Plastisol Coatings and Application Techniques

by DAVID H. HARDEN

Research Associate in Physical Medicine and Rehabilitation, University of Michigan Medical Center, Assistant Professor of Mechanical Engineering, Wayne State University

and

RICHARD D. KOCH

Research Orthotist in Physical Medicine and Rehabilitation, University of Michigan Medical Center

Braces and splints that apply supporting and corrective forces to the human body have traditionally been covered with various types of leather. At present, however, good leather hides are becoming very expensive and difficult to obtain. The problems involved in using leather have motivated research in the use of plastic materials and new covering processes to replace leather coverings. Ten years ago a polyvinylchloride-based material called plastisol was introduced as a covering material for hand splints. Since then this process has been used both experimentally and clinically at the University of Michigan Medical Center.

The effectiveness of a plastisol covering on hand splints led us to investigate the use of this material on other items such as back braces and leg-brace bands. Our first coating formulation was limited in application because of its high coefficient of friction and uncontrollable density, and the fact that no well-defined criteria for the coating process had been established. However, there remained the desirability of a smooth, encapsulating covering that could be applied simply by dipping the heated brace in the liquid material. Therefore a study was undertaken to characterize plastisol in detail and to perfect the dipping process. The resulting procedure is being effectively used on back braces, leg bands, pelvic bands, mouth sticks, hand splints, and brace straps. Clinical applications over the past five years tend to confirm the usefulness, acceptability, and advantages of this plastic covering.

I. PLASTISOL MATERIAL DESCRIPTION

A. Chemical Composition and the Fusion Process

Plastisol consists of a dispersion of fine vinyl resin particles in a plasticizing oil. Vinyl dispersion describes the nature of the material and the process by which the liquid plastisol is made. The resin particles absorb some of the plasticizer at room temperature and are held in suspension. When the resin is heated, the absorbing action is rapidly increased. Plasticizers remain in the plastisol material after fusion and import a flexible nature to the material.

These vinyl dispersions have additives such as light and heat stabilizers, pigments if color is desired, fillers, and other modifiers. Since plastisols have no solvent or water to evaporate, they are relatively simple to use and do not

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require elaborate venting of the curing oven. The plastisol formulations are stable for long periods at room temperature. Cans of liquid plastisol will not dry out or "skin over" during long periods of storage, even if left uncovered.

Dipping, i.e., immersion of an object in the liquid, is one of the oldest production methods used with vinyl dispersions. Dipping is divided into two types: hot dip and cold dip. Hot dipping is usually the simpler of the two methods and has been used in this study. Cold dips are generally used for objects such as wire baskets which will not hold as much heat as is required in the hot dip method. A special formulation is required if the material is to be cold dipped.

In hot dipping, heat transfer from the heated metal piece to the room temperature liquid causes the formation of a gel coat on the metal part. The thickness of the gel coat depends on the amount of heat transfer. The gel coat thickness can thus be controlled by the thickness and temperature of the object being coated. This gel coat has little or no mechanical strength because it is formed by swelling of the resin particles by absorption of the surrounding plasticizer. The swollen resin particles are then held together by physical contact only. Because the resin particles are not fused together, the gel coat is weak and crumbly, much like a piece of cheese. When the coated part is placed in the curing oven, however, the particles of resin fuse into a tough thermoplastic material, with the plasticizer acting as a lubricant between the vinyl molecules. The relative amount of plasticizer in the composition determines the flexibility of the product. Insufficient curing time or temperature will not fuse all the resin particles, leaving part of the plastisol in the crumbly gelled state. Over-curing due to excessive temperature or prolonged curing times causes a partial degradation of the material and alters its appearance and physical properties.

B. Physical Properties of Plastisol

Because the strength of the foamed plastisol is much lower than the regular plastisol, care should be taken to use this material only when a compressive force situation exists. The foamed material is not suitable for a tensile or shear force situation.

