



## STANDARD PARTS

### Hexagon bolts

Standard / Discription	Nominal Tensile Strength	Material
DIN EN 4131 / Aerospace Bolts, normal hexagonal head, coarse tolerance, normal shank, medium length thread, heat resisting nickel based alloy, aluminium IVD coated	1250 MPa	2.4668.7
DIN 65265 / Aerospace Hexagon screw with MJ-thread, titanium alloy, threaded approximately to head for temperatures up to 315 °C	1100 MPa	3.7164.7
DIN 65526 / Aerospace Hexagon bolt, close tolerance, with short length MJ-thread, titanium alloy for temperatures up to 315 °C	1100 MPa	3.7164.7
DIN EN 3820 / Aerospace Metric bolt, normal hexagon head, coarse tolerance normal shank, short thread in titanium, anodized, MoS <sub>2</sub>	1100 MPa	3.7164.7
DIN EN 3308 / Aerospace Bolt, normal hexagon head, threaded to head, in titanium, anodized, MoS <sub>2</sub>	1100 MPa	3.7164.7
DIN EN 2549 / Aerospace Normal hexagon head, metric, close tolerance normal shank, short thread in titanium, anodized, MoS <sub>2</sub>	1100 MPa	3.7164.7
DIN EN 4127 / Aerospace Bolts, normal hexagonal head, coarse tolerance, normal shank, short thread, titanium, aluminium IVD coated	1100 MPa	3.7164.7
LN 9386 / Aerospace Hexagon bolt, reduced head, titanium alloy	1100 MPa	3.7164.7
LN 29943 / Aerospace Hexagon screw, close tolerance, titanium alloy short thread	1100 MPa	3.7164.7
LN 29792 / Aerospace Hexagon screw, close tolerance, titanium alloy	1100 MPa	3.7164.7
DIN EN 3052 / Aerospace Bolt, normal hexagonal head, close tolerance, normal shank, short thread, corrosion resistant steel, passivated	1100 MPa	1.4944.6
DIN 65555 / Aerospace Hexagon screw with MJ-thread, corrosion-resisting steel, short thread for temperatures up to 425 °C	1100 MPa	1.4944.6



<b>Standard / Discription</b>	<b>Nominal Tensile Strength</b>	<b>Material</b>
DIN 65339 / Aerospace Hexagon screw, close tolerance, with MJ-thread, corrosion-resisting steel, short thread for temperatures up to 425 °C	1100 MPa	1.4944.6
DIN 65115 / Aerospace Hexagon screw with reduced shaft, MJ-thread, steel for temperatures up to 235 °C	1100 MPa	1.6604.5
DIN 65525 / Aerospace Hexagon screw, close tolerance, with MJ-thread, steel, short thread, for temperatures up to 235 °C	1100 MPa	1.6604.5
DIN 65527 / Aerospace Hexagon screw, close tolerance, with MJ-thread, steel, short thread	1100 MPa	1.6604.5
DIN EN 4129 / Aerospace Bolts, normal hexagonal head, coarse tolerance, normal shank, med. length thread, alloy steel, cadmium plated	1100 MPa	1.6604.5
DIN EN 2938 / Aerospace Bolt, hexagonal head, threaded to head, corrosion and heat resisting steel, silver plated	900 MPa	1.4944.4
DIN 65524 / Aerospace Hexagon screw with MJ-thread, steel, short thread for temperatures up to 235 °C	900 MPa	1.7220.5
DIN 65267 / Aerospace Hexagon screw with MJ-thread, steel, threaded approximately to head for temperatures up to 235 °C	900 MPa	1.7220.5
LN 65029 / Aerospace Hexagon screw, close tolerance, medium thread length	900 MPa	1.7220.5
LN 29930 / Aerospace Hexagon screw, close tolerance, steel, reduced head and short thread	900 MPa	1.7220.5
DIN 65522 / Aerospace Hexagon screw with MJ-thread, corrosion-resisting steel, threaded approximately to head for temperatures up to 425 °C	700 MPa	1.4541 A2-70
DIN 65523 / Aerospace Hexagon screw with MJ-thread, corrosion-resisting steel, short thread for temperatures up to 425 °C	700 MPa	1.4541 A2-70
DIN EN 2887 / Aerospace Bolts, normal hexagonal head, threaded to head, corrosion resisting steel, passivated	600 MPa	1.4541



