Creep Properties of Platinum Metals and Alloys

A number of industrial applications of the platinum metals involve their subjection to long-term stresses at high temperatures, and for the engineer responsible for design considerations in these fields there is a need for more data on the creep properties of these metals and their alloys. The use of platinum alloy catalyst gauzes up to three metres in diameter but constructed of wire only 0.04 to 0.06 mm. in diameter, operating at around 800°C, of platinum crucibles holding several litres of molten optical glass at about 1400°C, and of platinum bushings for the manufacture of glass fibre at temperatures up to 1500°C, are examples of such uses.

A survey of available data on this subject, together with some original work, has recently been presented by Dr. G. Reinacher of Degussa, Hanau (*Metall*, 1956, **10**, (13/14) 597–607). This gives first the results of room-temperature creep tests on palladium, platinum and 10 per cent rhodium-platinum in the annealed condition, while in the latter part of his paper the author reviews the relatively sparse literature on the creep properties of the platinum metals at high temperatures and evaluates them on a common basis.

Room Temperature Tests

The conventional proof stress (0.2 per cent extension) was first determined, and then the standard German 45-hour short-time creep limit, the stress necessary to produce a permanent extension of 0.2 per cent after 45 hours. Similar tests extending to 1,000 hours were carried out, and the three sets of values were plotted against time and extrapolated to 10,000 hours. The results are summarised in the table, from which it will be seen that, when in the annealed condition, the three materials tested behave similarly to some materials of much lower melting point in that they creep at stresses well below the 0.2 per cent proof stress. The interesting point emerges that while the proof stress does not itself form a sound basis for design, the ratio of 10,000 hour creep stress to proof stress remains reasonably steady and could provide a means of arriving at a safe loading.

Tensile and Creep Properties at Room Temperature
(Materials in Annealed Condition)

Stress in kg/mm²	Pd	Pt	10% Rh-Pt
Ultimate tensile ...	**19.8**	**14.6**	**33.6**
Proof (0.2%)	**5.1**	**8.35**	**12.4**
Creep			
(0.2%/45 hr.) ...	**5.0**	**7.85**	**11.45**
(0.2%/1,000 hr.)	**4.7**	**~7.85**	**~11.0**
(0.2%/10,000 hr.)	**4.4**	**7.6**	**10.8**
Proof Stress / U.T.S.	**25.8%**	**57.2%**	**36.9%**
Creep Stress (10,000 hr.) / Proof stress ...	**86.0%**	**91.0%**	**87.0%**

High Temperature Data

In the remainder of the paper, published short-time and long-time creep data are reviewed in an endeavour to establish worthwhile practical information. As a result, some useful data—which should, however, be treated with caution if applied in practice—have been derived for the creep properties of platinum up to 1300°C, of palladium, rhodium and iridium at 1000°C, and of platinum and its binary alloys with 10 per cent rhodium and iridium at 1100°C.