UDC 621.882-034.14.016.41/.44
:621.713:620.22:620.1

August 1993

Fasteners

Technical delivery conditions for bolt/nut assemblies with specific mechanical properties, for service temperatures from −200 °C to +700 °C

DIN 267 Part 13

Mechanische Verbindungselemente; technische Lieferbedingungen; Teile für Schraubenverbindungen mit besonderen mechanischen Eigenschaften zum Einsatz bei Temperaturen von − 200 °C bis + 700 °C

This standard, together with DIN 267 Part 29, August 1993 edition, supersedes March 1980 edition.

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

1 Scope and field of application

This standard specifies materials and mechanical properties of bolts and nuts intended for applications where safety is a major factor, such as pressure vessels, steam boilers, process and refrigeration plants, at service temperatures ranging from − 200 °C to + 700 °C, where more stringent requirements are to be met with regard to low temperature toughness and high temperature strength.

NOTE: Product grades T1, T2 and T3 as specified in the March 1980 edition of DIN 267 Part 13 are now covered in DIN 267 Part 29, which shall also be used where reference is made to these product grades in any existing documentation.

2 Materials and property classes

For fasteners designed for service temperatures from − 200 °C to + 700 °C, the materials and strength classes specified in tables 1, 2 and 4 shall apply, the range from − 200 °C to − 10 °C being dealt with in table 1, that from − 10 °C to + 300 °C, in table 2, and temperatures above + 300 °C, in table 4.

Where the strength values for bolts and nuts are not specified in DIN EN 20898 Part 1, ISO 898 Part 2 or ISO 3506, Standards DIN 17 240, DIN 17 280 and DIN 17 440 shall apply.

It shall be agreed at the time of ordering whether additional requirements are to be met (e.g. as specified in *AD-Merkblätter* (AD Codes of practice) W2, W 7 and W 10, *VdTÜV-Werkstoffblätter* (VdTÜV Material specifications) 435/3 and 490 or *Technische Regel für Dampfkessel* (Code of practice for steam boilers) TRD 106).

Continued on pages 2 to 5

2.1 Materials for service temperatures from −200 °C to −10 °C

Table 1: Materials

Material				Usual minimum temperature for continuous service[1])
designation	number	as in	symbol	
26 CrMo 4	1.7219	DIN 17 280	KA	− 60 °C
12 Ni 19	1.5680		KB	−120 °C
X 5 CrNi 18 10	1.4301	DIN 17 440 ISO 3506 or AD-W 10	A2[2])	−200 °C
X 5 CrNi 18 12	1.4303		A2[2])	−200 °C
X 6 CrNiTi 18 10	1.4541		A2[2])	−200 °C
X 5 CrNiMo 17 12 2	1.4401		A4[2]) [3])	− 60 °C
			A4[2]) [4])	−200 °C
X 6 CrNiMoTi 17 12 2	1.4571		A4[2]) [3])	− 60 °C
			A4[2]) [4])	−200 °C

[1]) Cf. *AD-Merkblatt* W 10.
[2]) When ordering, the property class shall be added to symbols A2 and A4, e.g. A2-70 (see ISO 3506), space permitting. Where a particular material is required, the material designation or number shall be stated instead of the steel grade specified in ISO 3506. This applies also to components with a thread size exceeding M 39.
[3]) This applies to bolts with head.
[4]) This applies to headless bolts.

2.2 Property classes for service temperatures from −10 °C to +300 °C

Table 2: Property classes (materials)

Property class		Symbols	
Bolts and screws as in DIN EN 20 898 Part 1	Nuts as in ISO 898 Part 2	Bolts and screws as in DIN EN 20 898 Part 1	Nuts as in ISO 898 Part 2
5.6	5-2[1])	5.6	5-2[1])
8.8	8	8.8	8

[1]) Use of Thomas steel and free-cutting steel is prohibited where the symbol '-2' is added to the property class symbol.

Table 3: Elevated temperature yield stress for property classes 5.6 and 8.8

Property class	Minimum yield stress, R_{eH} or $R_{p\,0.2}$, in N/mm², at				
	+ 20 °C	+ 100 °C	+ 200 °C	+ 250 °C	+ 300 °C
5.6	300	270	230	215	195
8.8	640	590	540	510	480

2.3 Materials for service temperatures above +300 °C

Table 4: Materials

Material				Usual minimum temperatures for continuous service
designation	number	as in	symbol	
C 35 N[1]) or C 35 V[1])	1.0501	DIN 17 240	Y	+350 °C
Ck 35	1.1181		YK	+350 °C[2])
35 B 2[5])	1.5511	DIN 1654 Part 4 VdTÜV WB 490	YB	+350 °C[2])
24 CrMo 5	1.7258	DIN 17 240	G	+400 °C
21 CrMoV 5 7	1.7709		GA	+540 °C
40 CrMoV 4 7	1.7711		GB	+500 °C[6])
X 22 CrMoV 12 1	1.4923		V[3]), VH[4])	+580 °C
X 19 CrMoVNbN 11 1	1.4913		VW	+580 °C
X 8 CrNiMoBNb 16 16	1.4986		S	+650 °C
X 5 NiCrTi 26 15	1.4980	VdTÜV WB 435/3	SD	+650 °C
NiCr20 TiAl	2.4952	DIN 17 240	SB	+700 °C

[1]) This applies only to nuts.

