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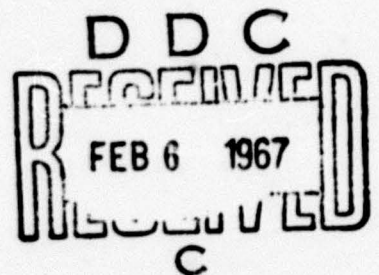
TECHNICAL REPORT 6613

**INSTRUCTION MANUAL FOR PREPARING
POROUS EPOXY ARM PROSTHESES**

Reported by

James T. Hill, Cml. Engr.
Henry G. Mouhot, Cml. Engr.

June 1966



**U. S. ARMY MEDICAL BIOMECHANICAL RESEARCH LABORATORY
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ABSTRACT

A simplified procedure for preparing porous arm sockets is described. Preimpregnation of the stockinet and evaporation of solvent prior to lay-up result in a stronger, more porous socket.

INTRODUCTION

This is the third of a series of reports describing new methods for preparing porous laminates.

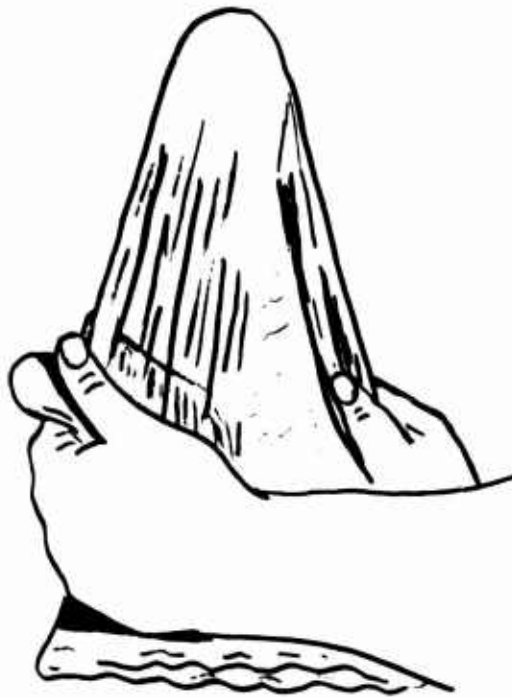
The first report, AMBRL Technical Report #6609 described a method for preparing PTB porous sockets. The second report, AMBRL Technical Report #6612 described the research findings that led to this development. This report describes methods for preparing porous arm prostheses.



Step 1. Mold Preparation

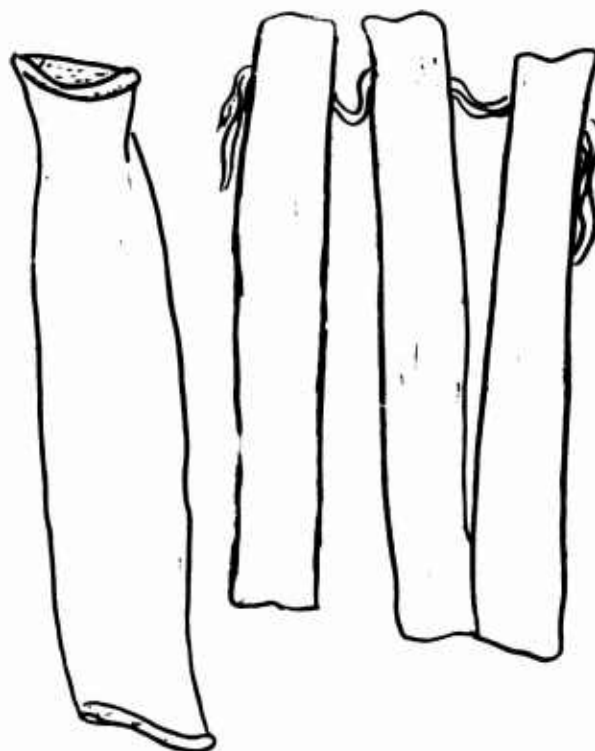
Prepare the stump model in the usual manner. Place the model in a vise, distal end up, and coat it with a release agent such as Hi-Glo^{*}. Allow this coating to dry.

* Western States Lacquer, Dallas 12, Texas



Step 2. PVA Sheet

Moisten a sheet of polyvinyl alcohol (PVA) and stretch it down over the stump model. Tie at the base. If preferred, use a PVA sleeve and then cap with a sheet of PVA and heat seal.



