### NATIONAL BUREAU OF STANDARDS REPORT

#### **NBS PROJECT**

#### NBS REPORT

0708-20-3824

December 31, 1957

5758

Progress Report

DENTURE BASE RELINERS . FOR SELF USE

by

#### John W. Stanford\* Harold J. Caul\* George C. Paffenbarger\*

\* Research Associates, Research Division of the American Dental Association, Dental Research Section, National Bureau of Standards.

This work is a part of the dental research program conducted at the National Bureau of Standards in cooperation with the Council on Dental Research of the American Dental Association, the Army Dental Corps, the Air Force Dental Service, the Navy Dental Corps and the Veterans Administration.

#### IMPORTANT NOTICE

NATIONAL BUREAU OF STA Intended for use within the G to additional evaluation and re listing of this Report, either in the Office of the Director, Nat however, by the Government a to reproduce additional copies

Approved for public release by the director of the National Institute of Standards and Technology (NIST) on October 9, 2015 rogress accounting documents maily published it is subjected reproduction, or open-literature ion is obtained in writing from Such permission is not needed, prepared if that agency wishes

U. S. DEPARTMENT OF COMMERCE NATIONAL BUREAU OF STANDARDS



## DENTURE BASE RELINERS FOR SELF USE Abstract

The chemical compositions of and effects on denture base resin of ten brands of denture relining materials for self use were investigated. On the basis of approximate composition the reliners may be divided into three groups, one containing solvents, another plasticizers as a major constituent and the third little or no plasticizers or solvent. The reliners containing the large percentages of plasticizer and the one containing the solvent appear to adversely affect the physical properties of a denture base resin.

-----

#### 1. INTRODUCTION

Denture relining materials are no innovation. For the past few years they have been used extensively [1, 2].

Some physical and working properties of the reliners for self use and the effects of these relining materials on certain physical properties of denture base resins are presented in this report. A qualitative picture of the chemical compositions of the reliners is also included.

#### 2. MATERIALS STUDIED

Ten relining materials were investigated. A list of the products and the companies manufacturing or distributing them is given in Table 1.

These reliners were purchased at retail stores with the exception of Dendex and Com-Fit Pads which were procured directly from the manufacturer. Dates of procurement are also given in Table 1.

3. EXPERIMENTAL PROCEDURE AND RESULTS

3.1 Analysis and Composition

In order to explain the effect of these relining materials on denture base resins it was necessary to determine their compositions. It was also desirable to have this information since they are obviously not the self-curing acrylic reliners which are in common use by the dental profession. Also since the relining materials are in prolonged contact with the mucous membranes information on composition would be helpful to other investigators if the evaluation of possible toxic effects is desired in the future.

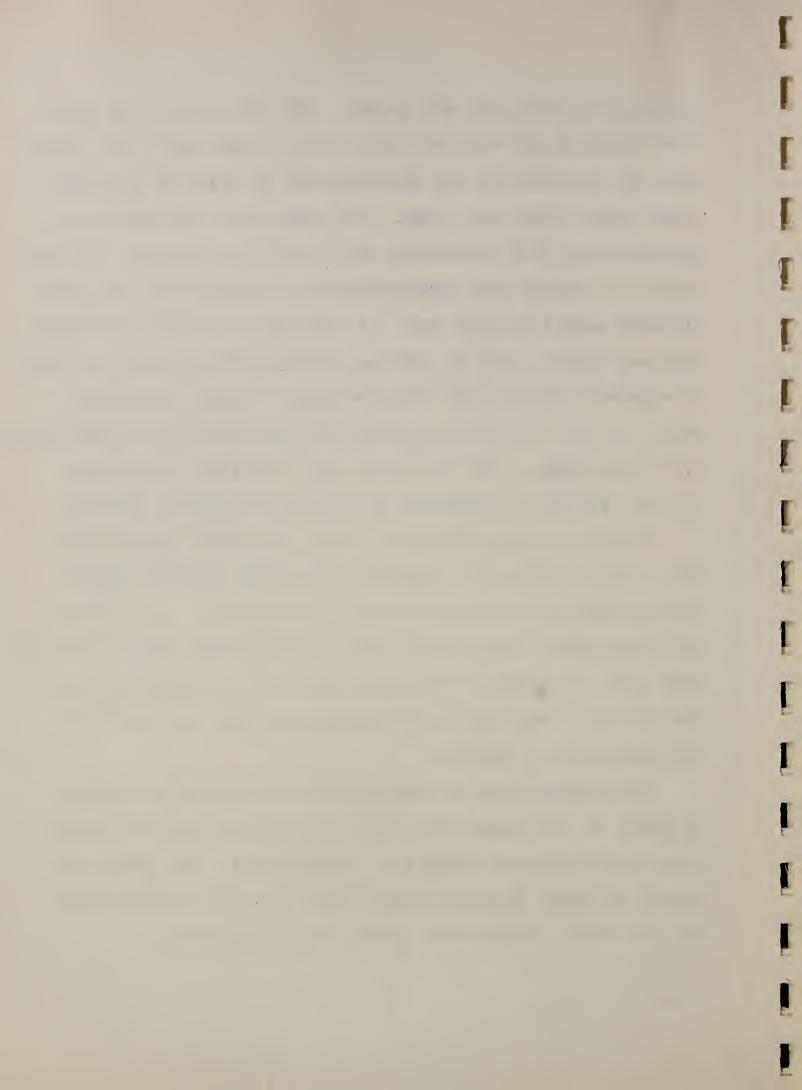
Preliminary experiments consisting of heating to several temperatures from 100° to 175°C and ignition at dull red heat showed that these relining materials are primarily organic in nature and that nine of the ten materials do not contain sol-vents.

