

## BOLTING MATERIAL ASTM SPECIFICATIONS

### Bolting Material Specifications

Common designation	Specification No.	Grade	Notes	Common designation	Specification No.	Grade	Notes
Alloy & S.S. Bolting	A193	-	(2)(3)	High Temp Bolting	A449	-	(7)(8)
Carbon Steel Bolting	A307 B	-	(4)(5)	Alloy Steel Bolting	A453	651/660-	(9)
Low Temp Bolting	A320	-	(2)(3)(6)	Alloy Steel Bolting Sp.	A540	-	-
Q & T Alloy Bolting	A354	-	-	17-4 PH Bolting	A564	630	(7)
Monel 400 Bolting	B164	-	(10)(11)(12)	Ni-Cr-Fe Alloy Bolting	B408	-	(10)(11)(12)
Monel 400 Bolting	B165	-	(20)	Alloy 20 Bolting	B473	-	(10)
Hastelloy B-2 Bolting	B335	N10665	(10)	Hastelloy C-276 Bolting	B574	N10276	(10)
Monel K-500 Bolting	B865	N05500	(20)	Hastelloy C-22 Bolting	B574	N06022	(10)
Inconel 600 Bolting	B166	N06600	(10)(11)	High Temp PH Ni Alloy	B637	N07718	(10)
				High Temp PH Ni Alloy	A1014	-	(20)

#### GENERAL NOTES:

- The user is responsible for assuring that bolting material is not used beyond the limits specified in the governing code or regulations.
- ASME Boiler and Pressure Vessel Code Section II material that also meet the requirements of the listed ASTM specification may also be used.
- Material limitations, restrictions, and special requirements are shown on pressure-temperature tables.
- Check latest version of ASME B16.34 as this standard is continually updated. Do not use these tables for design or ordering purposes. The above data is extracted from ASME B16.34 2009.
- Note (1) below applies to all grades.

#### NOTES:

- Repair welding of bolting material is not permitted.
- Where austenitic bolting materials have been carbide solution treated but not strain hardened, they are designated Class 1 or Class 1A in ASTM A193. ASTM A194 nuts of corresponding material are recommended.
- Where austenitic bolting materials have been carbide solution treated and strain hardened, they are designated Class 2 in ASTM A193. ASTM A194 nuts of corresponding material are recommended.
- For limitations of usage and strength levels, see ASME B16.34 para. 5.1.2.
- Bolts with drilled or undersize heads shall not be used.
- For ferritic bolting materials intended for service at low temperatures, ASTM A194 Gr. 7 nuts are recommended.
- Acceptable nuts for use with quenched and tempered steel bolts are ASTM A194 Grade 2 and 2H.
- Mechanical property requirements for studs shall be the same as for bolts.
- Bolting materials suitable for high-temperature service with austenitic stainless steel valve materials.
- Nuts may be of the same material or may be of compatible grade of ASTM A194.
- Forging quality not permitted unless the producer last heating or working these parts tests them as required for other permitted conditions in the same specification and certifies their final tensile, yield, and elongation properties to equal or exceed the requirements for one of the other permitted conditions.
- Maximum operating temperature is arbitrarily set at 260°C (500°F), unless material has been annealed solution annealed, or hot finished, because hard temper adversely affects design stress in the creep-rupture temper range.

### Bolting Temperature Range

Bolt Material	Nut Material	Temperature Range
ASTM A193 Grade B7/B7M	ASTM A194 Grade 2H	-20°F (-30°C) to +1000°F (+538°C)
ASTM A320 Grade L7/L7M	ASTM A194 Grade 7†	-150°F (-101°C) to +1000°F (+538°C)
ASTM A193 Grade B16	ASTM A194 Grade 4†	-20°F (-30°C) to +1100°F (+593°C)
ASTM A193 Grade B8/B8M	ASTM A194 Grade 8	-450°F (-268°C) to +1500°F (+815°C)
ASTM A193 Grade B8/B8M CL2	ASTM A194 Grade 8	-450°F (-268°C) to +1000°F (+538°C)

The above temperature range is for bolting. For combined temperature range of valve body and bolting material see next page.

† ASTM A194 Grade 7 replaces Grade 4 (ASTM has withdrawn Grade 4 whilst still acceptable was removed from ASTM Standard due to lack of use and material availability).

