XM-25, UNS S45000, 1.4594, X5CrNiMoCuNb14-5, Custom 450, B50A789 - Turbine Blade Steels Datasheet

Alloy **C450**, XM-25 martensitic age-hardenable stainless steel which exhibits very good corrosion resistance with strength. XM-25 alloy has a yield strength somewhat greater than 689 MPa in the annealed condition. A single-step aging treatment develops higher strength with good ductility and toughness. This stainless can be machined, hot-worked, and cold-formed in the same manner as other martensitic age-hardenable stainless steels. A particular advantage is ease of welding and brazing. XM-25 stainless is generally supplied in the annealed condition, requiring no heat treatment by the user for many applications. Mechanical properties will depend on the aging temperature selected.

GTD 450 martensitic age-hardenable stainless steel. This alloy is relatively soft and formable in the annealed condition. A single-step aging treatment develops exceptionally high yield strength with good ductility and toughness. This stainless can be machined in the annealed condition, and welded in much the same manner as other precipitation hardenable stainless steels. Because of its low work-hardening rate, it can be extensively cold formed. The dimensional change during hardening is only about -0.001 in/in, which permits close-tolerance finish machining in the annealed state. GTD 450 stainless represents a significant advancement in the area of precipitation hardening stainless steels. It should be considered where simplicity of heat treatment, ease of fabrication, high strength and corrosion resistance are required in combination.

Custom 450 stainless steel has very good corrosion resistance, high strength and good processing characteristics. A simple one-step aging treatment can make Custom450 obtain high strength, good plasticity and toughness.

Chemical Composition

Grade	Chemical Composition WT %															
	C	Mn	Si	P	S	Cr	Cu	Ni	Mo	Nb	V	N	Ag	Pb	Sn	Ai
C450	≤0.05	≤1.00	≤1.00	≤0.03	≤0.03	14.0-16.0	1.25-1.75	5-7	0.5-1.0	0.35-0.75						
Alloy 450	≤0.05	≤1.00	≤1.00	≤0.03	≤0.03	14.0-16.0	1.25-1.75	5-7	0.5-1.0	0.35-0.75						
UNS S45000	≤0.05	≤1.00	≤1.00	≤0.03	≤0.03	14.0-16.0	1.25-1.75	5-7	0.5-1.0	Nb >8x (%C)						
XM-25	≤0.05	≤1.00	≤1.00	≤0.03	≤0.03	14.0-16.0	1.25-1.75	5-7	0.5-1.0	Nb >8x (%C)						
GTD450, B50A789 Class A, B, E, F, H	0.025-0.045	≤1.00	≤1.00	0.025	0.005	14-16	1.25-1.75	6-7	0.5-1.0	0.4-0.75 / 14 x C Min	0.1	0.03	0.005	0.005	0.1	0.05
GTD450, B50A789 Class G	0.03-0.05	0.3-0.8	0.2-0.5	0.020	0.005	14-16	1.35-1.75	6.2-6.8	0.6-1.0	8xC-15xC	0.1	0.03	0.005	0.005	0.1	0.03
ASTM A564	≤0.05	≤1.00	≤1.00	≤0.03	≤0.03	14.0-16.0	1.25-1.75	5-7	0.5-1.0	Nb >8x (%C)						
04Cr15Ni7Cu2MoNbVN	0.03-0.05	0.2-0.5	0.3-0.8	0.02	0.005	14-16	1.35-1.75	6.2-6.8	0.6-1.0	8*C-15*C	0.10	0.03	0.005	0.005	0.10	
X 5 CrNiMo	≤0.07	≤1.00	≤0.70	≤0.04	≤0.015	13.0-15.0	1.20-2.00	5.0-6.0	1.20-2.00	0.15-0.60						

Grade	Chemical Composition WT %															
	C	Mn	Si	P	S	Cr	Cu	Ni	Mo	Nb	V	N	Ag	Pb	Sn	Ai
CuNb 14 5																
1.4594	≤0.07	≤1.00	≤0.70	≤0.04	≤0.01 5	13.0-1 5.0	1.20-2 .00	5.0-6. 0	1.20-2 .00	0.15-0 .60						
Custo m 450	≤0.05	≤0.50	≤0.50	≤0.03	≤0.03	14.50- 16.50	1.25-1 .75	5.50-7 .00	0.50-1 .00							