Cost and weight are two additional factors affecting the practicality of plastisol as a brace covering. Several brace parts were covered with leather or plastisol and the part weights compared. A band from a leg brace required 40 grams of regular plastisol to give the same covered size as 25 grams of sewn leather and felt. Thus, a plastisol covered brace is heavier than a leather covered brace if the covering volumes are equal since regular plastisol is more dense than leather. A brace properly covered with plastisol, however, will have less volume of covering than a leather covered brace. The plastisol need not extend $\frac{1}{4}$ " to $\frac{1}{2}$ " beyond the load bearing metal framework to allow for stitching as does leather. A narrower band may be used with plastisol because of the excellent surface continuity compared with the rough broken surface produced by stitching of the leather covering. Therefore, a plastisol covered brace can be equal in weight or only slightly heavier than a similar leather covered brace.

The cost of plastisol is approximately \$10.00 per gallon or \$1.00 per pound. The material cost for the leg band previously mentioned is thus less than 10 cents, only a fraction of the cost of leather covering. The time required for applying the plastisol to a single band is similar to that required for sewing of a leather covering. Plastisol's labor saving advantage becomes highly significant when an assembled brace is coated. It requires no more time to heat, dip and cure a complete brace than a single part. The

leather covering time, however, increases in proportion to the area covered. Plastisol covering thus offers an economic advantage from both the material cost and labor cost aspects. In addition, plastisol offers longer life which reduces replacement costs.

C. Toxicity*

Certain materials when placed in contact with the skin may produce a reaction, either through the mechanical action of the two surfaces rubbing together, or by chemical reaction between the substance and the skin. A "patch test" was used to check for reactions souch as redness, irritation, inflamation, or eruption. Samples of plastisol and horsehide were placed on 53 subjects, 28 in the lumbar area of the back over the erector spinae muscle, 3 in the upper back between the scapulae, and 22 in the shoulder region over the deltoid muscle.

After 47 to 50 hours the patches were removed and the skin examined for evidence of irritation. Of the 53 subjects, three showed a reaction. One subject developed erythema under the leather patch, the plastisol patch, and the tape which held the patches in place. The erythema in each of these areas lasted 4 to 6 hours. Another subject developed mild erythema localized to the area under the plastisol patch. In this case the redness disappeared in a few hours. Erythema developed under the leather patch in the third subject. Twenty-four hours later this reaction cleared up.

None of the plastisol patches discolored from the test, but in many instances the skin under plastisol was found to be moist. This is attributed to the nonporous and nonabsorbent nature of the plastisol. The leather, however, absorbed perspiration and became moist or saturated and discolored.

Forty-eight hours after the patches were removed the subjects were again examined and did not show any new signs of positive reaction or any residual signs of reactions. The major significance of this test is that it shows plastisol to be less affected by body contact and that plastisol patches produce no more skin reaction than did leather patches.

II. DETAILS OF THE BASIC COATING PROCESS

Essentially, the coating process involves the transfer of heat from the metal to the liquid plastisol, which forms a gel on the metal surface. This very weak, soft material then must be cured in a hot oven to fuse the resin particles in the liquid dispersion to form a tough coating on the metal part.

The six steps involved in coating a metal part are: (1) metal preparation, (2) preheating of metal, (3) dipping, (4) surface sealing, (5) curing, and (6) cooling and finishing. Proper control of each step is important in obtaining optimum results. Useful variations in results can be achieved by controlled alterations in the basic steps.

A. The Six Basic Steps in Plastisol Coating

1. Metal Preparation

Durability and appearance of the final coated product depend to a considerable degree on the care taken in preparing the metal part. Sharp metal edges give an internal cutting effect which causes a breakdown in the

^{*} The authors are indebted to Michael Schermer, a University of Michigan medical student in the Class of 1969, for his assistance in conducting tests on toxicity and coefficient of friction.



Figure 5-Preparing Metal.

Figure 6-Preheating Metal.

coating from forces applied over the sharp edge; also the coating is thinner at sharp edges. Plastisol coating should not be used to cover poor metalwork. Well-rounded edges on the metal parts are easily produced by a fine belt sander, Figure 5, or filing or grinding. Contours and curves should be smooth and flowing to avoid abrupt changes in cross-section or configuration.

