# Oxidation of Mo-Re at Reduced Oxygen Pressures*

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Alloys of Mo-Re are of interest for structural use in space systems because of their good high temperature strength and corrosion resistance to liquid alkali metals. Although both Mo and Re readily oxidize above 400°C in air or other environments containing relatively high partial pressures of oxygen, embrittlement from internal oxidation, as occurs with Nb and Ta alloys, was not expected because of low oxygen solubility in these metals. Studies are being conducted to examine oxidation behavior of Mo-41 Re at reduced oxygen pressures ($10^{-3}$ ! $10^{-6}$ torr range) as might occur in vacuum or argon environments that could be encountered during fabrication and testing of space system components.

In vacuum, weight change rates were low below ~600°C ($10^{-4}$ to $10^{-5}$ mg/cm$^2$/h). In general, low temperatures/pressures result in weight gains due to growth of $MoO_2$ at the surface. Although weight gains generally increase with temperature, if the pressure of oxygen reaches a sufficient level, oxidation of $MoO_2$ to $MoO_3$ occurs which leads to weight losses from evaporation of $MoO_3$ in the dynamic environment. Contrarily, in flowing argon (1 atm), weight increases continued to occur even at high temperatures/pressures. Significant weight changes, either gains or losses and in vacuum or argon, were characterized by formation of an external layer of $MoO_2$ and a complex, hard, internal oxidation zone that consisted of several phases containing some combination of Mo, Re, and oxygen. Oxidation exposure generally resulted in small decreases in room temperature tensile strength and ductility, but there was no systematic change in properties with growth of the oxidation zone.

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Thus far the data indicate that dynamic vacuum environments containing oxygen partial pressures $\#10^{-6}$ torr would be required to protect Mo-41 Re from significant oxidation effects at temperatures to 900°C. If an argon environment is required, oxygen levels of 5-10 ppm are sufficient to cause a significant oxidation rate of this alloy at temperatures $\$800$°C.