### Cheese head screws with internal serration

Standard / Discription	Nominal Tensile Strength	Material
DIN 65 537 / Aerospace Cheese head bolt with internal serration, MJ thread, short thread, nickel alloy for temperatures up to 315 °C / 425 °C	1250 MPa	2.4668.7
DIN 65 539 / Aerospace Cheese head bolt with internal serration, MJ thread, reduced shank, nickel alloy for temperatures up to 315 °C / 425 °C	1250 MPa	2.4668.7
DIN 65 515 / Aerospace Cheese head bolt with internal serration, MJ thread, short thread, titanium alloy for temperatures up to 315 °C	1100 MPa	3.7164.7
DIN 65 517 / Aerospace Cheese head bolt with internal serration, close tolerance, MJ thread, short thread, titanium alloy for temperatures up to 315 °C	1100 MPa	3.7164.7
DIN 65540 / Aerospace Cheese head bolt with internal serration, MJ thread, reduced shank, titanium alloy for temperatures up to 315 °C	1100 MPa	3.7164.7
LN 29950 / Aerospace Cheese head screw with internal serration, titanium alloy	1100 MPa	3.7164.7
LN 29949 / Aerospace Cheese head screw with internal serration, corrosion-resisting steel, for temperatures up to 650 °C	1100 MPa	1.4944.6

### Hexagon socket screws

Standard / Discription	Nominal Tensile Strength	Material
DIN EN ISO 4762 ( DIN 912 ) Hexagon socket head cap screw, steel, corrosion-resisting steel, nonferrous metall	depending on material and thread size	8.8 / 10.9 / 12.9 A2-70 / A4-70 A2-50 / A4-50
DIN EN ISO 10642 Hexagon socket countersunk head screw, steel, corrosion-resisting steel, nonferrous metall	depending on material and thread size	8.8 A2-70 A2-50



<b>Standard / Discription</b>	<b>Nominal Tensile Strength</b>	<b>Material</b>
NFL 22-220 Hexagonal socket cylindrical head screw, threaded to head, with hole for lockwire, ISO thread, 4h class	depending on code letter (material)	TA (3.7164.1) TX (3.7164.7)
NFL 22-224 Hexagonal socket cylindrical head screw, threaded to head, with hole for lockwire, ISO thread, 4g class		CM (1.4944.4) CX (1.4944.6)
NFL 22-225 Hexagonal socket cylindrical head screw, threaded to head, without hole for lockwire, ISO thread, 4g class		TJ (2.4668.7) TM (2.4668.9) BE (30NCD16)

### Double hexagon bolts

<b>Standard / Discription</b>	<b>Nominal Tensile Strength</b>	<b>Material</b>
DIN EN 2874 / Aerospace Large bihexagonal head bolt, close tolerance, normal shank, medium length thread, nickel alloy, passivated	1550 MPa	2.4668.9
DIN 65442 / Aerospace Double hexagon screw, close tolerance, with medium-length MJ-thread, corrosion resisting nickel alloy for temperatures up to 315 °C	1550 MPa	2.4668.9
LN 29955 / Aerospace Double hexagon screw, close tolerance, corrosion-resisting steel, medium thread length	1500 MPa	1.4534.6
DIN 65440 / Aerospace Double hexagon screw, close tolerance, with MJ-thread corrosion-resisting Ni-alloy, medium thread length for temperatures up to 315 °C	1250 MPa	2.4668.7
DIN EN 2928 / Aerospace Double hexagonal head bolt, relieved shank, long thread, heat resisting nickel based alloy, silver plated	1250 MPa	2.4668.7
LN 29769 / Aerospace Double hexagon bolt with nominal tensile strength of 1250 MPa, medium thread length	1250 MPa	1.6604.6
LN 65056 / Aerospace Double hexagon head bolt, close tolerance, from titanium alloy, medium thread length	1100 MPa	3.7164.7
DIN EN 4136 / Aerospace Bolts, normal bihexagonal head, coarse tolerance, normal shank, long thread, alloy steel, cadmium plated	1100 MPa	1.6604
LN 29902 / Aerospace Double hexagon screw, close tolerance, heat-resisting steel, for temperatures up to 650°C	900 MPa	1.4944.4



<b>Standard / Discription</b>	<b>Nominal Tensile Strength</b>	<b>Material</b>
LN 29551 / Aerospace Double hexagon screw, corrosion-resisting steel for temperatures up to 650°C	900 MPa	1.4944.4
NFL 22-232 Bihexagonal bolt with locking hole, ISO M thread, 4h class	depending on code letter (material)	depending on code letters (see above at page 4)
NFL 22-237 Bihexagonal bolt with locking hole, ISO M thread, 4g class		
NFL 22-231 Bihexagonal bolt, ISO M thread, 4g class		
NFL 22-236 Bihexagonal bolt, ISO M thread, 4g class		

