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 material’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-Lanthanum 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 3632°F (2000°C). This microstructure allows the alloy to be creep-resistant under extreme use conditions, while contributing to a lower cold 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.

Material Benefits
• Molybdenum (Moly)
  • Very high melting temperature of 4748°F (2620°C)
  • Excellent strength & stiffness at high temperatures
  • 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

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 moulds

• 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
  • Electric 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
Molybdenum, Mola, & TZM

Stocked Sizing & Properties
Our office stocks and fabricates commonly requested Moly and TZM parts for immediate shipment. Items include, but are not limited to fasteners, nuts, solid rods, wire, bars, sheets, baskets, grids, and element strips. If a specific size, grade, alloy, or fabrication is needed please contact our team.

<table>
<thead>
<tr>
<th>Properties</th>
<th>Unit</th>
<th>Molybdenum</th>
<th>TZM</th>
<th>Mola</th>
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<tbody>
<tr>
<td>Composition</td>
<td>%</td>
<td>≥ 99.97 Mo</td>
<td>99.38-99.41 Mo</td>
<td>99.30-99.70 Mo</td>
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<tr>
<td></td>
<td></td>
<td>0.50 Ti</td>
<td>0.3 - 0.7 La₂O₃</td>
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<tr>
<td>Density</td>
<td>lb/in³</td>
<td>gm/cm³</td>
<td>0.37</td>
<td>10.20</td>
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<tr>
<td>Meting Point</td>
<td>°F</td>
<td>°C</td>
<td>4748</td>
<td>2620</td>
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<tr>
<td>Electrical Resistivity</td>
<td>micro-ohm-cm</td>
<td>5.34</td>
<td>6.85</td>
<td>5.17</td>
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<td>Specific Heat</td>
<td>Cal/gm°C</td>
<td>0.061</td>
<td>0.073</td>
<td>0.061</td>
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<tr>
<td>Recrystallization Temperature</td>
<td>°F</td>
<td>°C</td>
<td>2012</td>
<td>1100</td>
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<td>Thermal Conductivity</td>
<td>W/m-k</td>
<td>142</td>
<td>202</td>
<td>147</td>
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<td>Coefficient of Linear Thermal</td>
<td>10⁻⁴(°F⁻¹)</td>
<td>2.70</td>
<td>2.50</td>
<td>2.70</td>
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<tr>
<td>Expansion</td>
<td>10⁻⁴(°C⁻¹)</td>
<td>4.90</td>
<td>5.20</td>
<td>4.90</td>
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<tr>
<td>Tensile Strength</td>
<td>KSI</td>
<td>MPa - RT</td>
<td>150</td>
<td>1034</td>
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<td></td>
<td>KSI</td>
<td>MPa - 500°C</td>
<td>75</td>
<td>517</td>
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<td></td>
<td>KSI</td>
<td>MPa - 1000°C</td>
<td>25</td>
<td>172</td>
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<td>Elongation</td>
<td>% in 1.0”</td>
<td>12</td>
<td>15</td>
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<td>Hardness</td>
<td>HV10</td>
<td>&gt; 220</td>
<td>220 DPH/RC</td>
<td>230 DPH/RC</td>
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<tr>
<td>Modules of Elasticity @ 20°C</td>
<td>GPa</td>
<td>320</td>
<td>320</td>
<td>310</td>
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</tbody>
</table>

**Comparison to pure Moly (Mo):**
- Higher
- + Much higher
- Lower
- ~ Comparable

- Stability at room temperature
- Stability at high temperature / Creep Resistance
  - ≤ 2552°F (1400°C)
  - > 2552°F (1400°C)
- Ductility after HT use
- Thermal conductivity
- Recrystallization Temperature
- Weldability