[2]) For nuts, the maximum service temperature for continuous service may be higher by 50 °C.

[3]) Symbol V denotes grade X 22 CrMoV 12 1 as in DIN 17 240, with a 0,2 % proof stress, $R_{p\,0,2}$, equal to or greater than 600 N/mm^2.

[4]) Symbol VH denotes grade X 22 CrMoV 12 1 as in DIN 17 240, with a 0,2 % proof stress, $R_{p\,0,2}$, equal to or greater than 700 N/mm^2.

[5]) For elevated temperature properties, see *VdTÜV-Werkstoffblatt* 490. The specifications of DIN 1654 Part 4 cover only mechanical properties at ambient temperature.

[6]) This temperature is different from that given in DIN 17 240 since the creep strength at elevated temperatures specified in DIN 17 240 is too high.

Table 5: Recommended bolt/nut material combinations

Material of	
bolt/screw	nut
Ck 35 35 B 2	C 35 N, C 35 V, Ck 35, 35 B 2
24 CrMo 5	Ck 35, 35 B 2, 24 CrMo 5
21 CrMoV 5 7	24 CrMo 5 21 CrMoV 5 7
40 CrMoV 4 7	21 CrMoV 5 7
X 22 CrMoV 12 1 X 19 CrMoVNbN 11 1	X 22 CrMoV 12 1
X 8 CrNiMoBNb 16 16	X 8 CrNiMoBNb 16 16
X 5 NiCrTi 26 15	X 5 NiCrTi 26 15
NiCr20TiAl	NiCr20TiAl

NOTE: When materials as specified in subclause 2.3 are used, any extension sleeves should be made of the same material as the associated bolts.

It should be noted that, where bolt/nut assemblies are used at elevated service temperatures and are subject to severe loading conditions in practice, the nut material must not be soft since otherwise the relaxation of stresses in the assemblies would be markedly increased. For such assemblies, the ratio of the bolt and nut yield stresses at elevated temperature shall be not less than 0,7.

3 Marking

Unless otherwise agreed, fasteners shall be marked (in compliance with DIN EN 20 898 Part 1, ISO 898-2, ISO 3506 or DIN 2510 Part 3 to Part 7) with the manufacturer's symbol and the material symbol or the property class as specified in tables 1, 2 and 4, space permitting.

4 Designation

The designation of low temperature or high temperature steel fasteners shall include the property class or the material, e.g.

Hexagon head bolt ISO 4014 – M 12 × 80 – 26 CrMo 4
Hexagon nut ISO 4032 – M 12 – 5-2
Stud bolt DIN 2510 LM 30 × 200 – X 8 CrNiMoBNb 16 16

Should fasteners, particularly those with elevated temperature properties, be made to product grade T1, T2 or T3 as specified in DIN 267 Part 29, this shall be additionally stated in the designation, e.g.

Hexagon head bolt ISO 4014 – M 12 × 80 – 8.8 – T1
Stud bolt DIN 2510 LM 30 × 200 – 24 CrMo 5 – T2

5 Testing

5.1 Mechanical properties and materials to be tested

Where fasteners are manufactured by machining without subsequent heat treatment, testing of the steel in accordance with the relevant standards shall be deemed sufficient. Testing of cold or hot formed products shall be carried out following final heat treatment (preferably on the finished product). Such tests shall be carried out for:

a) bolts and similar products of property classes, as specified in DIN EN 20 898 Part 1 (cf. subclause 2.2);

b) nuts and similar products of property classes, as specified in ISO 898-2 (cf. subclause 2.2);

c) products, as specified in ISO 3506;

d) products of low temperature steel (cf. subclause 2.1) and high temperature steel (cf. subclause 2.3), on the lines of DIN EN 20 898 Part 1 and ISO 898-2.

5.2 Acceptance inspection

ISO 3269 shall apply with regard to acceptance inspection unless otherwise specified at the time of ordering.

5.3 Inspection document

It shall be agreed whether a DIN 50 049 inspection document is to be issued.