2. Preheating

Since gelling of the liquid plastisol on the metal part is caused by heat transfer, it is necessary to preheat the part to be covered, Figure 6. The thickness of the coating depends on the amount of heat transferred. The heat transfer rate in turn depends on the temperature of the metal part, its specific heat and conductivity, and the mass of the part compared to its surface area. Thus, the coating thickness is governed by the thickness of the part as well as the temperature to which it is preheated, Chart 1. Preheating is usually done in an oven at 190° to 220°C for five to fifteen minutes depending on the coating thickness and thickness variation desired.

Considerable time is required to heat a cold metal part to the desired dipping temperature even in a hot oven, and the thicker the part, the more time required. Chart 1 shows results of a thermocouple test in which various thicknesses of aluminum were placed in an oven at 195°C. It is desirable to use the same oven temperature for the preheat step as for the curing step so that the oven does not have to be adjusted between steps. A single setting is advantageous too, in that it allows preheating and curing of several pieces simultaneously.

3. Dipping

The preheated metal part is removed from the oven with appropriate tools such a pliers or hooks and immediately dipped into the liquid plastisol, Figure 7. Gelling of the plastisol on the part continues as long as sufficient heat transfer takes place between the object and the surrounding liquid, thus the amount of heat transfer determines the thickness of the coating, Chart 1. The gelling process usually terminates in about two minutes if the parts are of moderate thickness. If the part is removed before gelling is complete, the coating will sag and gel further as the part is drained, creating an irregular surface. When the gelling process is terminated, in one to three minutes, the part should be slowly lifted from the plastisol bath and suspended for draining, Figure 8. Several minutes should be allowed for the liquid material to drain off.

4. Surface Sealing

Next the surface must be sealed (surface molecules gelled to prevent further sagging) by rotating the dipped part above a soft Bunsen burner



Figure 7-Dipping.

Figure 8-Dripping.



Figure 9-Flame Sealing.

Figure 10-Light Sealing.

flame, Figure 9, or by rotating it between two infrared lamps, Figure 10. If the plastisol surface is not sealed, the coating will "melt" and drain away when the object is placed in the hot oven for curing. The dippingand-sealing step is the most critical stage in the procedure, requiring considerable practice and skill.

5. Curing

In order to produce a tough, durable coating on a brace part, it is necessary to fuse the resin particles in what is called the curing step of the process. Since we are dealing with coating thicknesses of 1/16 to $\frac{1}{4}$ inch, considerable time is required for heat transfer from the curing oven to the inner part of the plastisol coating. This process depends on time and temperature, just as in roasting meat, which must reach a certain temperature at the center in order to be "done" to the desired degree. Chart 2a indicates the relationship between coating thickness, curing oven temperature, and curing time required to give the desired coating strength. Curing is best accomplished in oven temperatures ranging from 190° to 200°C for ten to twenty minutes, depending on the part and coating thickness. It should be noted that insufficient cure due to inadequate curing time or oven temperature results in a very weak coating. Since increased oven temperature reduces the time required for a complete cure, there is a tendency to increase the oven temperature beyond the recommended limit; however, while this may quickly cure the outer surface of the plastisol coating, the interior will be under-cured. Excessive oven temperatures may also cause discoloration of the surface before the inner part of the coating is completely cured.

6. Cooling and Finishing

After curing, the part is removed from the hot oven and either suspended for air-cooling or cooled in water. Because plastisol is a good insulator, the coated metal part may take several minutes to cool even in cold water. The plastisol coating does not reach its full strength and firmness until it is fully cooled.

Following the cooling of the coated part, the plastisol material may be stripped from any portion of the brace which is to be left bare. Any hooks or supporting devices which were used during the curing process may now be removed and the plastisol trimmed to give a neat appearance. It has been found that a scalpel or heated knife is handy for trimming and removing surface imperfections. Light sanding with fine sandpaper is also good for removing surface imperfections. Roughened surfaces can be smoothed by application of heat, either a Bunsen burner or in the curing oven at a high temperature. Care must be exercised, however, to prevent breakdown of the plastisol by the high temperature.