To obtain qualitative data on composition each material was placed in a small still pot which was enclosed within a temperature-controlled air jacket. The still pot was a glass tube closed at one end and with a ground glass ball joint which could be connected to the delivery tube by means of a ground glass socket joint and clamp. The temperature was raised in approximately 50°C increments until 350°C was reached. In this manner the resins were depolymerized or degraded and the plasticizers were distilled over. In the case of Dendex distillation was done at 100° to 120°C at atmospheric pressure in order to separate the solvents from the resin. These distillates were, in turn, fractionally distilled to separate the distillates by boiling range. The fractions were identified by infrared spectra, physical properties or qualitative organic methods.

After the major components were identified separations were usually obtained by solvent extraction methods using a soxhlet apparatus and quantitative estimates of the constituents were made. In one case vapor phase chromatographic methods were used. Because of the complexity of the constituents and the methods of analysis used the analyses are believed to be reproducible to 5 percent.

The compositions of these relining materials are given in Table 2. An inspection of this table shows that the materials can be classed roughly in three groups. One group contained solvents, another plasticizers as a major constituent and the third little or no plasticizer or solvent.

- 3 -

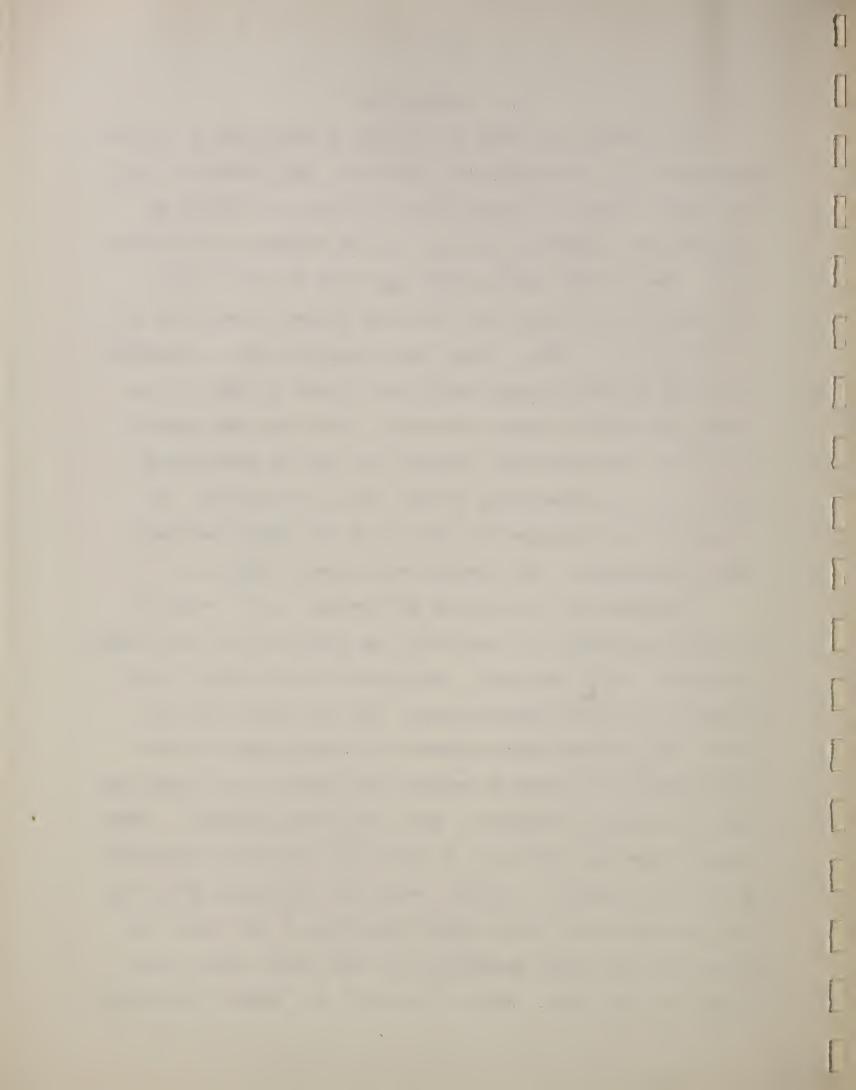


#### 3.2 Setting Time

To determine the time of setting, a thin coat of reliner, approximately 1 millimeter in thickness, was placed on duplicate glass slides by methods which followed as closely as possible the procedures outlined in the manufacturer's directions. One of the coated slides was left in air at  $37^{\circ} \pm$  $1^{\circ}C$  (98.6° ± 1.8°F) and the other was placed in water at  $37^{\circ}$  $\pm$  1°C (98.6° ± 1.8°F). Tests were conducted with a standard one pound Gillmore needle which was allowed to rest on the surface for thirty second intervals. The test was repeated at various time intervals ranging from one to twenty-four hours until no perceptible circle could be observed. If setting had not occurred by the end of one month the tests were discontinued. The results are given in Table 3.

