Fabrication Techniques Developed for Small-Diameter, Thin-Wall Tungsten and Tungsten Alloy Tubing

The fabrication of tungsten and tungsten alloys into small-diameter, thin-wall tubing of nuclear quality is difficult because of the high strength and high-ductile brittle transition temperature (DBTT) of these materials. The high DBTT (from 200° to 400°C) necessitates warm-working in a temperature range of limited familiarity. Tubing is required with diameters of 0.32 cm od or less, and with wall thicknesses of approximately 10% of the outer diameter.

The report describes methods for producing tungsten or tungsten-25 w/o rhenium (W25-Re) tube-blanks by double extrusion. The starting material, generally a pressed and sintered product, is in the form of a sleeve 3.17-cm od by 2.54 cm id and ≈10.2 cm long. Both initial and reextrusion processes use a filled-billet technique. The resultant tube blanks, ≈0.64-cm od by 0.51-cm id and 75 cm long, are structurally sound and suitable for secondary fabrication operations.

Secondary fabrication until recently has received little attention. Investigations have been carried out on swaging, ductile-core, mandrel, and plug-drawing techniques, but little tubing has been produced.

Work has been done on secondary fabrication operations, concentrating on the W-25 Re alloy. Plug-drawing has emerged as an excellent technique, both for the reduction of the overall tube dimensions and for the removal of the longitudinal surface striations resulting from the filled-billet extrusion sequence. Plug-drawing also obviates the need for core removal at the finished-tube size (<0.125-in. od). Even at larger tube sizes, core removal remains a problem.

Notes:
2. The report offers plans and recommendations for further research in the area of secondary fabrication. Early results of industrial participation are presented.
3. Inquiries concerning this innovation may be directed to:
   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B68-10284
   Source: W. R. Burt, D. C. Brillhart, R. M. Mayfield, and F. J. Karasek, Metallurgy Division (ARG-10100)

This document was prepared under the sponsorship of the Atomic Energy Commission and/or the National Aeronautics and Space Administration. Neither the United States Government nor any person acting on behalf of the United States Government assumes any liability resulting from the use of the information contained in this document, or warrants that the use of any information, apparatus, method, or process disclosed in this document may not infringe privately owned rights.
Patent status:
Inquiries about obtaining rights for commercial use of this innovation may be made to:
Mr. George H. Lee, Chief
Chicago Patent Group
U.S. Atomic Energy Commission
Chicago Operations Office
9800 South Cass Avenue
Argonne, Illinois 60439