Mechanical Properties

- Class E & F
  - Tensile strength ksi, min: 146-175
  - Yield Strength ksi, min: 132
  - Elongation in 4D, %, min: 16
  - Reduction of Area, %, min: 50
  - Hardness: Brinell, 3000 kg Load: 302-363
  - Impact, Room Temp., Charpy V-Notch (Ft.-Lbs.), min: 50
- Class H
  - Tensile strength ksi, min: 140-175
  - Yield Strength ksi, min: 120
  - Elongation in 4D, %, min: 16
  - Reduction of Area, %, min: 50
  - Hardness: Brinell, 3000 kg Load: 302-363
  - Impact, Room Temp., Charpy V-Notch (Ft.-Lbs.), min: 50
- Class G
  - Tensile strength ksi, min: 180-195
  - Yield Strength ksi, min: 120
  - Yield Strength - 0.02% Offset (ksi), min: 140
  - Elongation in 4D, %, min: 13
  - Reduction of Area, %, min: 45
  - Hardness: Brinell, 3000 kg Load: 380-415
  - Impact, Room Temp., Charpy V-Notch (Ft.-Lbs.), min: 40
- Class E, F, H

- Tensile strength ksi, min: 140-175
- Yield Strength ksi, min: 120
- Elongation in 4D, %, min: 16
- Reduction of Area, %, min: 50
- Impact, Room Temp., Charpy V-Notch (Ft.-Lbs.), min: 40

- Class G
  - Tensile strength ksi, min: 180
  - Yield Strength ksi, min: -
  - Elongation in 4D, %, min: 5
  - Reduction of Area, %, min: -
  - Impact, Room Temp., Charpy V-Notch (Ft.-Lbs.), min: -

- H1150 <= 300 mm (T)
  - Tensile strength R_m MPa: Min 860
  - Yield Strength R_p MPa: Min 515
  - A %: Min 12
  - Z %: Min 35
  - Hardness min: HR 26; HB 262
- H1150 <= 300 mm (L)
  - Tensile strength R_m MPa: Min 860
  - Yield Strength R_p MPa: Min 515
  - A %: Min 18
  - Z %: Min 55
  - Hardness min: HR 26; HB 262
- H1100 <= 300 mm (T)
  - Tensile strength R_m MPa: Min 895
  - Yield Strength R_p MPa: Min 725
  - A %: Min 11
  - Z %: Min 30
  - Hardness min: HR 30; HB 285
- H1100 <= 300 mm (L)

- Tensile strength R_m MPa: Min 895
- Yield Strength R_p MPa: Min 725
- A %: Min 16
- Z %: Min 50
- Hardness min: HR 30; HB 285

- H1050 <= 300 mm (T)
  - Tensile strength R_m MPa: Min 1000
  - Yield Strength R_p MPa: Min 930
  - A %: Min 9
  - Z %: Min 30
  - Hardness min: HR 34; HB 321
- H1050 <= 300 mm (L)
  - Tensile strength R_m MPa: Min 1000
  - Yield Strength R_p MPa: Min 930
  - A %: Min 12
  - Z %: Min 45
  - Hardness min: HR 34; HB 321
- H1025 <= 200 mm (L)
  - Tensile strength R_m MPa: Min 1035
  - Yield Strength R_p MPa: Min 965
  - A %: Min 12
  - Z %: Min 45
  - Hardness min: HR 34; HB 321
- H1000 <= 300 mm (T)
  - Tensile strength R_m MPa: Min 1100
  - Yield Strength R_p MPa: Min 1035
  - A %: Min 8
  - Z %: Min 27
  - Hardness min: HR 36; HB 331
- H1000 <= 300 mm (L)
  - Tensile strength R_m MPa: Min 1100

- Yield Strength R_p MPa: Min 1035
- A %: Min 12
- Z %: Min 45
- Hardness min: HR 36; HB 331

- H950 <= 300 mm (T)
  - Tensile strength R_m MPa: Min 1170
  - Yield Strength R_p MPa: Min 1100
  - A %: Min 7
  - Z %: Min 22
  - Hardness min: HR 37; HB 341
- H950 <= 300 mm (L)
  - Tensile strength R_m MPa: Min 1170
  - Yield Strength R_p MPa: Min 1100
  - A %: Min 10
  - Z %: Min 40
  - Hardness min: HR 37; HB 341