To demonstrate volatility differences in the reliners at room temperature an experiment was performed in which small quantities of the material were placed on individual cover glasses and weighed periodically. The procedure follows: Clean cover glasses were weighed on an analytical balance. Approximately 0.2 gram of reliner was placed on the glass and the cover glass and material were immediately weighed. These samples were then stored in a relatively dust-free atmosphere at  $21^{\circ} \pm 1^{\circ}$ C (69.8°  $\pm 1.8^{\circ}$ F). Weighings were made after one, two and three hours from initial weighing on the first day. After the first day, weighings were made every twenty-four hours for five days. Staze, Poli-Grip, Dr. Heath's Deodoriz-

- 4 -



ing Denture Adhesive, Dentur-Eze, Com-Fit Pads, Snug Denture Cushions and Ezo Dental Cushions showed no loss in weight. Perma-Fit and Brimms Plasti-Liner, both highly plasticized, showed very little loss in weight (1.2 and 0.5 percent, respectively). The sample of Dendex had the largest loss in weight, approximately 37 percent. The results summarized in Table 3 show that the faster setting materials had the greater loss in weight.

3.3 Adhesion to Denture Base Resin

To obtain some information on the relative adhesion of the different relining materials to methyl methacrylate, rods, 1/4 inch in diameter, were cut to approximately two inch lengths and ends made plane and parallel. Two pieces of the methyl methacrylate rod with a small amount of reliner between them, were inserted into a glass tube used as a guide for alignment. The two pieces of rod were compressed toward each other giving a thickness of reliner varying from 0.5 to 1 millimeter. After removal from the alignment tubes, the test specimens were stored for one week in distilled water at 37°  $\pm$  1°C (98.6°  $\pm$  1.8°F). Three specimens were tested for each of the relining materials. The results are shown in Table 3. Those reliners having no adhesion contain little or no plasticizer and no solvents.

- 5 -

Π Π I 

#### 3.4 Distortion and Crazing of Denture Base Resin

It was noted that some of the specimens used for setting time determination displayed wrinkled surfaces as if dimensional changes of the reliners were taking place. It was believed that these changes might give rise to forces which would tend to cause distortion when applied to an artificial denture.

Clear resin discs 0.5 millimeter in thickness, and 50 millimeters in diameter were cut across their diameters and coated on one side with reliners. These and an uncoated half-disc were placed in water at  $37^{\circ} \pm 1^{\circ}$ C (98.6° ± 1.8°F). After one month of immersion, the halves were placed against a straight edge and the amount of warpage measured with a toolmaker's microscope. Only one specimen of each material was prepared. The unlined specimen showed a change of approximately 0.001 inch. The reliners which exhibited wrinkled surfàces did show distortion of the resin base. The data are shown in Table 4.

Specimens of a clear denture base resin were used for the crazing test. These specimens were lined with each of the materials to determine if the solvents or plasticizers present would relieve strains as indicated by cracking or crazing which would appear in the resin base. The lined specimens were placed in distilled water at  $37^{\circ} \pm 1^{\circ}$ C (98.6 ± 1.8°F) and visual exam-

•

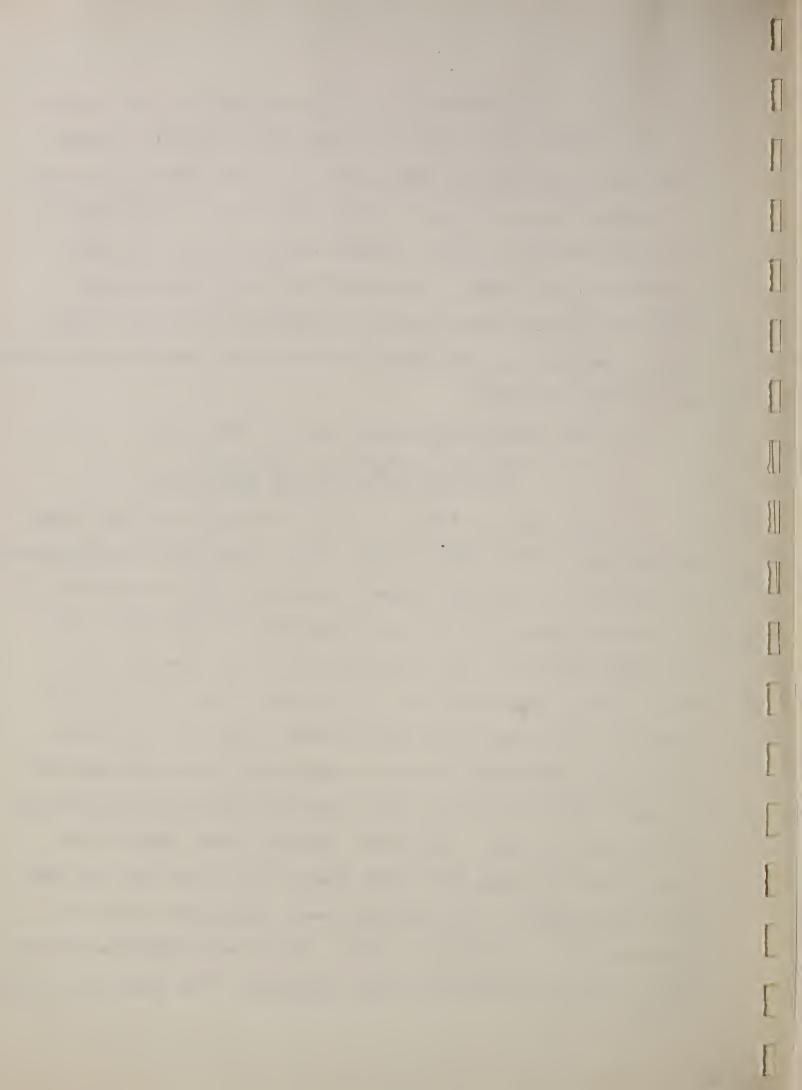
inations were made for crazing at the end of four hours and one week of storage. The specimens lined with Perma-Fit, Brimms Plasti-Liner and Dendex showed crazing at the end of four hours. The crazing increased over the one week period. From Table 2 it is apparent that these reliners contain solvent or large amounts of plasticizer. Specimens lined with Snug Denture Cushions and Dentur-Eze showed no crazing at the end of four hours, however, the specimens did show slight crazing after being relined for one week.

The results for crazing are shown in Table 4.

#### 3.5 Effect on Transverse Stiffness and Strength of Denture Base Resin

To determine the affects of the reliners on the stiffness and strength of the denture base resin, transverse test specimens as described in American Dental Association Specification No. 12 for Denture Base Resin [3] were prepared and coated with the relining materials. The thickness of reliner averaged 0.5 millimeters. Tests were run on specimens lined with all ten reliners four hours after application. Only four reliners, Dentur-Eze, Perma-Fit, Brimms Plasti-Liner and Dendex appeared to have adverse effects on the transverse stiffness and strength of the denture base. Additional specimens were coated with these four materials and tested twenty-four hours and one week after application. All specimens were stored and tested in water at 37°  $\pm$  1°C (98.6  $\pm$  1.8°F). Tests were conducted according to the specification testing procedure. The results on lined

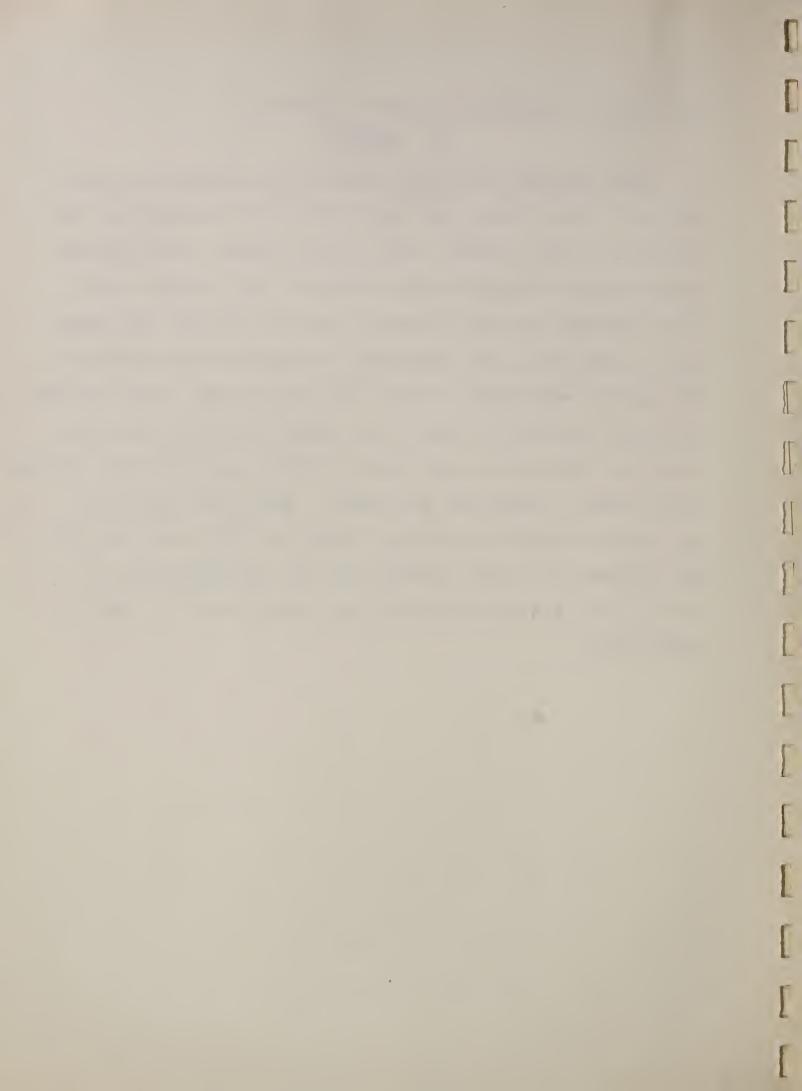
- 7 -



and unlined specimens are shown in Table 5.

