

TECHNICAL DATA SHEET

Molybdenum, TZM, & Mola

What is Molybdenum?

Molybdenum, known as Moly, is a refractory metal with a well-balanced range of properties and a melting temperature of 4748°F (2623°C) making it a great solution for many different industries and high-temperature applications where melting temperatures are a concern. Moly's extraordinary resistance to heat is possible thanks to the materials's high energy binding of individual atoms permitting usage in many industrial applications that would not be feasible with common metals and alloys. Moly is softer and more ductile than tungsten contributing to its machinability, but can also be alloyed with other compounds to increase specific performance attributes (TZM & Mola).

What is TZM?

Titanium-Zirconium-Molybdenum alloy, also known as TZM, is manufactured from molybdenum by using small quantities of tiny, extremely fine carbides through P/M or Arc Casting technology. This alloy, comprised of 0.50% Titanium, 0.08% Zirconium, and 0.01-0.04% Carbon is a great high strength solution for high temperature applications. TZM is stronger than pure molybdenum and possesses a higher recrystallization temperature and better creep resistance. Commonly used in applications involving demanding mechanical loads, it's recommended use temperature is between 1292°F (700°C) & 2552°F (1400°C).

What is Mola?

Molybdenum-Lanthom Oxide, also known as Mola, is an alloyed metal manufactured to provide specific advantages over pure Moly. This alloyed metal is made by adding Lanthanum Oxide during the manufacturing process, giving the molybdenum a so-called stacked fiber microstructure which is stable at temperatures up to 2632°F(2000°C). This microstructure allows the alloy to be creep-resistant under shear strength, higher tensile strength, and greater resistance to deformation at high temperatures. Mola is an ideal material for applications requiring dimensional stability and strength at temperatures above the capabilities of pure Moly or TZM.

Benefits

• Molybdenum (MOLY)

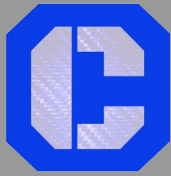
- Very high melting temperature of 4748°F (2620°C)
- Excellent strength & stiffness at high temperatures
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- Excellent thermal conductivity & low thermal expansion
- High density and high modulus of elasticity
- Good machinability, and easily fabricated
- Can alloy with other compounds to increase performance
- Good electrical conductivity and ductile
- High purity and excellent creep resistance
- Low emissivity and vapor pressure
- High dimensional stability & excellent corrosion resistance

• Titanium-Zirconium-Molybdenum Alloy (TZM)

- Higher recrystallization temperature
- Better creep resistance
- Can withstand 30,000-psi stress for over 100hrs, 3x that of Moly

• Molybdenum-Lanthom Oxide (Mola)

- Stacked fiber microstructure stable up to 3632°F (2000°C)
- High temperature of recrystallization
- Better ductility and wear resistance
- Lower cold shearing strength
- Higher tensile strength
- Greater resistance to deformation at high temperatures



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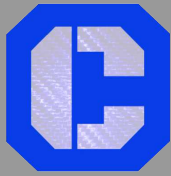
Applications

- **Molybdenum (MOLY)**
 - Hot zones for high-temperature furnaces
 - Sputtering targets for coating solar cells & flat screens
 - Heat shields & glass melting electrodes
 - Semiconductor base plates
 - Good brazing fixtures & boring bars
 - Tools and contacts
 - Pigments and catalysts
 - Filaments, ribbons, and wires for lighting
 - Jet tabs, rocket nozzles and missile parts
- **Titanium-Zirconium-Molybdenum Alloy (TZM)**
 - Forging tools
 - Supports, fixtures, and carriers
 - Hot runner nozzles
 - Rotating anodes in X-ray tubes
 - Hot Die forming
 - Furnace construction and metal working
 - Casting molds
- **Molybdenum-Lanthom Oxide (Mola)**
 - Furnace components such as stranded and other wires
 - Vacuum furnace fixtures and heating elements
 - Sintering and annealing boats
 - Illumination and internal parts in light bulbs
 - Electrical vacuum device
 - Tube component in cathod-ray pipe
 - Evaporator coils & medical devices
 - Retaining and feed wires
 - Power semiconductor device and applied magnet research
 - Aerospace and aircraft components

Technical Specifications Board

Comparison to pure Moly (Mo): + Higher ++ Much higher - Lower ~ Comparable		
Type	Molybdenum	Mola
Stability at high temperature/ Creep Resistance ≤2552°F(1400°C)	++	+
≥2552°F(1400°C)	+	++
Stability at room temperature	+	~
Ductility after HT use	+	++
Thermal conductivity	-	~
Recrystallization Temperature	+	++
Weldability	+	+

Thermal Conductivity W/m-k				
Type	Unit	Molybdenum	TZM	Mola
Thermal Conductivity	W/m-k	142	202	147



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Typical Physical Properties				
Type	Unit	Molybdenum	TZM	Mola
Composition	%	≥99.97 Mo	99.38-99.41 Mo 0.50 Ti 0.01-0.04 C	99.30-99.70 Mo 0.3-0.7 La ₂ O ₃
Density	lb/in ³ gm/cm ³	0.37 10.20	0.37 10.22	0.376 10.30
Melting Point	°F °C	4748 2620	4753 2623	4748 2620
Electrical Resistivity	micro-ohm-cm	5.34	6.85	5.17
Specific Heat	Cal/gm°C	0.061	0.073	0.061
Recrystallization Temperature	°F °C	2012 1100	2552 1400	2372 1300(90% def)
Coefficient of Linear Thermal Expansion	10 ⁻⁶ (°F) ⁻¹	2.70	2.50	2.70
	10 ⁻⁶ (°C) ⁻¹	4.90	5.20	4.90
Tensile Strength	KSI MPa - RT	150 1034	110 760	70 480
	KSI MPa - 500°C	75 517	-	22 150
	KSI MPa - 1000°C	25 172	-	12 80
Elongation	% in 1.0"	12	15	15
Hardness	HV10	> 220	220 DPH/RC	230 DPH/RC
Modules of Elasticity @20°C	GPa	320	320	310