**Hexalobular / six lobe recess bolts**

<b>Standard / Discription</b>	<b>Nominal Tensile Strength</b>	<b>Material</b>
DIN EN ISO 14579 Hexalobular socket head cap screw	depending on material and thread size	8.8 / 10.9 / 12.9 A2-70 / A4-70 A2-50 / A4-50
DIN EN ISO 14580 Hexalobular socket cheese head screw		
DIN EN ISO 14581 Hexalobular socket countersunk flat head		
DIN EN ISO 14583 Hexalobular socket pan head screw		
ASN A0090 Pan head screw with six lobe recess, ISO M thread	see NFL bolts	see NFL bolts



**Pan head and countersunk bolts**

<b>Standard / Discription</b>	<b>Nominal Tensile Strength</b>	<b>Material</b>
DIN 65324 / Aerospace Pan head screw, close tolerance, with internal offset cruciform ribbed drive recess, titanium alloy, short length MJ-thread, for temperatures up to 315 °C	1100 MPa	3.7164.7
DIN 65179 / Aerospace Countersunk head screw, close tolerance, with internal offset cruciform ribbed drive recess, titanium alloy, short length MJ-thread, for temperatures up to 315°C	1100 MPa	3.7164.7
DIN EN 3037 / Aerospace Pan head, offset cruciform recess, close tolerance normal shank, short thread, titanium, anodized, MoS <sub>2</sub>	1100 MPa	3.7164.7
DIN EN 3304 / Aerospace Countersunk reduced head, offset cruciform recess, close tolerance, short thread, titanium, anodized, MoS <sub>2</sub>	1100 MPa	3.7164.7
DIN EN 3381 / Aerospace Countersunk normal head, offset cruciform recess, close tolerance, short thread, titanium, anodized, MoS <sub>2</sub>	1100 MPa	3.7164.7
DIN EN 4178 / Aerospace Pan head, six lobe recess, coarse tolerance normal shank, medium length thread, titanium, anodized, MoS <sub>2</sub>	1100 MPa	3.7164.7
LN 9441 / Aerospace Countersunk head screw, cross-recessed, titanium alloy	1100 MPa	3.7164.7
LN 9442 / Aerospace Pan head screw, cross-recessed, titanium alloy	1100 MPa	3.7164.7
LN 29958 / Aerospace Pan head screw with internal offset cruciform ribbed drive recess, titanium alloy, threaded to head	1100 MPa	3.7164.7
LN 29787 / Aerospace Countersunk head screw with torq-set recess, fully threaded to head, titanium alloy,	1100 MPa	3.7164.7
LN 29 957 / Aerospace Pan Head bolt with Torq-Set recess, titanium alloy, short thread length	1100 MPa	3.7164.7
DIN EN 4499 / Aerospace 100° countersunk reduced head, offset cruciform recess, close toleranz, normal shank, short thread, titanium alloy, aluminium pigmented coating	1100 MPa	3.7164.7
DIN 65284 / Aerospace Countersunk head screw with ribbed torq-set recess and MJ-thread, fully threaded, corrosion-resisting steel, for temperatures up to 425°C	1100 MPa	1.4944.6



<b>Standard / Discription</b>	<b>Nominal Tensile Strength</b>	<b>Material</b>
DIN EN 3038 / Aerospace Pan head, offset cruciform recess, close tol. normal shank, short thread, corrosion resistant steel, passivated	1100 MPa	1.4944.6
DIN 65316 / Aerospace Countersunk head screw, close tolerance, with internal offset cruciform ribbed drive recess, corrosion-resisting steel, short length MJ-thread, for temperatures up to 425°C	1100 MPa	1.4944.6
DIN 65319 / Aerospace Pan head screw, close tolerance, with internal offset cruciform ribbed drive recess, corrosion-resisting steel, short length MJ-thread for temperatures up to 425°C	1100 MPa	1.4944.6
DIN EN 3759 / Aerospace pan head screws, offset cruciform recess, threaded to head, heat and corrosion resisting steel, passivated	1100 MPa	1.4944.6
DIN EN 3760 / Aerospace 100° countersunk normal head, offset cruciform recess, threaded to head, heat and corrosion resisting steel, passivated	1100 MPa	1.4944.6
DIN 65314 / Aerospace Countersunk head screw, close tolerance, with internal offset cruciform ribbed drive recess, steel, short length MJ-thread, for temperatures up to 235°C	1100 MPa	1.6604.5
LN 9136 / Aerospace Countersunk head screw, cross-recessed, non-magnetizable	700 MPa	1.4541 A2-70
LN 9139 / Aerospace Round head screw, cross-recessed, non-magnetizable	700 MPa	1.4541 A2-70



