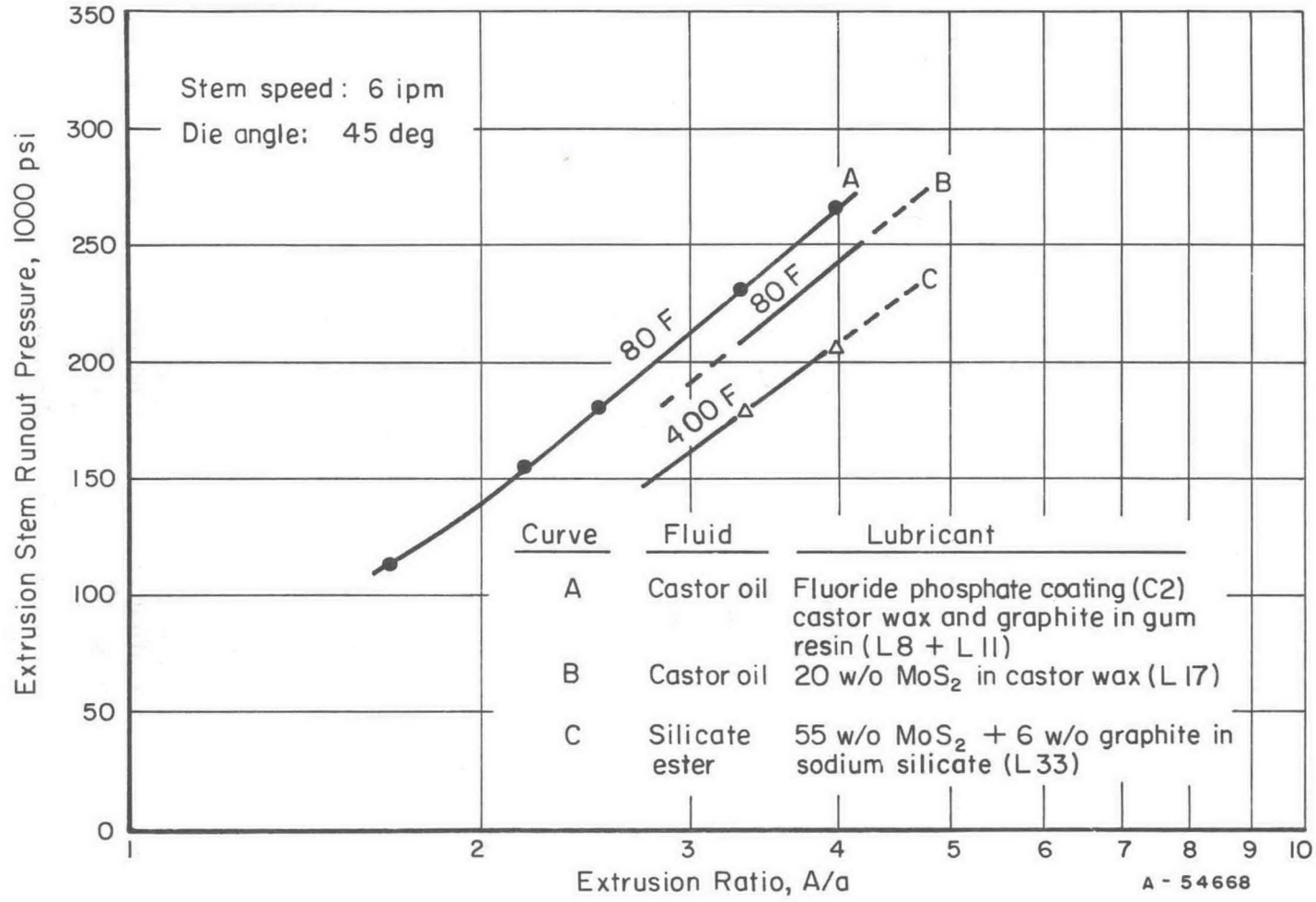

FIGURE 6. COMPARISON OF PRESSURES FOR THE HYDROSTATIC EXTRUSION OF Ti-6Al-4V TITANIUM-ALLOY ROUNDS AT TWO TEMPERATURES

WARM EXTRUSION OF BERYLLIUM ROUNDS

A single trial was made to extrude a beryllium round at 500 F. The extrusion conditions and experimental data obtained are listed below.

Trial	417
Billet diameter	1-3/4 inches
Extrusion ratio	2.5:1
Area reduction	60 percent
Stem speed	6 ipm
Die angle	45 degrees
Lubricant	L31
Fluid	Polyphenyl ether
Stem seal	2 PTFE O-rings

Although an extruded product 4-1/2 inches long was produced, neither a well-defined breakthrough nor runout pressure was achieved. Comparing the fluid-compressibility curves with other trials using the same fluid, it appears that extrusion started at approximately 65,000 psi (less than half the pressures required to extrude at room temperature) and continued to extrude up to a pressure of 124,000 psi, when the trial was stopped. On examination of the extrusion and die, it was found that lubrication breakdown had occurred, resulting in severe galling on one side of the die land. The die used here was designed to effect a gradual release of the elastic stresses present in the extrusion on exiting from the die land.

The extruded product exhibited less cracking than that when beryllium was extruded at room temperature. These results show considerable promise for the warm extrusion of beryllium, and further warm trials will be conducted with new die designs and improved lubricants, and at higher ratios.

Hydrostatic Extrusion and Drawing of Beryllium Wire

The aim of this portion of the program is to determine the technical feasibility of producing beryllium wire down to a target diameter of 0.001 inch by hydrostatic extrusion and drawing. In this Battelle-developed process, the wire is subjected to hydrostatic fluid pressure on the entry side of the die and draw stress on the exit side.

Equipment has been designed and assembled to provide control over the draw stress and exit velocity of the extruded wire. This is accomplished with a variable-speed drive motor through an electromagnetic torque limiter. The output shaft, which carries a 2.8-inch-diameter coiling reel has a speed range of 0 to 50 rpm and a stepless control of torque in the range of 2 to 12 in.-lb. For a starting wire diameter of 0.020 inch, the expected draw load at the first reduction would be about 5 pounds. A load-measuring device has been designed and calibrated to monitor the draw load. It is able to measure draw loads as low as 0.1 pound.

Consideration has been given to the method by which the wire within the container is uncoiled. Two methods are being evaluated: