Limitations of Moly Heating Elements:

1) **Moly reacts rapidly with oxygen**, beginning at 250 °C. Therefore, it cannot be used in air. Oxides of Molybdenum vaporize at relatively low temperatures, leaving the material unprotected. The result of heating Moly in air is rapid loss of surface material. Fluffy white or yellowish "parachutes" of re-condensed oxides usually appear in the surrounding cooler areas.

2) **Moly reacts with Carbon Gases** at temperatures of 1200 °C. or higher. Molybdenum carbides form, starting on the outer surface. The result is apparent thickening of the element cross section as Molybdenum carbide grows on the surface. This surface material is a poor conductor of electricity and heat— often leading to early failure. Such carbide affected elements show increased electrical resistance as the remaining unaffected core material gets thinner.

Good element life for Moly elements requires that they be used in vacuum, or atmospheres containing less than 10 ppm of oxygen, water, CO, CO_2, methane, or other gas sources of Oxygen or Carbon. Element designs using thicker sections can last much longer than thin sections, especially if these are present. Also note that methane can be formed from carbon or graphite items in Hydrogen atmospheres if traces of water or Oxygen is present.

3) **Moly reacts with many solid substances at higher temperatures**. Design and maintenance of equipment should keep hot Moly elements well clear of contact with ordinary furnace parts, dirt, dust, or any other substances.
Moly itself is the best element hangar material. Ceramics of high density and purity, that are known to be compatible with Moly are also acceptable for supports.
See the Reaction Temperature Chart for more information on Moly reactions with various substances

4) **Molybdenum is frequently brittle** at low temperatures. Thicker sections, and any pieces that have been formed or joined may sometimes break easily at room temperatures. Elements, hangars, terminals, and connectors that have once been heated may be very brittle at room temperatures.
Always handle Moly heating elements and parts very carefully; think of them as glass. Generally; used elements are difficult to re-install, or to bend, straighten, weld, etc.

5) **Molybdenum has a very large increase of resistance between room temperature and operating temperatures**. About 5 to 1. An electrical system designed for proper operation of Moly elements at high temperature might be overloaded at room temperature. See Resistivity of Molybdenum at Various Temperatures. It is therefore necessary to carefully design and specify the power control system to handle the high startup current. Also, when heating up from room temperature, always begin heating slowly; especially with new, potentially brittle Moly elements.

Pure Molybdenum Reaction Temperatures With Various Substances

Substance	Temp.	Description of Reaction
GASES:		
Air or O_2 :	250°C	Slight Oxidation beginning
Air or O_2 :	600°C	Rapid Oxidation
Br	800°C	Reacts
Cl	300°C	Reacts
CO_2	1200°C	Oxidation Begins
CO	1400°C	No Reaction
F	20°C	Reacts
H_2	>2600°C	No Reaction
H_2S	1200°C	MoS forms
Hydrocarbons	1100°C	Carbide formation begins
Hydrocarbons	>1300°C	Rapid Carburization
I	500°C	No Reaction
N_2	1500°C	Nitrides begin to form
NO_x	700°C	Oxidation
NH3	>2500°C	No Reaction
SO2	700°C	Oxidation
Steam	700°C	Rapid Oxidation
OTHER ELEMENTS:		
C	1100°C	Carbide formation begins
C	>1300°C	Rapid Carburization
Hg	20°C	No significant solubility
P		No Reaction, even at “higher temperatures”
S	440°C	Sulfides begin to form
Si		Silicides form at “higher temperatures”
MOLTEN OXIDIZING SALTS:		
KCl_3, K_2CO_3, KNO_2, KNO_3,		Violent Reaction at molten salt temperature
Na_2CO_3, NaO_2, PbO_2,		Violent Reaction at molten salt temperature