COATING PROCESS REVIEW

- 1. Metal Preparation—Clean the surface and round all edges (polishing not necessary).
- 2. Preheating of Metal—The metal parts must be given sufficient heat content to pick up the desired coating thickness. Preheating is usually done in an oven at 190° to 220°C for five to fifteen minutes depending on the coating thickness and thickness variation desired.
- 3. Dipping—The preheated metal part is dipped into the liquid plastisol for several minutes until the heat has been dissipated and the desired coating thickness attained. The part is then slowly removed and the excess material allowed to drain off.
- 4. Surface Sealing—Next the part is rotated above a soft Bunsen burner flame or between two infrared lights to seal the coating surface quickly. Sagging during the curing step is thus prevented.
- 5. Curing—The dipped and sealed part is placed in the curing oven at temperature of 190° to 200°C for ten to twenty minutes depending on the part size and coating thickness. During this step the polyvinylchloride resin particles undergo fusion, to form the desired tough plastisol coating.
- 6. Cooling and Finishing—After removing the part from the curing oven the handling hooks are removed and the coating is trimmed and sanded to obtain a neat appearance. The part is then ready for use.

B. Plastisol Coating Equipment

The requirements outlined here involve equipment that will be needed in addition to that normally found in a brace shop equipped with metal-brace fabricating tools. Application of the plastisol coating requires additional equipment for heating the metal parts, dipping them, and sealing and curing the plastisol coating. Small tools for handling the hot parts are normally a part of brace ship equipment. A timer is a refinement which makes control of the process easier; otherwise a wristwatch or clock may be used.

Metal preheating and plastisol curing are best accomplished in a thermostatically controlled gas or electric oven, Figure 11, which has some sort of forced circulation and a vent for the slight fumes produced during the final curing process. The thermostat should be able to control the oven temperature to within 5° of the desired set-point since a larger variation will reduce controllability and thus affect the quality of the finished parts. A glass





Figure 11—Preheating and Curing Oven.

Figure 12-Small Tools Required.

panel in the oven door is essential for observing progress of the curing; the onset of discoloration that warns of overcure can be quickly detected. The oven should have rods or a rack near the top of the interior chamber for hanging the parts to be heated or cured.

Since the liquid plastisol does not evaporate or age appreciably under normal room conditions, it is not necessary to have an air-tight dipping container; however, the container should be covered when it is not in use, to prevent accumulation of dust or dirt particles on the plastisol surface. The can in which the material is purchased can be used as the dipping container, but a specially prepared tank or glass container may be more suitable in size and shape for the particular parts to be coated.

A Bunsen burner, Figure 9, or two infrared lamps, Figure 10, are required for the sealing process after the part has been dipped. Two gooseneck desk lamps can be set so that the two infrared bulbs face each other several inches apart; the part to be sealed can be slowly rotated between these lamps. If a gas supply is available and the open flame of a Bunsen burner is permissible, sealing can be accomplished by slowly rotating the part to be sealed over the top of the soft Bunsen burner flame. This method requires caution because the flame temperature is high enough to scorch the surface very quickly if the part is held in the flame.

Small tool and equipment requirements consist of simply fabricated wire hooks for hanging the parts in the oven or cooling rack, and tools such as pliers or vice-grip pliers for handling the hot parts, a sharp knife or a scalpel, sandpaper for trimming and finishing the final plastisol coating, and several hanging racks located both over the dip tank and in some appropriate cooling area, Figure 12.

III. EXTENDED APPLICATIONS

Several modifications of the basic coating process will give useful coating property variations. For example, the plastisol material may be bonded to the brace by a primer material; a soft layer of foamed plastisol may be applied before the final tough coating; coating thickness can be varied from one point to another on a single part; and plastisol straps can be fabricated as an integral part of the brace coating or mechanically attached to the brace.

