THE USE OF LOW FRICTION HOUSING LINER IN UPPER-EXTREMITY PROSTHESES [a]

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INTRODUCTION

In an effort to improve the efficiency of force transmission in upper-extremity prostheses, Northwestern University Prosthetic Research Center has explored the use of low friction plastic materials. Housing liners made of DuPont "Teflon" TFE fluorocarbon resins have adequate performance characteristics and can be easily utilized by prosthetic facilities.

Heavy duty steel housing allows enough room for a .016 wall thickness tubing, thus assuring adequate wearing surface and long term durability (Fig. 1). Attempts to use thin wall tubing in standard housing have not been as successful either in installation or wearing characteristics. Since all prosthetic components are available, the prosthetist need only use the larger housing and install the lining material.

EQUIPMENT

Prosthetic Components

Heavy Duty Housing, Hosmer CHC–100 HD or equal
Heavy Duty Housing Ferrules, Hosmer C–715 HD or equal
Heavy Duty Housing Retainers, Hosmer C–709 HD or equal

[a] Based on work performed under VA Contract V1005M–1079.

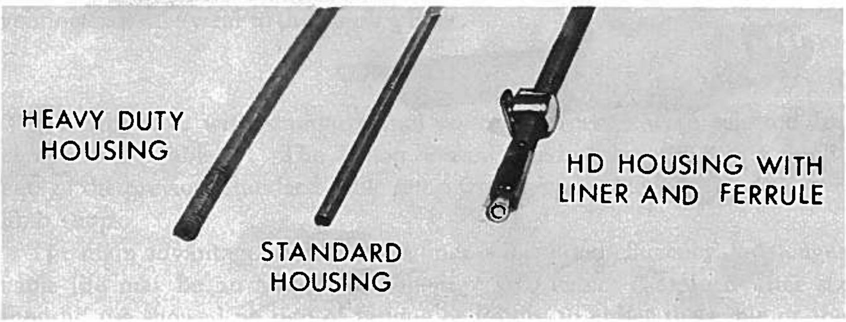


FIGURE 1

Heavy Duty Housing Crossbar and Assembly, Hosmer C–710 HD or equal

1/16 in. Steel Cable, Hosmer C–100 or 00–200 or equal

Liner Components and Tools

TFE Spaghetti Tubing #13 AWG, .076 id .016 wall thickness

Ungar #776 Soldering Iron Handle and Cord Set (Fig. 2)

Ungar #1234 Thread-in Soldering Element (Fig. 2)

Flaring Tip (Fig. 2 and 4)

PROCEDURE

Housing

The cable housing is planned to be the normal length. Ferrules are added at the ends of the housing to provide a bell-shaped exit for the plastic liner. Teflon tubing is inserted into the housing so that when completed the flares are slightly longer than the housing to allow for bending without crushing the flare.

Flaring Technique (Fig. 3)

The flaring tool is allowed to reach maximum heat. The heated tip is inserted into the plastic tubing, causing the material to flare outward. With the flaring tool in place, the assembly is immersed in water to harden the

