Then a tantalum coat was deposited in a similar manner onto the Mo/Re deposit to a thickness between 0.13 and 0.18 mm. The tantalum coat serves as a sealing layer, increasing the protection of the Mo/Re alloy against the formation of such volatile oxides as MoO_3.

Next, the pressure in the chamber was reduced to <100 mtorr (less than about 13 Pa) and the cartridge allowed to cool. Once the cartridge had cooled to room temperature, the chamber was opened to the atmosphere and the cartridge was removed from the mandrel.

A cross section of a representative cartridge tube fabricated in this process showed a good bond between the tantalum coat and the main body of Mo/Re alloy. Both the Mo/Re and the Ta were dense. Because this tube was not heat treated, the Mo/Re-alloy layer still contained two phases — one Mo-rich and one Re-rich. Tests of the mechanical properties of tubes like this one in the as-sprayed condition have revealed a vast improvement over similar tungsten-alloy tubes in the as-sprayed condition.

This work was done by Richard Holmes of Marshall Space Flight Center and Scott O'Dell, Timothy McKechnie, and Christopher Power of Plasma Processes, Inc. For further information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. MFS-31540-1

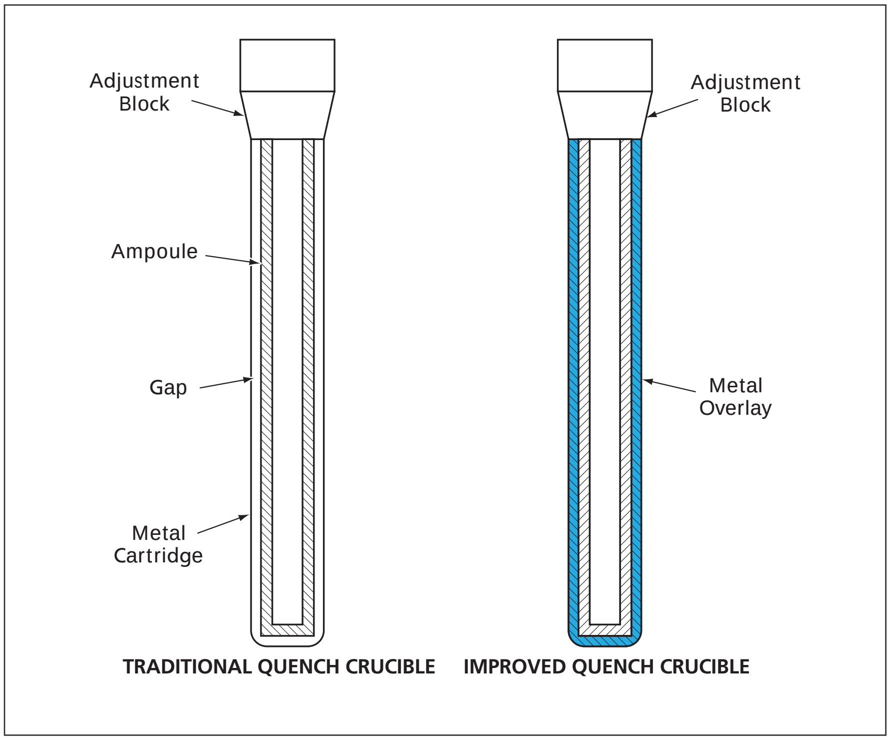
Quench Crucibles Reinforced With Metal

Specimens can be quenched rapidly, without cracking ampules.

Marshall Space Flight Center, Alabama

Improved crucibles consisting mainly of metal-reinforced ceramic ampules have been developed for use in experiments in which material specimens are heated in the crucibles to various high temperatures, then quenched by, for example, plunging the crucibles into water at room temperature. A quench crucible of the traditional type intended to be supplanted by the improved crucibles consists mainly of a ceramic or graphite ampule inside a metal cartridge, with a gap between the metal and the cartridge, as shown on the left side of the figure.

The need for the improved quench crucibles arises as follows: In a traditional quench crucible, the gap between the ampule and the metal cartridge impedes the transfer of heat to such a degree that the quench rate (the rate of cooling of the specimen) can be too low to produce the desired effect in the specimen. One can increase the quench rate by eliminating the metal cartridge to enable direct quenching of the ampule, but then the thermal shock of direct quenching causes cracking of the ampule.



The **Metal Cartridge and Gap** surrounding the ampule are replaced with an overlay of metal in intimate contact with the ampule.

In a quench crucible of the present improved type, there is no gap and no metal cartridge in the traditional sense. Instead, there is an overlay of metal in direct contact with the ampule, as shown on the right side of the figure. Because there is no gap between the metal overlay and the ampule, the heat-transfer rate can be much greater than it is in a traditional quench crucible. The metal overlay also reinforces the ampule against cracking.

The choice of ampule material and metal depends on the specific application. In general, the ampule material should be chemically compatible with the specimen material. The overlay metal should be chosen to have a coefficient of thermal expansion (CTE) as close as possible to that of the ampule material. Examples of suitable ampule/metal-overlay material pairs include the following:

- graphite (CTE = 8.0×10^{-6} K^{-1}) and stainless steel (CTE = 9.9×10^{-6} K^{-1})
- aluminum nitride (CTE = 5.2×10^{-6} K^{-1}) and tungsten heavy alloy (CTE = 5.0×10^{-6} K^{-1}) and
- silicon carbide (CTE = 4.5×10^{-6} K^{-1}) and tungsten heavy alloy (CTE = 5.0×10^{-6} K^{-1}).

Several thermal-spray processes for applying metal overlays to ampules were investigated. Of these processes, vacuum plasma spraying was found to yield the best results.

This work was done by Richard R. Holmes and Edgar Carrasquillo of Marshall Space Flight Center and J. Scott O'Dell and Timothy N. McKechnie of Plasma Processes Inc. For further information, contact Sammy Nabors, MSFC Commercialization Lead, at sammy.a.nabors@nasa.gov. MFS-31598-1