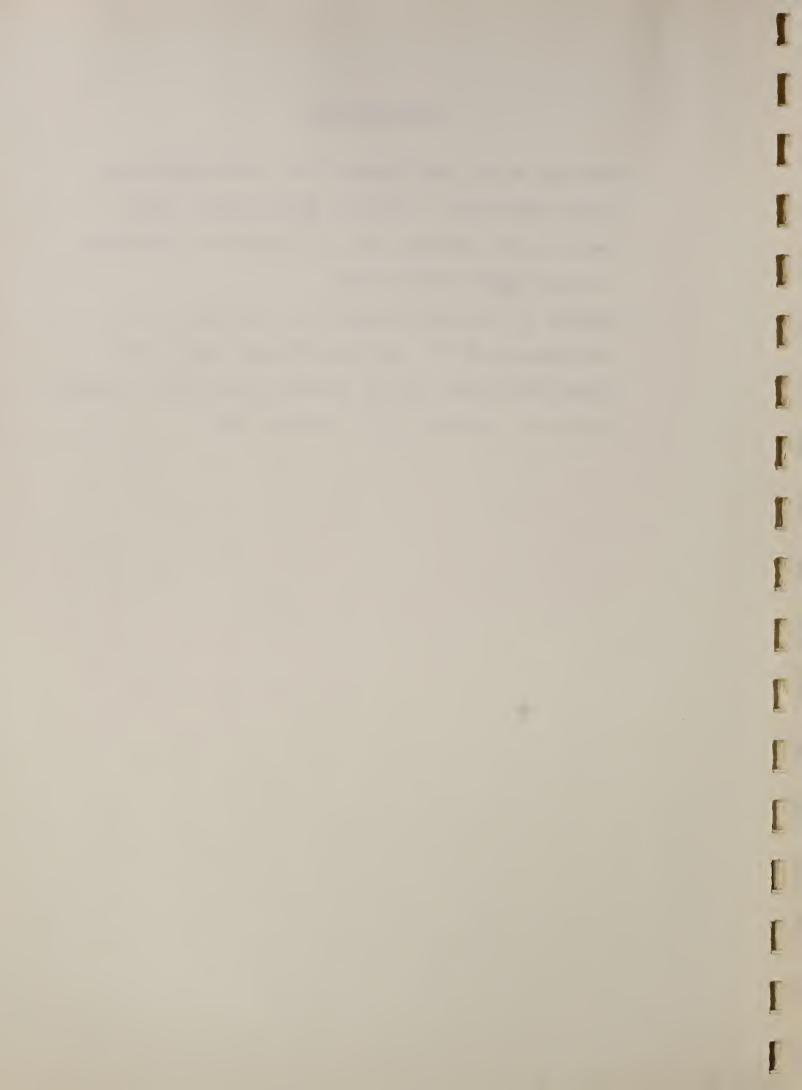
#### 4. SUMMARY

There appears to be some correlation between the composition of the reliners and their effects on the physical properties of a denture base resin. The reliners containing the higher amounts of plasticizer (Perma-Fit and Brimms Plasti-Liner) and the solvent containing reliner (Dendex) all craze, distort and reduce the transverse strength and stiffness of the denture base resin to about the same degree. Snug Denture Cushions, and Com-Fit Pads do not appear to affect the properties of the denture base resin as greatly as Perma-Fit, Brimms Plasti-Liner, Dentur-Eze and Dendex. Ezo Dental Cushions, Dr. Heath's Deodorizing Denture Adhesive, Staze and Poli-Grip are composed of either paraffin wax and gum Tragacanth or Cotton Cloth and do not affect the properties of the denture base resin.

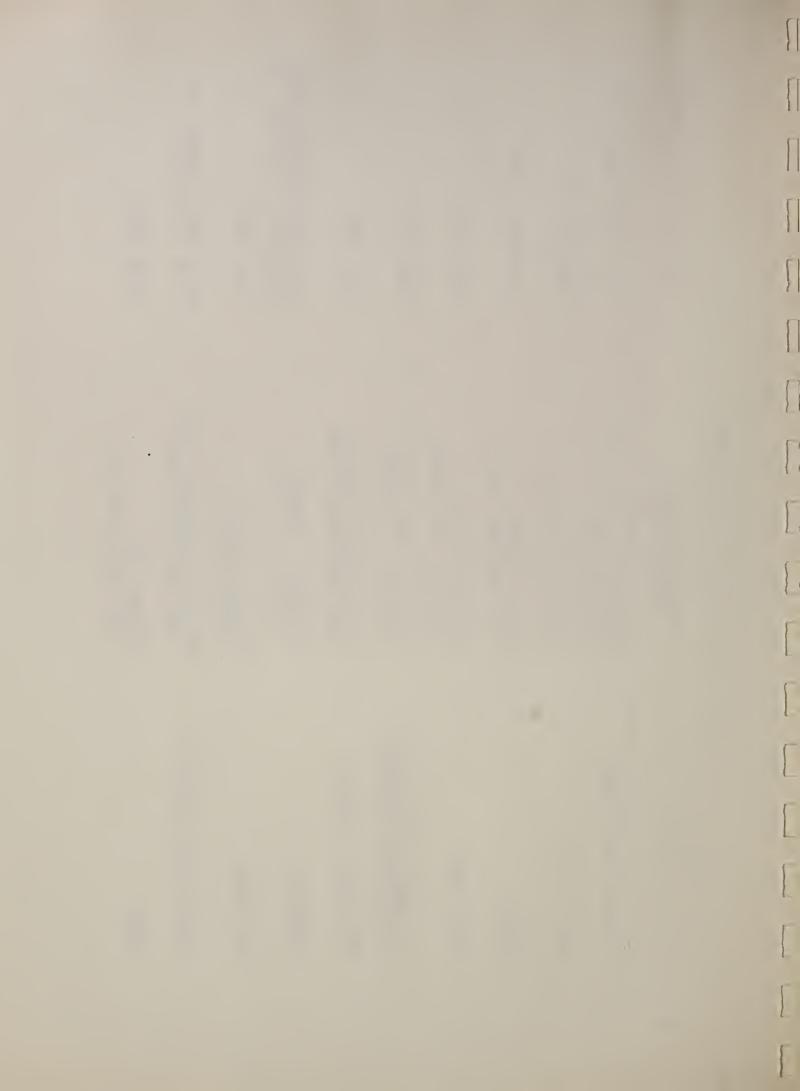


#### BIBLIOGRAPHY

- Skinner, E. W., and Pomes, C. E. Self-hardening Lining Materials. J.A.D.A. <u>32</u>:419 April 1945.
- Beall, J. R. and Caul, H. J. "Liners" for Dentures. J.A.D.A. <u>33</u>:304 March 1946.
- 3. Swaney, A. C., Paffenbarger, G. C., Caul, H. J., and Sweeney, W. T. American Dental Association Specification No. 12 for Denture Base Resin: Second Revision. J.A.D.A. 46:54 January 1953.



