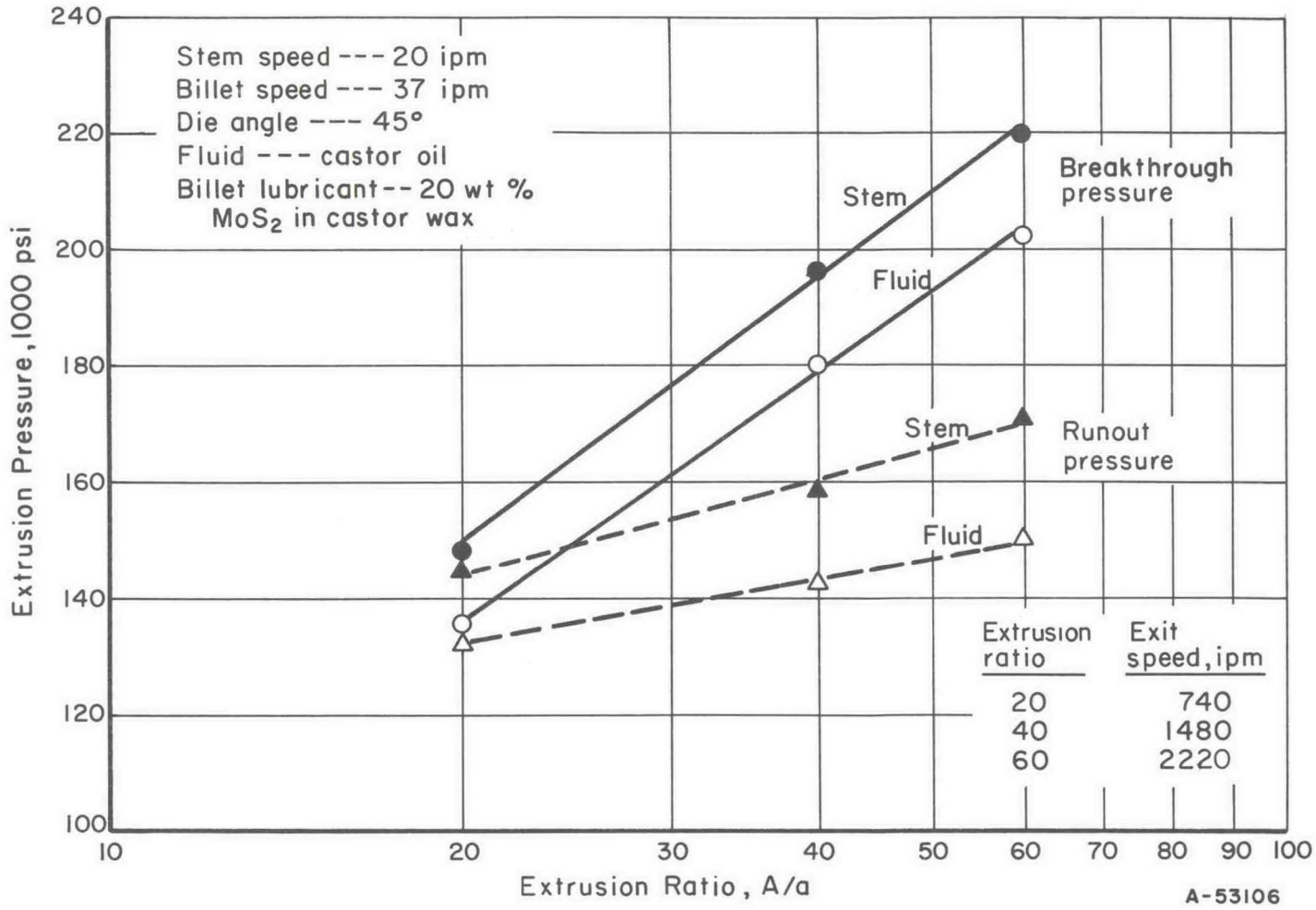

FIGURE 3. EFFECT OF EXTRUSION RATIO ON PRESSURE FOR COLD HYDROSTATIC EXTRUSION OF 7075-0 ALUMINUM

The grit billet finishes did not succeed in preventing stick-slip but were effective in improving the finish of the extruded product and minimizing cracking. Grit blasting produces a matte finish which smoothens out fairly well on the extruded surface. The machined finish, however, results in a slight helical groove pattern which becomes more pronounced with increasing initial surface roughness and extrusion ratio. In fact, the helical groove pattern has been observed on grit-blasted billets that were extruded at ratios of 40 and 60:1. This is evidence of the machined surface that had been covered over by grit blasting. It appears also that, in the case of relatively rough machined billets (300-500 μ-in.) and high ratios, the helical grooves become sites for initiating surface cracks.

COLD HYDROSTATIC EXTRUSION OF Ti-6Al-4V ALLOY ROUNDS

Ti-6Al-4V alloy has the same tendency for stick-slip during extrusion as 7075 aluminum. Moreover, when the billet lubricant breaks down to a point where metal-to-metal contact occurs, the alloy tends to gall or adhere severely to the die. Efforts to extrude Ti-6Al-4V alloy were concentrated on determining a better lubrication system than those investigated previously[1]. Data are given in Table 4 for extrusions made with various lubricants at stem speeds of 6 inches per minute and an extrusion ratio of approximately 3.33:1.

The combination of L17 with a fluoride-phosphate coating (C2) appeared promising (Trial 286). The breakthrough fluid pressure (186,000 psi) was about 6 per cent lower than that obtained (202,000 psi) with L11 and L8 lubricants (castor wax over a 10 wt % graphite-gum resin mixture) in the previous program[1]. Moreover, no stick-slip nor severe pressure buildup occurred during runout.

Lubricants L24 through L27 contained substantial quantities of iodine. The purpose of the iodine was to react chemically with the billet surface to form a product that would offer less frictional resistance than the titanium alloy itself. Except for L27, these lubricants appeared to reduce the tendency toward stick-slip. However, the improvements did not appear to be significant.

Some modifications of the present lubricants and new lubricants are being planned for evaluation in the next series of extrusion trials.

COLD HYDROSTATIC EXTRUSION OF T-SECTIONS

A series of extrusion trials was conducted to investigate the effect of die design for extrusion of a T-section. A photograph of the two dies evaluated is given in Figure 4. One die design, used in the previous program[1], consists of a conical entry defined by a single angle of 45 degrees. The other die design differs in that the conical entry is defined by a compound angle: a 45-degree conical surface leading into a 160-degree conical surface, the latter circumscribing the T-opening. The latter design offers the potential advantage of reducing die machining costs. Also, the latter design permits the die bearing surface to be less irregular, which may be an advantage during extrusion. However, it was recognized that the relatively flat area near the T-opening would raise the extrusion pressure over that obtained with the "single-angle" die but the extent of this pressure rise had to be determined by experiment.