## Studs

Standard / Discription	Nominal Tensile Strength	Material
DIN 65395 / Aerospace Stud with MJ-thread, steel, ring locked for temperatures up to 235 °C	900 MPa	1.7214.5
DIN 65396 / Aerospace Stud with MJ-thread, corrosion-resisting steel, ring locked, for temperatures up to 425 °C	1250 MPa	2.4668.7
LN 9036 / Aerospace Stud, threaded end is approx. outer diameter by two	900 MPa	1.7220.5 1.7214.5

## Washers

Standard / Discription	Nominal Tensile Strength	Material
DIN 65209 / Aerospace Washer, countersunk	1.4544, 1.7220, 1.4943	
LN 29952 / Aerospace Washer, outer diameter is approx. hole diameter by three	1.7220, 1.7214, 1.4544	
LN 9016 / Aerospace Washer, bevelled	1.7220, 1.7214, 1.4544, 1.4943, 1.4944	
LN 9025 / Aerospace Washer	1.7214, 1.4544, 1.4934, 1.4944, 3.1364, 3.1354	





# MANUFACTURING TECHNOLOGIES AND ACCEPTANCE REQUIREMENTS FOR FASTENERS

## Manufacturing of standard parts and fulfilment of the acceptance requirements according to Technical Specifications

Technical Specification	Manufacturing and testing requirements
DIN 65058 / AIR 9173 / NAS 4003 / ISO 8168 for corrosion-resisting steel, strength class 900 MPa and 1100 MPa ( 1.4944.4 / 1.4944.6 )	<ul style="list-style-type: none"> <li>- The head of the bolts shall be forged to achieve the head to shank grain flow and fillet work effect</li> </ul>
DIN ISO 9152 / AIR9185 / NAS 4004 / DIN 65251 for titanium alloy, strength class 1100 MPa ( 3.7164.7 )	<ul style="list-style-type: none"> <li>- The thread shall be rolled to achieve thread grain flow and fillet work effect</li> </ul>
DIN 65251 / AIR 9184 / NAS 4004 for titanium alloy, strength class 900 MPa ( 3.7164.1)	<ul style="list-style-type: none"> <li>- Microstructure examinations of the head to shank and the thread grain flow, the fillet work effect, as well as the grain structure and grain size of the finished part</li> </ul>
DIN 65013 / AS 7468 for work strengthened and corrosion resistant Co-alloys, strength class 1800 MPa ( MP 35 N )	<ul style="list-style-type: none"> <li>- Tensile tests at room temperature</li> <li>- Tension fatigue tests at room temperature</li> <li>- Hardness tests according to Vickers or Rockwell</li> </ul>
LN 65009 / AIR 9173 / NAS 4002 for tempering steels, strength class 1100 MPa and 1250 MPa	<ul style="list-style-type: none"> <li>- Magnetic or dye penetration testing to check surface discontinuities by aerospace qualified people according to DIN EN 4179 / NAS 410 and DIN EN 473</li> </ul>
EN 2583 / AIR 9167 / AS 7466 high strength precipitation-hardening nickel alloy, strength class 1270 MPa ( 2.4668.7 )	
ISO 9154 / EN 3833 / AIR 9169 / NAS 4008 high strength precipitation-hardening nickel alloy, strength class 1550 MPa ( 2.4668.9 )	
DIN 65 160 Normal tensile strength 1220 MPa, 1 400 MPa and 1 550MPa (1.4534.4 / 1.4534.5 / 1.4534.6)	



## THREADS

### Comparison of ISO metric threads and MJ – threads with different tolerances and their advantages

screw thread	pitch-diameter [mm]		core-diameter [mm]		stressed cross section [mm <sup>2</sup> ]	root of thread radius [mm]
	max.	min.	max.	min.		
M4x0,7 - 6g	3,523	3,433	3,119	3,002	8,658	0,101 – 0,088
M4x0,7 - 4h	3,545	3,489	3,141	3,058	8,773	
MJ4x0,7 - 4h6h	3,545	3,489	3,192	3,094	8,907	0,126 – 0,105
M6x1 - 6g	5,324	5,212	4,747	4,596	19,905	0,144 – 0,125
M6x1 - 4h	5,350	5,279	4,773	4,663	20,111	
MJ6x1 - 4h6h	5,350	5,279	4,845	4,713	20,398	0,180 – 0,150
M10x1,5 - 6g	8,994	8,862	8,128	7,938	57,533	0,216 – 0,188
M10x1,5 - 4h	9,026	8,936	8,160	8,017	57,964	
MJ10x1,5 - 4h6h	9,026	8,936	8,268	8,087	58,695	0,271 – 0,255

#### Advantages of MJ - thread:

- **larger core diameter**

⇒ larger stressed cross section

- **larger root of thread radius**

⇒ lower stress concentration / notch effect

resulting characteristics:

⇒ **increased tensile strength but**

⇒ **mainly improved tension fatigue strength**