

# CHEMICAL PROPERTIES OF BOLTS, SCREWS AND STUDS (ISO 898-1)

PROPERTY CLASS	MATERIAL AND HEAT TREATMENT	CHEMICAL COMPOSITION LIMIT (CAST ANALYSIS, %) <sup>f</sup>					TEMPERING TEMPERATURE °C, min.
		C		P	S	B <sup>b</sup>	
		min.	max.	max.	max.	max.	
<b>4.6<sup>d</sup></b>	Carbon steel or carbon steel with additives	-	0.55	0.05	0.06	Not specified	-
<b>4.8<sup>d</sup></b>							
<b>5.6<sup>g</sup></b>		0.13	0.55	0.05	0.06		
<b>5.8<sup>d</sup></b>		-	0.55	0.05	0.06		
<b>6.8<sup>d</sup></b>		0.15	0.55	0.05	0.06		
<b>8.8<sup>e</sup></b>	Carbon steel with additives (e.g. Boron or Mn or Cr) quenched and tempered	0.15 <sup>e</sup>	0.40	0.025	0.025	0.003	425
	Carbon steel quenched and tempered	0.25	0.55	0.025	0.025		
	Alloy steel quenched and tempered <sup>g</sup>	0.20	0.55	0.025	0.025		
<b>9.8<sup>e</sup></b>	Carbon steel with additives (e.g. Boron or Mn or Cr) quenched and tempered	0.15 <sup>e</sup>	0.40	0.025	0.025	0.003	425
	Carbon steel quenched and tempered	0.25	0.55	0.025	0.025		
	Alloy steel quenched and tempered <sup>g</sup>	0.20	0.55	0.025	0.025		
<b>10.9<sup>e</sup></b>	Carbon steel with additives (e.g. Boron or Mn or Cr) quenched and tempered	0.20 <sup>e</sup>	0.55	0.025	0.025	0.003	425
	Carbon steel quenched and tempered	0.25	0.55	0.025	0.025		
	Alloy steel quenched and tempered <sup>g</sup>	0.20	0.55	0.025	0.025		
<b>12.9<sup>eHI</sup></b>	Alloy steel quenched and tempered <sup>g</sup>	0.30	0.50	0.025	0.025	0.003	425
<b>12.9<sup>eHI</sup></b>	Carbon steel with additives (e.g. Boron or Mn or Cr) quenched and tempered	0.26	0.50	0.025	0.025	0.003	380

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<sup>a</sup> In case of dispute, the product analysis applies

<sup>b</sup> Boron content can reach 0.005%, provided non-effective boron is controlled by the addition of titanium and/or aluminium

<sup>c</sup> For cold forged fasteners of property classes 4.6 and 5.6, heat treatment of the wire used for cold forging or of the cold forged fastener itself may be necessary to achieve required ductility

<sup>d</sup> Free cutting steel is allowed for these property classes with the following maximum sulfur, phosphorus and lead contents: S: 0.34%; P: 0.11%; Pb: 0.35%

<sup>e</sup> In case of plain carbon boron steel with a carbon content below 0.25% (cast analysis), the minimum manganese content shall be 0.6% for property class 8.8 and 0.7% for property classes 9.8 and 10.9.

<sup>f</sup> For the materials of these property classes; there shall be a sufficient hardenability to ensure a structure consisting of approximately 90% martensite in the core of the threaded sections for the fasteners in the "as-hardened" condition before tempering

<sup>g</sup> This alloy steel shall contain at least one of the following elements in the minimum quality given: chromium 0.30%, nickel 0.30%, molybdenum 0.20%, vanadium 0.10%. Where elements are specified in combinations of two, three or four and have alloy contents less than those given above, the limit value to be applied for steel class determination is 70% of the sum of the individual limit values specified above for two, three or four elements concerned.

<sup>h</sup> Fasteners manufactured from phosphated raw material shall be dephosphated before heat treatment, the absence of white phosphorus enriched layer shall be detected by a suitable test method

<sup>i</sup> Caution is advised when the use of property class 12.9/12.9 is considered. The capability of the fastener manufacturer, the service conditions and the wrenching methods should be considered. Environments can cause stress corrosion cracking of fasteners as processed as well as those coated