	Date of Procurement	July 1955, August 1956	September 1955	September 1955	July 1955	July 1955	July 1955	July 1955, August 1956, September, November 1957	July 1955	July 1955, August 1956	July 1955
1. Reliners Investigated	Manufacturer or Distributor	Plasti-Liner Co., Inc. Buffalo, New York	Com-Fit Company Scipio, Indiana	Dendex Company Los Angeles, Calif.	Dentur-Eze Inc. Seattle, Washington	International Cosmetics. Co. Chicago, Illinois	Ezo Products Company Philadelphia, Penna.	Perma-Fit Company Chicago, Illinois	Hudson Products Jersey City, N. J.	Midland Pharmacal Corp. New York, New York	Staze, Inc. New York, New York
Table 1	Brand	Brimms Plasti-Liner	Com-Fit Pads	Dendex .	Dentur-Eze	Dr. Heath's Deodoriz- ing Denture Adhesive	Ezo Dental Cushions	Perma-Fit	Poli-Grip	Snug Denture Cushions	Staze



### Table 2

# Approximate Compositions of Reliners (per cent by weight)

	·													,		
		R	esir	ns		Mi	.sc.		Pl	ast	iciz	zers	5	So	lver	its
Brand	Poly (Methyl Methacrylate)		Ccellylose Nitrate	Poly (Butyl Methacrylate)	Coumarone- Indene	Paraffin Wax	Gum Tragacanth	Cotton Cloth	Fatty Acid Triglyceride	Dibutyl Phthalate	Glyceryl Triacetate	Ester Tvne	Butyl Phthalyl Butyl Glycolate		Ethyl Alcohol	Toluene
Dendex Material* Solvent			40	. <sub>1</sub> 97						15				25 1 <b>0</b> 0	10	10
Brimm's Plasti-Liner	15										85					
Perma-Fit	25.					15					60					
Dentur-Eze**	ыў.	Р		0.0	P					P						
Snug Denture Cushions				80					20							_
Com-Fit Pads		90					50			_			10			
Dr. Heath's Deodorizing Denture Adhesive	بد 1					45	50					5	1			
Ezo Dental Cushions						85		15								
Poli-Grip						50	50									
Staze						50	50									
	L										L			1		

\* Tentative composition analysis.

\*\* Methods of analysis have not yet been found.

P Present.