Step 3. Sew Stockinet

A. Cut one length of Banlon stockinet and three lengths of orthopedic stockinet long enough to pull over stump model and tie to pipe. Turn Banlon inside out and sew end in a curve to match distal end of the stump. Sew orthopedic stockinet in a similar manner. Trim excess stockinet at the sewn end.

B. Now cut stockinet for outer socket as follows: 1 Banlon and 1 orthopedic stockinet, 3-5 inches longer than outer layup. Cut a second piece of orthopedic stockinet a little more than double the length of layup. Turn Banlon inside out.

Step 4. Roll a piece of PVA in a moistened towel.

Step 5. Weighing

Weigh all pieces of stockinet to the nearest gram.

Note: As the strength and porosity of the socket depend upon the amount of resin-solvent mixture, which is dependent on the stockinet weight, the next step is most important.

Step 6. Mixing Resin

Referring to Table I (use Table II for vacuum layup), go down the first column until you come to the weight of the stockinet. The amount of resin components will be found directly to the right in the next 3 columns.

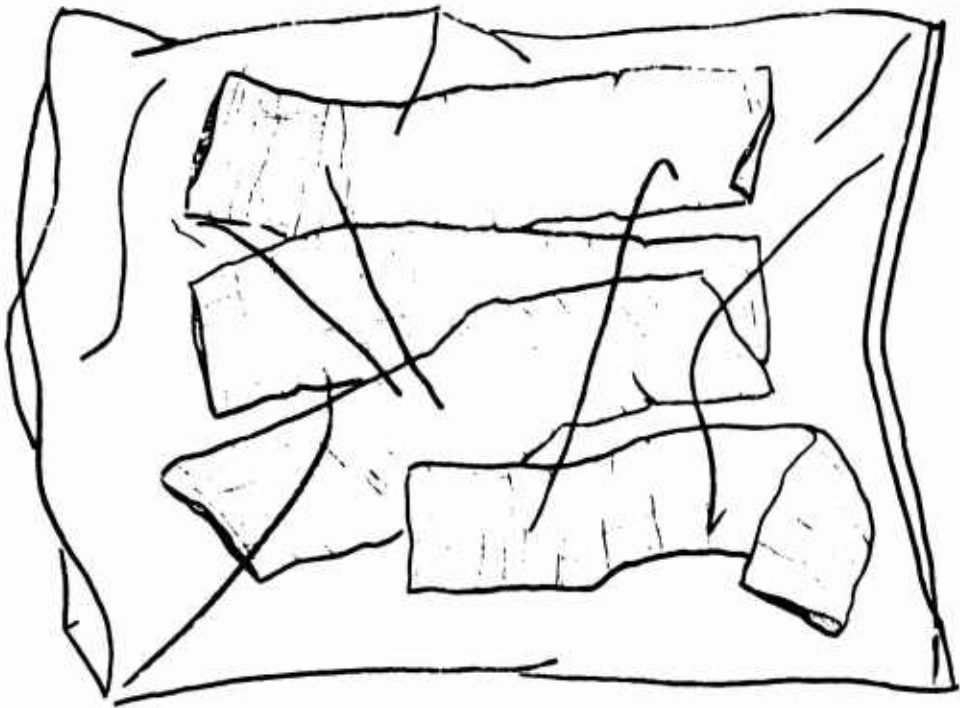
For example: Stockinet weight = 70 grams; then, directly to the right under the column headed EPON 815, you will find a weight of 100 grams. Under column headed VERSAMID 140, you find 50 grams, and under METHYLENE CHLORIDE column, you find 100 grams. These are the amounts of each ingredient that should be mixed together for the 70 grams of stockinet.

Add pigment.



Step 7. Impregnating Stockinet

Pile the stockinet on top of each other and roll loosely. Place in the bottom of a polyethylene bag (8" x 12" or larger). Carefully pour all of the resin mixture into the bag onto the stockinet. Grasp the bag and knead to insure impregnation of all stockinet. This kneading only takes a minute or less.



Step 8. Inspecting Stockinet

Before removing the stockinet pieces from the bag, spread them apart and inspect for uniform impregnation. If some areas are underimpregnated, squeeze resin into these areas from other parts of the stockinet.

