

## MOLYBDENUM ALLOY AST-4 TZM Arc-Cast Sheet 3402

**Description of Product** This specification covers rolled sheet of carbon-deoxidized TZM alloy (Molybdenum + 0.5 Titanium + 0.08 Zirconium) produced from sheet bar consolidated by the H.C. Starck consumable electrode vacuum-arc-casting process.

**Chemical Characteristics<sup>1)</sup>**  
 (Mass fraction in % [cg/g]; ppm [ $\mu$ g/g])

The chemical composition of the sheet bar used to produce rolled sheet shall conform to the following limits:

Mo(By Difference)	min.	99.25	%
N	max.	0.002	%
Ni	max.	0.002	%
O	max.	0.0030	%
Si	max.	0.010	%
Fe	max.	0.010	%
C	0.01	-	0.03 %
Zr	0.06	-	0.12 %
Ti	0.40	-	0.55 %

**Structure** Sheet will be supplied in a stress-relieved condition unless otherwise requested.

**Mechanical Properties** Tensile tests will be conducted at room temperature (65°F – 85°F) using in a strain rate of 0.002 to 0.005 in/in/min. through 0.6 % offset and 0.02 to 0.05 in/in/min. to fracture. Tensile properties will be determined on specimens taken transverse to the final rolling direction. Test specimens will be prepared and tested according to ASTM Specification No. E-8, utilizing a gage length of 2 inches.



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1) Information on testing methods on request.

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### Physical Characteristics

Tensile properties shall meet the following minimum values:

Thickness (Inches)	Tensile Strength (psi Minimum)	Yield Strength (0.2 % Offset) (psi Minimum)	Elongation (% Minimum)
0.010 to 0.025	120.000	100.000	6
Over 0.025 to 0.060	120.000	100.000	7
Over 0.060 to 0.090	120.000	100.000	9
Over 0.090 to 0.187	120.000	100.000	10

Bend tests will be conducted on specimens, at least 1 inch wide x 2 inches long, taken from the sheet with the major axis transverse to the final rolling direction.

Bend Radius    Bend Severity 90°  
2T            to 0.065 in.

T indicates the sheet thickness. Bend radius is equivalent to one half of the mandrel (or insert) diameter. Testing is performed at room temperature (65°F – 85°F).

### Thickness Tolerance:

THICKNESS (INCHES)	UP TO 12 INCHES WIDE (INCHES)	OVER 12 THROUGH 24 INCHES WIDE (INCHES)
0.010 to 0.019	± 0.0015	
Over 0.019 to 0.029	± 0.002	
Over 0.029 to 0.039	± 0.0025	± 0.003
Over 0.039 to 0.049	± 0.003	± 0.0035
Over 0.049 to 0.070	± 0.004	± 0.004
Over 0.070 to 0.187	± 5 %	± 5 %

### Width Tolerance:

THICKNESS* (INCHES)	SLIT (INCHES)			SHEARED (INCHES)	
	.250 THRU .500	OVER .500 THRU 6	OVER 6 THRU 12	OVER 12 THRU 24	.500 THRU 12    OVER 12 THRU 24
0.010 to 0.015	± 0.10	± 0.10	± 0.15	-----	± 0.31    -----
0.016 to 0.020	± 0.10	± 0.15	± 0.31	-----	± 0.31    -----
0.021 to 0.035		± 0.31	± 0.31	± 0.62	± 0.31    ± 0.62
0.036 to 0.060		± 0.31	± 0.62	± 0.62	± 0.62    ± 0.62
0.061 to 0.070		± 0.62	± 0.62	± 0.62	± 0.62    ± 0.62
0.071 to 0.090					± 0.62    ± 0.62
0.091 to 0.187					± .125    ± .125

\*For thickness 0.71 to 0.187 inches; sheet will be sheared, abrasive cut, band saw cut, or water jet cut to the tolerances shown.

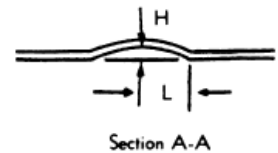
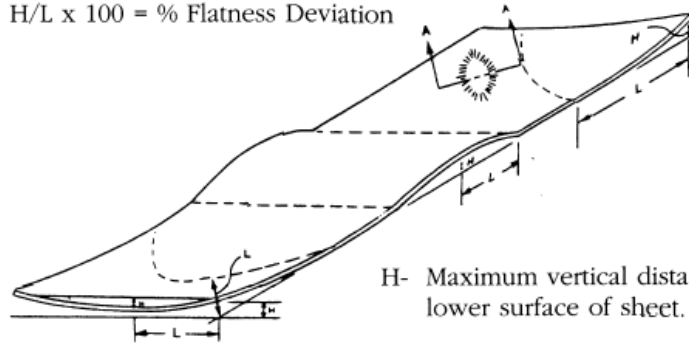
Bedsheet is sold as a usable width, therefore any cracks or delaminations on the edges are acceptable as long as a 6, 12 or 24 inch minimum width can be yielded from the material.

**Length Tolerance**            For specified lengths, the tolerance for all sizes is + .0625 - 0 inch per foot of length. Edge Straightness-Maximum camber is .0625 inch per foot of length.

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**Flatness Tolerance** The total deviation from flatness will not exceed 4 % maximum, as determined by the following formula:

$$H/L \times 100 = \% \text{ Flatness Deviation}$$



- H- Maximum vertical distance between flat surface and lower surface of sheet.
- L- Minimum horizontal distance between highest point on sheet and point contact with flat surface.

**Surface Condition** Sheet is supplied with a matte finish. It will be of uniform quality, clean, and free from foreign matter. It will be free from edge delaminations as determined by visual examination, with the exception of bedsheet width. Normal shear tears are not considered as delaminations.

**Hazards identification in Advertising (Directive 67/548/EEC Article 26, Directive 1999/45/EC Article 13 and REGULATION (EC) No 1272/2008 Article 48)**  
none.

**Identification** The material will be identified with appropriate specification number, ingot or lot number, and nominal size. Shipping containers will be marked with the name of the customer and the purchase order number.

**Rejection** H.C. Starck must receive written notification of rejected material with the reason for rejection. The right is reserved to inspect rejected material at customer plant for claim validation. The material may be returned only after proper authorization.

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