Standards and other documents referred to

DIN 267 Part 29	Fasteners; product grades for bolt/nut assemblies for service temperatures from – 200 °C to + 700 °C
DIN 1654 Part 4	Cold-heading and cold extruding steels; technical delivery conditions for heat treatable steel
DIN 2510 Part 3	Bolted connections with waisted shank bolts; stud bolts
DIN 2510 Part 4	Bolted connections with waisted shank bolts; studs
DIN 2510 Part 5	Bolted connections with waisted shank bolts; hexagon nuts
DIN 2510 Part 6	Bolted connections with waisted shank bolts; cap nuts
DIN 2510 Part 7	Bolted connections with waisted shank bolts; extension sleeves
DIN 17 240	High-temperature bolt and nut materials; quality requirements
DIN 17 280	Plate, strip, wide flats, sections, bars and forgings made of steel with low temperature toughness; technical delivery conditions
DIN 17 440	Stainless steel; technical delivery conditions for sheet, hot rolled strip, wire rod, drawn wire, steel bars, forgings and semi-finished products
DIN 50 049	Inspection documents for the delivery of metallic products
DIN EN 20 898 Part 1	Mechanical properties of fasteners; bolts, screws and studs
ISO 898-2 : 1980	Mechanical properties of fasteners; nuts with specified testing forces
ISO 3269 : 1988	Fasteners; acceptance inspection
ISO 3506 : 1979	Fasteners of stainless steel; technical delivery conditions
AD-Merkblatt W 2	*Austenitische Stähle* (Austenitic steels)
AD-Merkblatt W 7	*Werkstoffe für Druckbehälter; Schrauben und Muttern aus ferritischen Stählen* (Materials for pressure vessels; ferritic steel bolts and nuts)
AD-Merkblatt W 10	*Werkstoffe für tiefe Temperaturen; Eisenwerkstoffe* (Ferrous materials for low service temperatures)
Technische Regel für Dampfkessel TRD 106	*Schrauben und Muttern aus Stahl* (Code of practice for steel bolts and nuts)

VdTÜV-Werkstoffblatt 435/3[1])	*Warmfester austenitischer Walz- und Schmiedestahl X 5 NiCrTi 26 15 (Werkstoff-Nr. 1.4980)* (Unalloyed austenitic rolled and forging steel with elevated temperature properties, of grade X 5 NiCrTi 26 15 (material number 1.4980))
VdTÜV-Werkstoffblatt 490[1])	*Schrauben und Muttern aus dem warmfesten Stahl* 35 B 2 *(Werkstoff-Nr.* 1.5511) (Bolts and nuts of unalloyed steel with elevated temperature properties, of grade 35 B 2 (material number 1.5511))

Previous editions

DIN 267 Part 13: 07.68, 03.80.

Amendments

The following amendments have been made to the March 1980 edition.

a) The specifications of the standard have been split between Parts 13 and 29.

b) The title and the scope of the standard have been amended.

c) The specifications for threads, product grades, surface roughness and tolerances are now given in Part 29.

d) In table 1, the materials have been harmonized with those specified in DIN 17 280 and DIN 17 440. Grades X 12 CrNi 18 9 (1.6900) and X 10 CrNiTi 18 10 (1.6903) are no longer included.

e) The symbol '-2' has been defined differently (cf. table 2).

f) In tables 2 and 3, the symbol '-2' for property class 5.6 has been omitted (corrigendum); property class 4.6-2 is no longer specified.

g) Compliance with the elevated temperature yield stress values for property class 8.8 is now required (previously only recommended).

h) In table 4, grade Cq 35 has been replaced by grade 35 B 2 and for grade C 35, the 'quenched and tempered' (V) condition has been specified.

i) Annex A and examples of application are no longer included.

j) The standard has been editorially revised.

Explanatory notes

DIN 267 Part 13 has been split up into two Parts for the following reasons:

1) The mechanical properties (materials, property classes) and product grades (tolerances) for fasteners are normally specified in separate standards and are to be given separately when ordering the products.

2) Each standard can be used independently, i.e. the tolerances specified in DIN 267 Part 29 need not be complied with in the case of products for use at low temperatures as specified in DIN 267 Part 13.

Cross references in both standards make it easier for the standards to be applied, particularly with regard to existing documentation.

The symbol '-2' (for property class 5) means that both free-cutting steel and Thomas steel are not to be used for applications as defined in clause 1, this being a very important requirement. This, however, does not preclude the manufacture of nuts by machining.

International Patent Classification

F 16 B 035/00
F 16 B 037/00
F 16 B 033/00
F 16 B 017/00

[1]) Obtainable from *Verlag TÜV Rheinland GmbH*, Postfach 10 17 50, D-50672 Köln.