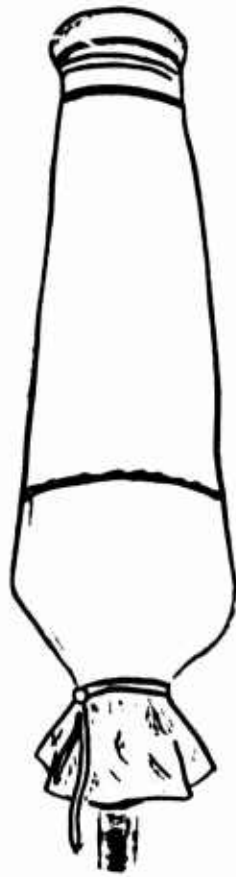
Step 9. Precure

Place pieces of stockinet side by side on paper towels and put into a circulating air oven set at 95 C (203 F) for exactly 5 minutes.

Step 10. Stockinet Layup

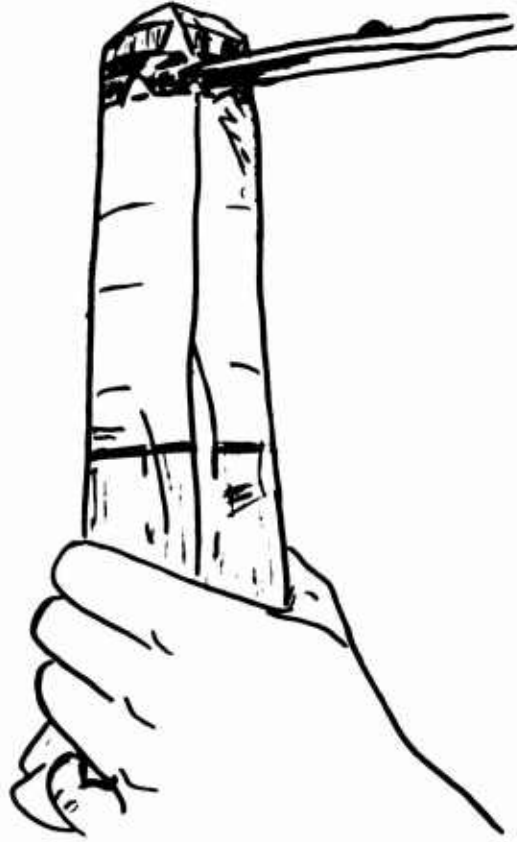
First, pull sewn Banlon over model and tie at proximal end. Then, pull the remaining sewn orthopedic stockinet over model and tie. Turn the last piece inside out before pulling over layup.

Pull moistened PVA sheet over layup and tie.



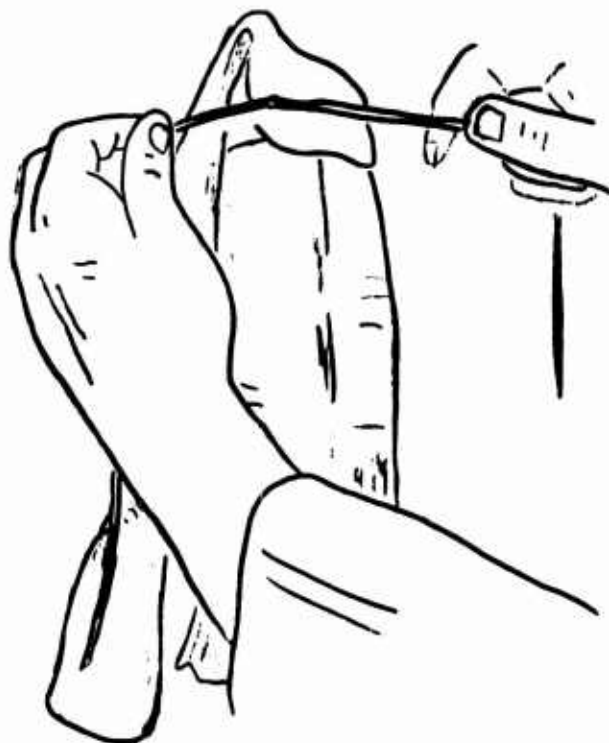
Step 11. Forearm Buildup

You are now ready for the forearm buildup. This buildup should be done in the usual manner, using either plaster of Paris or polyethylene wax. The plaster is preferred because the wax may get into the pores of the prosthesis. After the plaster has hardened, remove the paper or mylar cylinder and shape plaster (wax) to the desired contour. Remove any plaster from the knurled surface of the wrist unit. Coat plaster with Hi-Glo parting lacquer.



