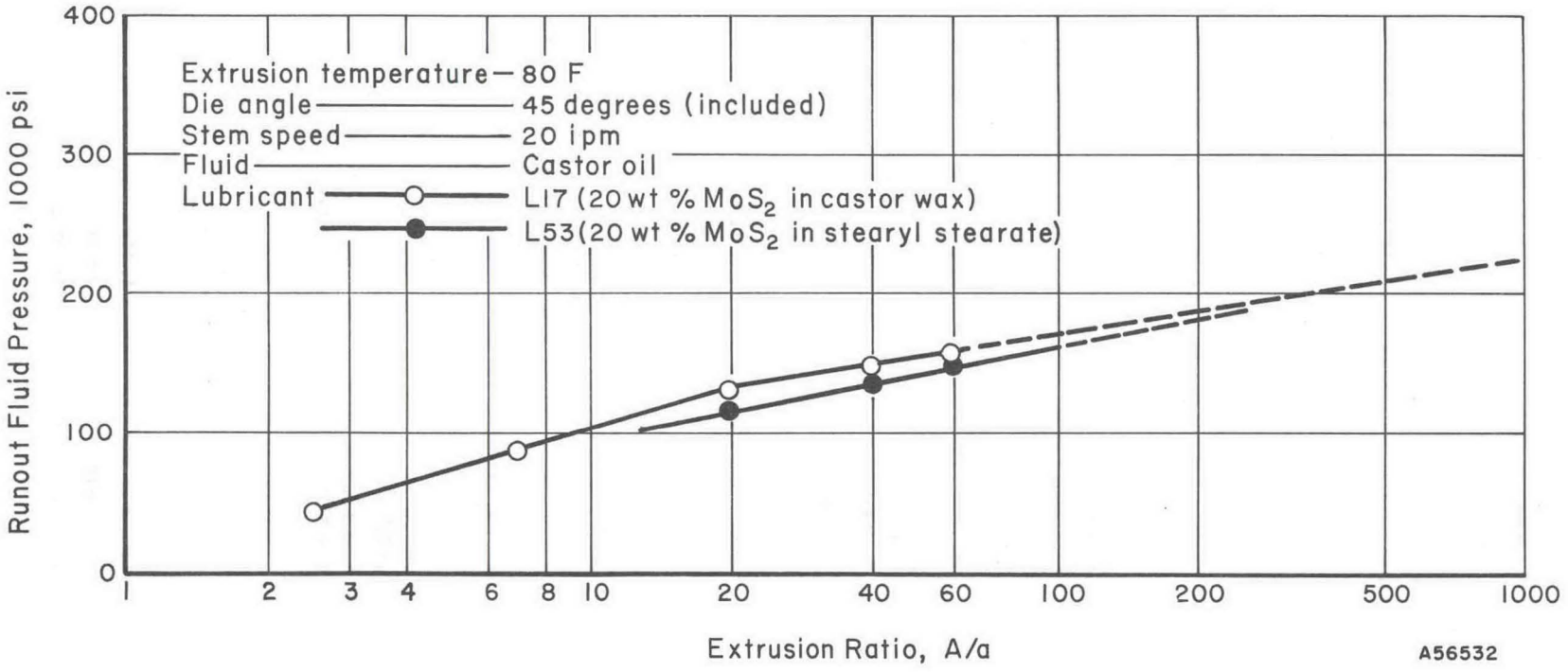

FIGURE 13. EFFECT OF EXTRUSION RATIO ON FLUID RUNOUT PRESSURES IN THE HYDROSTATIC EXTRUSION OF 7075-O ALUMINUM ROUNDS

Reliability of Data

Much of the discussion of the relative effects of the process variables is centered on comparisons of the breakthrough pressures, P_b and runout pressures, P_r. To determine the significance of pressure differences, the coefficients of variation in P_b and P_r were determined for five trials (463, 464, 453, 454, and 472) where good lubrication was obtained under nominally identical extrusion conditions. These pressure data are given in Table VI. The standard deviations were approximately 1,480 psi and 1,340 psi for P_b and P_r, respectively. The coefficients of variation were approximately 1.1 percent in each case. Consequently, it is suggested that the conclusions based on one trial are probably reliable.

Billet Finish

A billet finish of 60-120 microinches obtained by machining was used as the basis for evaluating lubrication, extrusion ratio and stem speed. In the evaluation of billet finish, however, a range of 35-500 microinch obtained by machining or grit blasting was used in conjunction with two billet lubricants. Table VI gives the data obtained in this study.

Billet finishes in the order of 35 to 50 microinches, rms, resulted in the highest breakthrough pressure peak regardless of whether Lubricant L11 (Trial 251) or L17 (Trial 308) were used. Increasing the roughness to the 300-500 microinch range lowered these pressure peaks but generally did not succeed in preventing stick-slip.

In one trial (Trial 249) a low and gradual breakthrough pressure was followed by a smooth runout. This low breakthrough pressure, which was the main reason for the elimination of stick-slip, is attributed to the geometry of the rough machined surface on the billet. The billet-surface roughness peaks were sharper and a greater capacity for trapping lubricant in the valleys, than for the remaining trials, thus enhancing the squeeze lubrication potential. Other factors such as the method of lubricant application to the billet may have played an important part in the elimination of momentary seizure.

The grit-blast finishes lowered the breakthrough stick-slip peaks but did not succeed in preventing them. The matte finish produced by grit blasting smoothed out well on the extruded surface. The machined finish on billets, however, results in a helical grooved pattern on the extrusion which becomes more pronounced with increasing surface roughness and extrusion ratio. For billets machined to a rough finish (300-500 microinches), the helical grooves became sites for initiating surface cracks.

Lubrication Systems

Table VI gives data for the evaluation of 14 billet lubricants and 4 fluids (Trial 347 and below) at a ratio of 20:1 and stem speed of 20 ipm. Several good billet lubricants were developed and data obtained using these lubricants at higher ratios are given in Table VII.