials for steel flanges, Class designated*

[7] EN 1759-3, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, Class designated — Part 3: Copper alloy flanges*

[8] EN 1759-4, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, class designated — Part 4: Aluminium alloy flanges*

[9] EN 10045-1, *Metallic materials — Charpy impact test — Part 1: Test method*

[10] EN 13445-2, *Unfired pressure vessels — Part 2: Materials*

[11] EN ISO 3269, *Fasteners — Acceptance inspection (ISO 3269:2000)*

[12] EN ISO 4042, *Fasteners — Electroplated coatings (ISO 4042:1999)*

[13] EN ISO 10684:2004, *Fasteners — Hot dip galvanized coatings (ISO 10684:2004)*

[14] EN ISO 16048, *Passivation of corrosion-resistant stainless-steel fasteners (ISO 16048:2003)*

[15] ISO 965-1, *ISO general purpose metric screw threads — Tolerances — Part 1: Principles and basic data*

[16] ISO 965-3, *ISO general purpose metric screw threads — Tolerances — Part 3: Deviations for constructional screw threads*

[17] ISO 965-4, *ISO general purpose metric screw threads — Tolerances — Part 4: Limits of sizes for hot-dip galvanized external screw threads to mate with internal screw threads tapped with tolerance position H or G after galvanizing*

[18] ISO 965-5, *ISO general purpose metric screw threads — Tolerances — Part 5: Limits of sizes for internal screw threads to mate with hot-dip galvanized external screw threads with maximum size of tolerance position h before galvanizing*

[19] ISO 8992, *Fasteners — General requirements for bolts, screws, studs and nuts*

[20] BS 3692, *ISO metric precision hexagon bolts, screws and nuts — Specification*

[21] BS 4190, *ISO metric black hexagon bolts, screws and nuts — Specification*

[22] DIN 976-1, *Stud bolts — Part 1: Metric thread*

[23] DIN 2510-3, *Bolted connections with reduced shank — Stud-bolts*

[24] DIN 2510-5, *Bolted connections with reduced shank — Hexagon nuts*

[25] NF E29-043, *Non alloy and alloy steel bolting for pressure equipment — Specifications*

[26] Directive 97/23/EC of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment.

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