Step 12. PVA Sleeve

Prepare a PVA sleeve, moisten and pull down over the buildup and trim at the wrist unit.



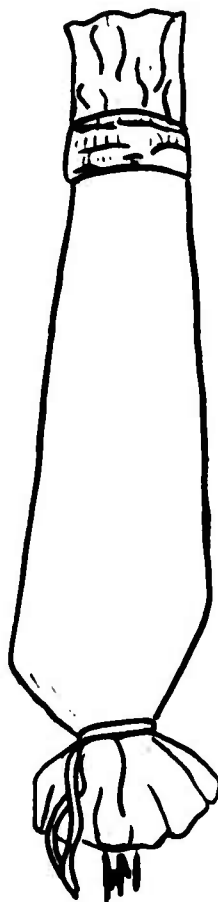
Step 13. Layup Outer Banlon

Pull Banlon 1-2 inches over distal end and tie to wrist unit. Trim excess stockinet that is proximal to wrist unit.



Step 14. Layup Orthopedic Stockinet

Take the short piece of orthopedic stockinet and pull it over the long piece in such a manner that each piece meets at one end. (The outer end of the short piece should extend just past the middle of the long piece). Hold the Banlon stockinet extended above the wrist unit and slip these pieces of orthopedic stockinet (double end first) over the free end and down until the double piece covers the entire layup, with the other end of the short piece just distal to the wrist unit. Tie both pieces to the wrist unit, then stretch them tight and tie at the proximal end. The piece of Banlon should now be inside the untied end of orthopedic stockinet that extends beyond the wrist unit. Pull the remaining pieces of stockinet back over layup and tie at proximal end.



Step 15. Cure

Pull moistened PVA sleeve snugly over layup and tie at each end so there is smooth contact at all places between PVA and layup. Tape PVA sleeve around wrist unit to insure proper strength. Place layup into 95 C (203 F) oven for 2 hours.

Step 16. Mold Removal

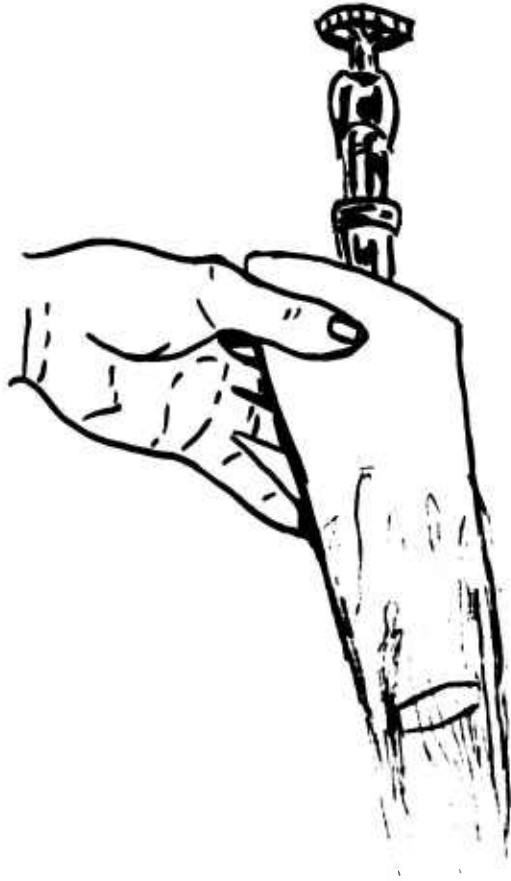
While the laminate is still warm, cut the end of the layup to the desired length. The outer socket should separate easily from the inner socket.

The plaster may be removed by striking the stockinet with a rubber mallet. If necessary, use a chisel to dig the plaster out of the distal end of the socket. Remove any PVA film remaining by stripping by hand or if necessary, by dissolving the film with hot water.



Step 17. Trim

Hold the prosthesis firmly on the amputee's stump and mark the trim line. Remove the socket and trim in the usual manner. After the socket and forearm have been properly aligned, sand the edges and bond together with liquid epoxy resin (EPON 815 - 4 pts., Curing Agent T 1 - 1 pt.) Cure with a heat gun or place in an oven at 95 C (203 F) for 20 minutes.



Step 18. Test Porosity

Test the porosity of the finished prosthesis by holding it under a water tap and allowing the water to run through the prosthesis. If the prosthesis has been prepared properly, the laminate should show homogeneous porosity.