A 120-121

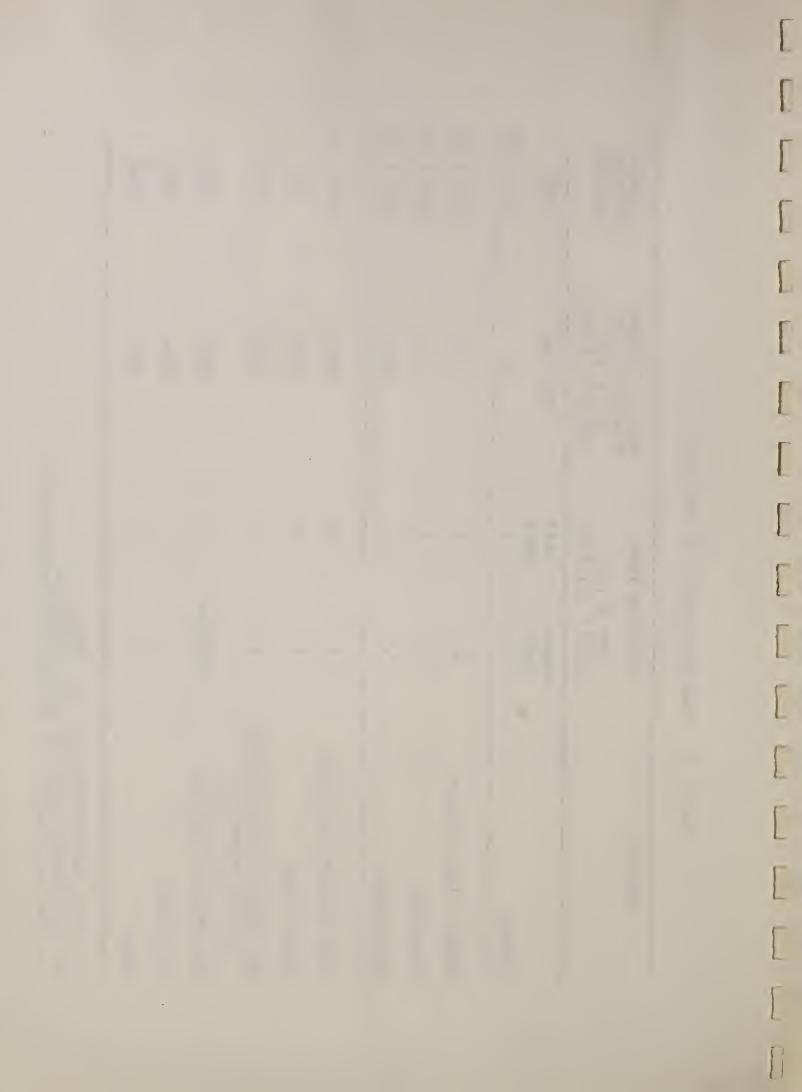


of Reliners
Properties
Some
°.
Table

Material	Setting Time 37 • ± 1 • C) (98.6 • ± 1.8 • F)	ime c) <sup>c</sup> .8°F)	Loss in Weight Stored in Air 21°±1°C (69.8°±1.8°F)	Adhesion Tensile Strength
Dendex	Water Days 1	Air Days 1	Per Cent 37	PSI 400 ± 40
Brimms Plasti-Liner	4	*	0.5	1500 ± 80
Perma-Fit	CJ	*	1.2	1200 ± 40
Dentur-Eze	*	30	None	200 ± 20
Snug Denture Cushions	*	*	None	100 ± 0
Comfit Pads	*	*	None	* *
Dr. Heath's Deodorizing Denture Adhesive	+	*	None	None
Ezo Dental Cushions	Softens	*	None	None
Poli-Grip	+	*	None	None
Staze	+	*	None	None

<sup>\* \* +</sup> 

Does not harden within 30 days. Not tested, only one side adhesive. Swells in water, no setting time measureable.



m o '	ЪЛ	~	4
Ta	Lа	е	4

Effect of	of	Reliners	on	a	Denture	Base	Resin	
-----------	----	----------	----	---	---------	------	-------	--

Brand	Crazing at One Week	
Dendex	Crazing	0.044
Brimms Plasti-Liner	Crazing	0.031
Perma-Fit	Crazing	0.028
Dentur-Eze	Slight crazing	0.005
Snug Denture Cushions	Slight crazing	None
Comfit Pads	None	0.001
Dr. Heath's Deodorizing Denture Adhesive	None	None
Ezo Dental Cushions	None	None
Poli-Grip	None	None
Staze	None	None

Effect of	Rel	on a	Denture Base	se Resin		
	Time	Reliner	Remained (	on Resin Be	Before Testing	cing
		4 Hours	ស	24	Hours	
"	Deflect 1500 to	lection from 1500 gm to	Load at Failure	Deflecti 1500 to	lection from 1500 gm to	Load at Failure
	3500 gm	5000 gm		3500 gm	5000 gm	
	mm	mm	gm	mm	mm	gm
Dendex Brimms Plasti-Liner Perma-Fit Dentur-Eze Snug Denture Cushions Comfit Pads Dr. Heath's Deodorizing Denture Adhesive Ezo Dental Cushions Poli-Grip Staze		4 4 mm	4900 44900 5300 5300 5300 5300 5300 5300 5300 5	0000  И И И И	4 m t t m t t m t t m t t m t t m t t m t t m t t m t m t m t m t m t m t m t m t m t m t m t m t m t m t m t m	4900 5100 4900
Unlined Denture Base	1.8	3.9	5500			
+ All specimens broke before * Wax was not adhesive, ther	efore there	readings co fore, not t	gs could be made not tested.	de .		

Table 5

Transverse Tests

All specimens broke before readings could be made. Wax was not adhesive, therefore, not tested.



US COMM-NBS-DC

All specimens broke before readings could be made Wax was not adhesive, therefore, not tested. + \*

Time Reliner Remained on Resin Before Testing	1 Week	Deflection from Load 1500 gm at to Failure	3500 gm 5000 gm	mm mm gm	iner 2.0 4.2 5000 2.0 + 4.4600 44600 + 4600 4,4600 + 4600 4,800 + 4800 1001 * 4800	
		Material			Dendex Brimms Plasti-Liner Perma-Fit Dentur-Eze Snug Denture Cushions Comfit Pads Dr. Heath's Deodorizing Denture Adhesive Ezo Dental Cushions Poli-Grip Staze	Unlined Denture Base

Table 5 (Continued)

Base Resin Effect of Reliners on a Denture Transverse Tests