## Valve Material & Corresponding Bolting Combined Temperature Range

Valve Body Material	Corresponding Bolting	Material Nuts	Lower Temp.	Upper Temp.
Grade WCB (Carbon Steel)	ASTM A193 Gr B7*	ASTM A194 Gr 2H	-29°C	427°C
Grade LCB (Carbon Steel)	ASTM A320 Gr L7†	ASTM A194 Gr 7†	-46°C	343°C
Grade WC1 (Carbon Moly)	ASTM A193 Gr B7*	ASTM A194 Gr 2H	-29°C	400°C
	ASTM A193 Gr B16	ASTM A194 Gr 4†	-29°C	454°C
Grade WC6 (1¼ Cr-½ Mo)	ASTM A193 Gr B7*	ASTM A194 Gr 2H	-29°C	400°C
	ASTM A193 Gr B16	ASTM A194 Gr 4†	-29°C	593°C
Grade WC9 (2¼ Cr-1 Mo)	ASTM A193 Gr B7	ASTM A194 Gr 2H	-29°C	400°C
	ASTM A193 Gr B16	ASTM A194 Gr 4†	-29°C	593°C
Grade C5 (5Cr-½ Mo)	ASTM A193 Gr B7*	ASTM A194 Gr 2H	-29°C	400°C
	ASTM A193 Gr B16	ASTM A194 Gr 4†	-29°C	593°C
Grade C12 (9Cr-1 Mo)	ASTM A193 Gr B7	ASTM A194 Gr 2H	-29°C	400°C
	ASTM A193 Gr B16	ASTM A194 Gr 4†	-29°C	593°C
Grade CF8 (Type 304)	ASTM A320 Gr B8***	ASTM A194 Gr 8	-254°C	575°C
	ASTM A193 Gr B8**	ASTM A194 Gr 8	-150°C	650°C
Grade CF8M (Type 316)	ASTM A320 Gr B8M***	ASTM A194 Gr 8M	-250°C	575°C
	ASTM A193 Gr B8M**	ASTM A194 Gr 8M	-150°C	750°C
Grade LC3 (3½ Ni)	ASTM A320 Gr L7†	ASTM A194 Gr 7†	-101°C	343°C

\* Alloy steel bolting, A193 Gr B7 bolts and A194 Gr 2H nuts can only be used at moderate temperatures depending on the permissible differential expansion of valve design which may vary between manufacturers.

\*\* ASTM A193 Gr B8/B8M bolting can rate from -198°C to 800°C, however many manufacturers of bolts and/or valves specify the narrower rating range shown.

\*\*\* For temperatures lower than -200°C (-325°F) ASTM A320 Gr B8/B8M bolting must be impact tested. Class 2 strain hardened required for high pressure/larger sizes (refer to manufacturer) and low temperature service.

† All L7 bolts and Grade 7 nuts must be Charpies impact tested (standard for A320 L7/L7M) for service temperature lower than -29°C. Whilst still acceptable, A194 Grade 4 have been withdrawn from ASTM standard due to lack of use and availability (Grade 7 is used in lieu). An 'L' is added as a suffix to indicate Charpies testing on nuts only i.e. Gr 7L. Charpies testing is required for 5/8" size and over as per ASTM A194 supplementary section S3 if the valve is used in service lower than -29°C.

The above chart shows the combined temperature range, taking into account the valve and bolting material ratings. Refer to ASTM pressure/temperature charts. For limitations of usage and strength levels refer ANSI B16.34.

Where austenitic bolting materials have been carbide solution treated but not strain hardened, they are designated Class 1 or Class 1A. Where austenitic bolting materials have been carbide solution treated and strain hardened, they are designated Class 2. In B8 and B8M, 'Class 2' is recommended for higher classes 900lb and above in larger sizes depending on temperature due to its higher tensile strength (carbide solution treated, strain hardened).

A193 Gr B7 and Gr L7 are acceptable for NACE (as class III NACE Bolting) service as bolting is "Non wetted parts", however if bolts themselves must conform to NACE, then B7M, L7M bolts are required. B8M bolting being equivalent to 316, automatically conforms to NACE.

Temperature range of studs can vary widely depending on size, stud, manufacturer, bonnet enclosure and valve manufacturers calculation. Also refer to ASTM standard for 'design temperature rating' of bolting.

For technical references and ASTM/ASME cross reference information on stainless, duplex, chrome-moly and alloy steel used in valves & piping systems in the petrochemical and refining. Go to our website: <http://www.australianpipelinevalve.com.au>

We can manufacture exotic grades like Nickel, Super Duplex F55 and Monel (ASTM A494-M35-1), Cd4M-Cu, Hastelloy C (ASTM A-494 CW12MW) and 317 (C8GM) in short lead-time.