- +AT Dia. or Thick max 100 mm
  - Tensile strength R_m MPa: max 1200
- P1070 Dia. or Thick max 100 mm
  - Tensile strength R_m MPa: 1070-1270
  - Yield Strength R_p MPa: Min 1000
  - A %: Min 10
  - Hardness: HB 360
- P1000 Dia. or Thick max 100 mm
  - Tensile strength R_m MPa: 1000-1200
  - Yield Strength R_p MPa: Min 860
  - A %: Min 10
  - Hardness: HB 360
- P930 Dia. or Thick max 100 mm
  - Tensile strength R_m MPa: 930-1100

- Yield Strength R_p MPa: Min 720
- Akv J: Min 40
- A %: Min 15
- Hardness: HB 360

Physical Properties

Properties	Metric	Imperial
Density	7.80 cm^3	0.282 lb/in^3

Heat Treatment

- B50A789A - Hot rolled; overaged 1150 ° F ± 25 ° F, and prepared with no defects detrimental to forging/extruding.
- B50A789B - Solution treated, 1900 ° F ± 25 ° F, or water quench and prepared with no defects detrimental to forging/extruding.
- B50A789E - Solution treated, 1900 ° F ± 25 ° F, forced air cool or water quench and aged at 1070 ° F ± 10 ° F.
- B50A789F - Same as B50A789E.
- B50A789G - Forged, solution treated, 1900 ° F ± 25 ° F, forced air cool, oil quench and aged at 900 ° F min. ± 8 ° F (5 ° C).
- B50A789H - Forged, solution treated, 1900 ° F ± 25 ° F, forced air cool and aged at 1100 ° F ± 10 ° F.

XM-25, S45000, 450 Alloy stainless steel alloy can be hot worked by soaking at 1150-1177 ° C (2100-2150 ° F) followed by cooling and fully annealing.

XM-25, S45000, 450 Alloy stainless steel alloy can be cold worked using all common techniques.

XM-25, S45000, 450 Alloy stainless steel alloy is annealed by soaking at 1024-1052 ° C (1875-7925 ° F) for 1 h followed by quenching in water or oil.

XM-25, S45000, 450 Alloy stainless steel alloy is soaked at specific temperature for 4 h followed by cooling to obtain condition H900, H950, H1000, H1050 or H1150.

Solution annealing: heating to 1024 °C ~ 1052 °C, holding for 15h. and cooling rapidly. In order to achieve the best aging effect, water quenching is preferred. Custom 450 is generally delivered in the solution annealed state at the factory, and then ready for use or subsequent age hardening treatment. Age hardening: increase the tensile strength and yield strength of Custom 450 by aging at 427 ° C ~ 538 ° C for 4 hours, and then air cooling. The recommended 482 ° C aging can make it obtain the best combination of strength, plasticity and toughness. Overaging at temperatures up to 538 ° C increases its plasticity and reduces its strength. Dimensional shrinkage during heat treatment: age hardening at 482 ° C, approximately 0.001 inch per inch shrinkage. Critical temperature: A--632 ° C: A--707 ° C: M--118 ° C: M--38 ° C

Welding Properties

XM-25, S45000, 450 Alloy stainless steel alloy can be welded using shielded methods to reduce contamination. Custom 450 solderability - Soldering and Brazing: No preheating is required to prevent cracking during soldering. Standard methods of welding stainless steel can be used with Custom 450. When optimum corrosion resistance is required, parts should be annealed after welding. A similar (Cmstom 450) filler material should be used to maintain optimum weld metal strength. The recommended brazing temperature should be consistent with the annealing temperature range so that re-annealing is not necessary. Brazing consumables used for Type 304 stainless steel shall be used.

Machining Properties

XM-25, S45000, 450 Alloy stainless steel alloy uses feeds and speeds comparable with other martensitic stainless steels. It is preferred to use positive feeds and slow speeds to achieve good results.Custom 450 Machinability: This alloy can be successfully machined by the same process as other martensitic stainless steels of comparable strength classes.thermal processing - this alloy is easy to thermal process in the temperature range of 900 °C ~ 1260 °C. It is not only easy to process, but also to obtain fine grain size (this alloy). The optimum thermal processing temperature range is 1150 ° C ~ 1177 ° C. Cold working - Custom450 has a low work hardening rate and can be subjected to a large amount of cold working without intermediate annealing. Sharply bent deep drawing or stretching operations that produce localized elongations are to be avoided.

Similar or Equivalents Steel Grade

Custom 450, XM-25, S45000, 450 Alloy, 1.4594, X5CrNiCuMo15-06, X5CrNiMoCuNb14-5, GE B50A789, MAT 238863, 04Cr15Ni7Cu2MoNbVN