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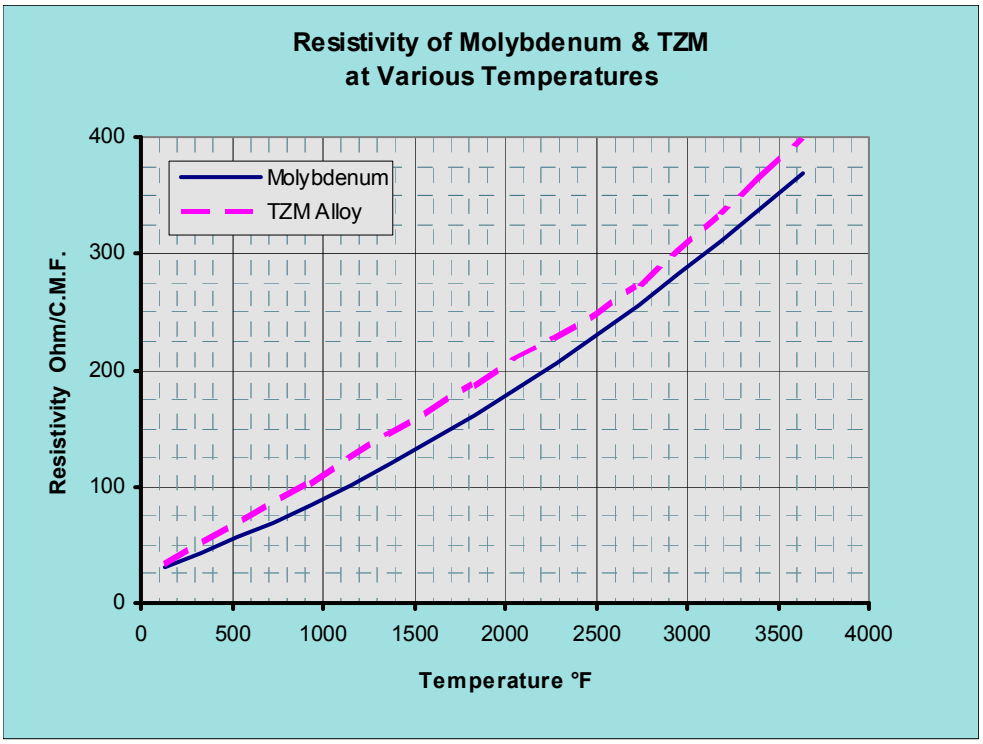

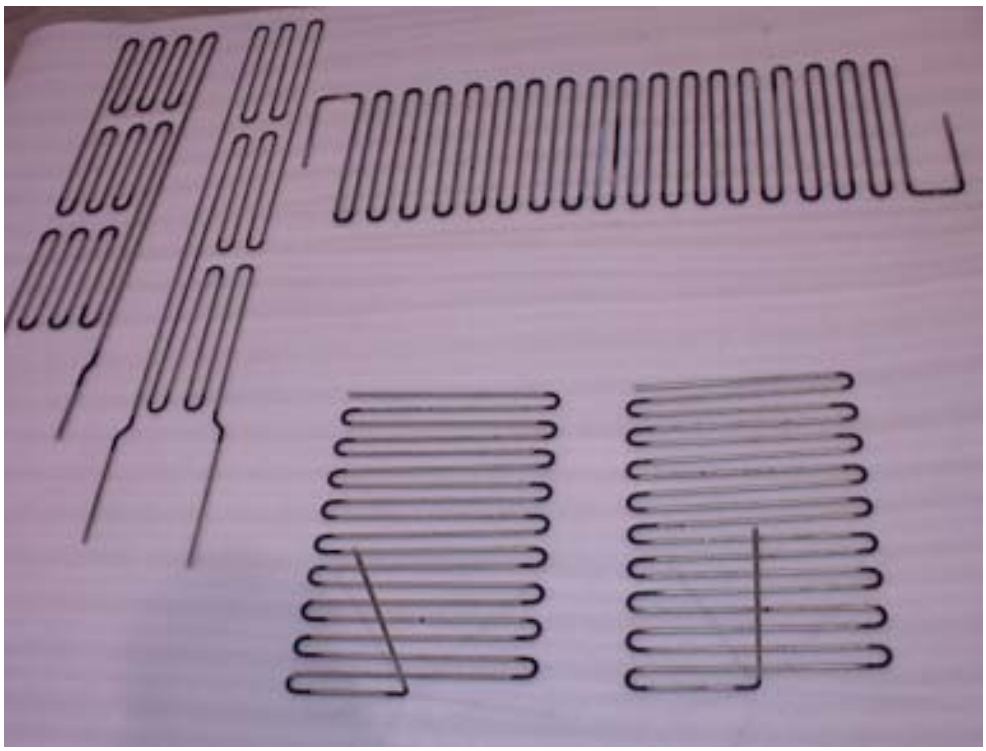

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