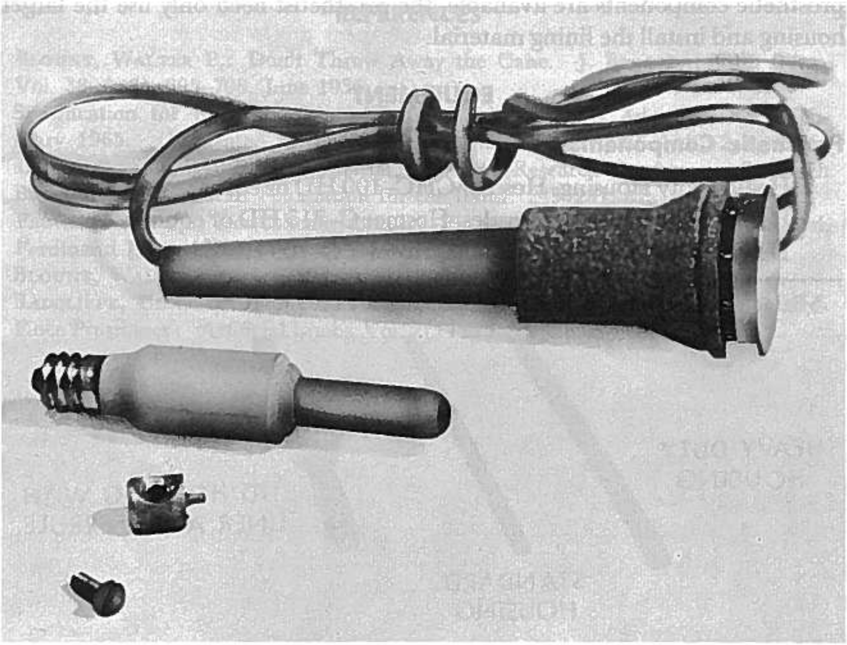


FIGURE 2

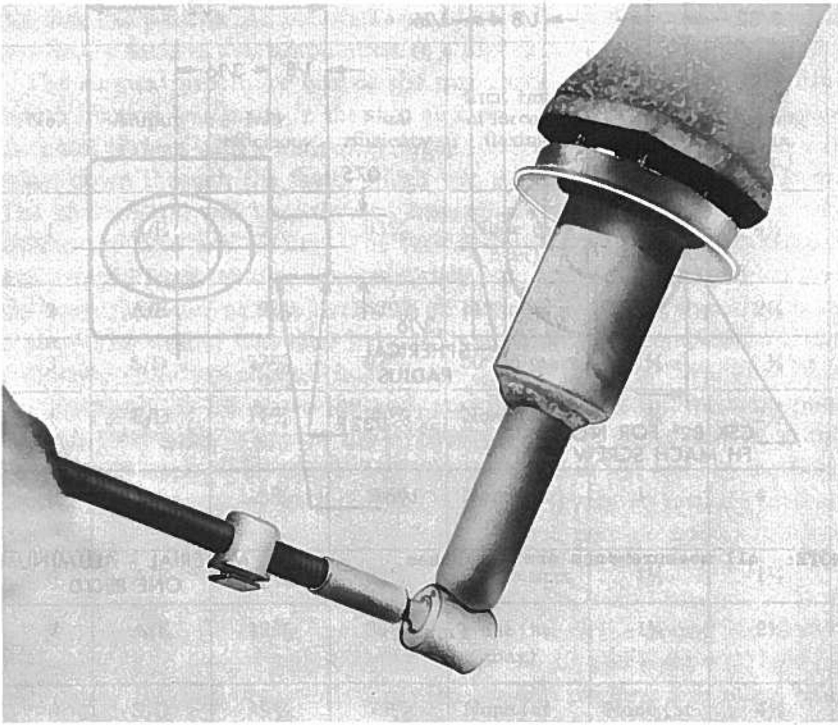


FIGURE 3

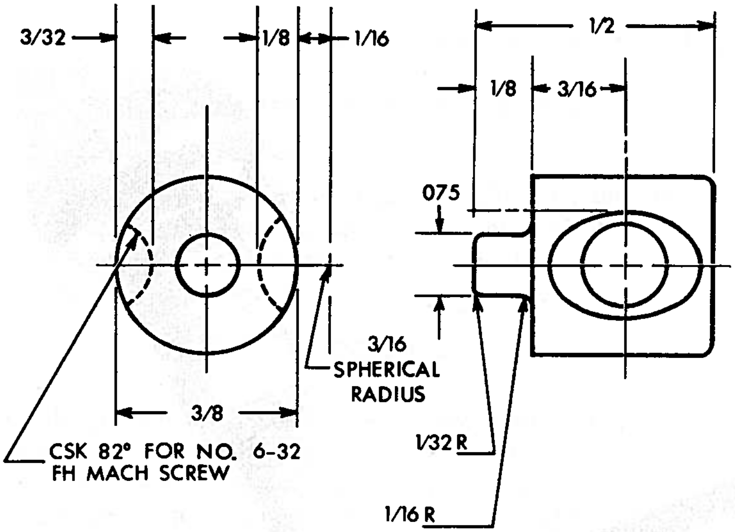
plastic material. It is important that a separate container of water be used to avoid possible electrical short from using the flaring tool near the water supply. The cooled tip is withdrawn from the Teflon, completing the flaring process. The tubing is cut to the correct length. When the flaring tool has again reached maximum heat, the process is repeated. In above-elbow prostheses the housing liner should be installed in both the proximal housing and the forearm lift housing.

The use of $\frac{1}{16}$ in. swaged cable appears to be the most efficient in preventing excessive wear to the housing liner.

CONCLUSIONS

Ten amputees with standard dual control harnesses were selected for comparison (Table 1). The Teflon housing lined cable setup was a duplicate of the previous standard cable setup which represented the work of five limb shops.

The main advantage of the Teflon liner is increased efficiency, but longer cable life may be an additional benefit. Two cables examined after six months' use showed no sign of fatigue or failure to either the cable or the liner.



NOTE: All measurements are in inches.

MATERIAL - ALUMINUM
ONE REQ'D

FIGURE 4

TABLE 1

No.	Amput.	Incr. efficiency	Final efficiency	Incr. range of forearm flexion	Incr. hook opening (max. flex.)	Final hook opening (max. flex.)
1	A/E	15%	83%	None (at max)	None (at max)	4¼
2	A/E	9%	62%	14° to max	1⅛	2⅞
3	S/D	27%	97%	30° to max	⅛	⅛
4	E/D	11%	88%	None (at max)	¼	2½
5	A/E	13%	89%	None (at max)	1	4
6	A/E	20%	83%	15° to max	1½	1½
7	A/E	12%	87%	None (at max)	1¾	2¾
8	S/D	19%	75%	None (at max)	None (at max)	4¼
9	A/E	14%	88%	None (at max)	⅛	3
10	A/E	11%	84%	None (at max)	None (at max)	4¼

Average increased efficiency, 15%.