Step 19: Assemble

Complete harnessing in the usual manner. (note: Rivet holes should be reinforced with resin (4 parts EPON 815 to 1 part Curing Agent T 1).

Note: A similar technique may be used when utilizing a wax buildup if polyethylene wax is used.

TABLE I
Weight of Resin Components Necessary for Making
Porous Prostheses

Wt. Stockinet Grams	Wt. of Resin Components		
	EPON 815	VERSAMID 140	METHYLENE CHLORIDE
25	40	20	40
30	47	23	47
35	54	27	54
40	60	30	60
45	67	33	67
50	73	36	73
55	81	40	81
60	87	43	87
65	94	47	94
70	100	50	100
75	107	53	107
80	114	57	114
85	121	60	121
90	129	64	129
95	136	68	136
100	143	71	143
105	150	75	150
110	157	78	157
115	164	82	164
120	171	85	171
125	179	89	179
130	186	93	186
135	193	96	193
140	200	100	200

Table I (Continued)

Wt. Stockinet Grams	Wt. of Resin Components		
	EPON 815	VERSAMID 140	METHYLENE CHLORIDE
150	214	107	214
160	228	114	228
170	243	121	243
180	257	128	257
190	272	136	272
200	286	143	286
210	300	150	300
220	314	157	314
230	329	164	329
240	343	171	343
250	357	178	357
260	372	186	372
270	386	193	386
280	400	200	400
300	428	214	428
320	457	228	457
340	485	242	485
360	514	257	514
380	543	271	543
400	572	286	572
420	600	300	600
440	628	314	628
460	657	328	657
480	685	342	685
500	714	357	714

TABLE II
For Vacuum Techniques Only
Weight of Resin Components Necessary for Making Porous Prostheses

WT. STOCKINET GRAMS	WEIGHT OF RESIN COMPONENTS		
	EPON 815	VERSAMID 140	METHYLENE CHLORIDE
25	36	18	48
30	42	21	56
35	49	24	65
40	55	27	73
45	61	30	81
50	66	33	88
55	73	36	97
60	78	39	104
65	84	42	112
70	90	45	120
75	96	48	128
80	103	51	137
85	109	54	145
90	116	58	154
95	122	61	163
100	129	64	172
105	135	67	180
110	141	71	188
115	148	74	197
120	154	77	205
125	161	80	213
130	167	83	222
135	173	87	231
140	180	90	240

(Continued)

TABLE II

WT. STOCKINET GRAMS	WEIGHT OF RESIN COMPONENTS		
	EPON 815	VERSAMID 140	METHYLENE CHLORIDE
150	193	96	258
160	206	103	275
170	218	109	291
180	232	116	309
190	244	122	325
200	257	129	343
210	270	135	360
220	283	141	377
230	296	148	395
240	308	154	412
250	321	160	428
260	334	167	445
270	347	173	463
280	360	180	480
300	385	193	514
320	411	206	547
340	437	218	582
360	463	231	617
380	488	244	652
400	514	257	685
420	540	270	720
440	565	283	755
460	592	296	789
480	617	309	822
500	643	322	857

LAMINATING MATERIALS

EPON 815 Curing Agent T 1	Shell Chemical Company 380 Madison Avenue New York, New York
VERSAMID 140	General Mills Chem. Division Kankakee, Illinois
METHYLENE CHLORIDE	Any Chemical Supply House
Banlon Stockinet	Bell-Horn 451 N. Third Street Philadelphia, Pennsylvania 19123
Hi-Glo Parting Lacquer	Western States Lacquer Co. Dallas, Texas
PVA	Any Prosthetics Supply House
Silastic RTV S-5370	Dow Corning Corporation Midland, Michigan
Silicone Rubber 502	Dow Corning Corporation Midland, Michigan
A. C. Polyethylene Wax Grade 629	Semet Solvay Products Allied Chemical & Dye Corp. New York, New York
Mylar	E. I. DuPont de Nemours Film Division Wilmington, Delaware
Disposable Gloves	Medical Supply House
Polyethylene Bags - 2 mils.	Any Chemical Supply House

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13. ABSTRACT A simplified procedure for preparing porous arm sockets is described. Preimpregnation of the stockinet and evaporation of solvent prior to lay-up result in a stronger, more porous socket. KEY WORDS: Laminated plastics - porous Laminated plastics - artificial limbs Artificial limbs - upper extremity Prosthetics - upper extremity			

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