A. Bonding the Coating by Means of Metal Primer

It is often necessary to apply the plastisol coating over an adherent primer so there will be no relative motion between the coating and the brace and so no moisture or dirt can get under the edge of any coating terminations. We have found that plastisol coatings which did not adhere at points of maximum pressure, such as the edges of leg bands or upper thigh bands, were subject to internal failure by the cutting action of the metal edges, especially if these are sharp. Shifting of the plastisol coating also can be eliminated by causing the material to adhere to the brace part. A small amount of primer applied to the part where the coating is to terminate is very helpful in preventing foreign material from entering between the coating and the metal part.

Adhering of the plastosol coating to the metal can be obtained by dipping the part to be coated or by brushing small areas with a special primer furnished by the plastisol manufacturers. This primer should be applied before the preheating of the metal part. The normal preheating step will then evaporate the primer solvent and cure the primer so that it forms a very strong bond between the metal part and the subsequent plastisol coat. It should be noted, however, that a primed metal part becomes very difficult to strip for recoating. Because of this, it is suggested that limited areas be primed and that no primer be put in cracks or crevices formed by joining of two metal parts.

B. Foamed Plastisol Underlayer

It is often necessary to provide a soft padding or a built-up section on a brace. This can be produced by covering part of a brace with a soft, thick plastisol material of lower density. The effect is easily accomplished by first covering the metal part with a modified plastisol which expands by chemical foaming action during the curing process. This technique has been used successfully to produce up to 100% expansion of this underlayer on the metal parts.

The foamed underlayer of plastisol is obtained by dipping the preheated metal part first in the special foaming type plastisol and then proceeding through the sealing step and part of the curing step, as with the regular material. However, it should be noted that the foamed underlayer should be cured for three minutes only, at which time it should be quickly removed from the oven and dipped into the regular plastisol to obtain the tough outer layer. This outer layer should then be sealed and cured according to the normal cycle, being particularly careful to avoid extended curing periods which might cause a sagging of this much thicker coating. A good oven is essential for this step. If the oven does not have adequate circulation and becomes hotter at one point than another, the foaming action will be very uneven and the result will be unsatisfactory. It is usually desirable to apply a primer coat before preheating the metal part for the foamed underlayer. This foamed underlayer of plastisol has a much lower strength and thus should be used only when a cushion effect is desired under the tough regular plastisol coating.

C. Variable Coating Thickness on a Single Part

It is possible to have thin and thick sections on a single brace part by properly controlling the temperature of the part before it is dipped. As described earlier, the hotter parts or hotter sections of a part will pick up a thicker gel coat during the dipping step. The metal with a uniform crosssection can be given the required temperature gradient by either cooling part of a normally preheated part with small sections of wet toweling, Figure 14, or local heating of the part by a concentrated heat source. For example, one band of a brace requiring a thicker coating can be heated in the Bunsen burner flame for a few seconds immediately before the dipping step, Figure 15.





Figure 14-Wet Towel Cooling Uprights.

Figure 15—Heating Band in Flame for Thicker Coating.

Often a part to be coated must be given special preheating treatment in order to obtain a uniform coating thickness. An example of this requirement would be the coating of a leg brace which contains relatively thin bands attached to heavier cross-sectioned uprights. It is the natural tendency of a uniformly heated brace of this type to pick up a much heavier plastisol coating on the thicker cross-sectioned upright of the brace than on the thinner leg bands. Since it is usually preferable to have the reverse coating proportion, special treatment must be given to the brace during preheating to obtain the desired results. If the brace uprights are cooled with a wet towel, or the leg bands are heated for a few seconds in an open Bunsen burner flame, the coating thicknes on the bands can be equal to or thicker than the coating on the uprights. Another more subtle way of obtaining a similar temperature gradient can be accomplished by preheating the part for a shorter time at a higher temperature. Since thick parts heat more slowly, the preheat time and temperature can be adjusted to produce a much higher temperature in the thin band than in the thick upright, Chart 1.

Controlling the depth of submergence of the part in the dipping tank can often be used to control the coating thickness if one end or extremity of the brace requires a thicker coating. If partial insertion of a part into the liquid plastisol is followed by a complete submergence after the part cools somewhat, a variation in coating thickness is easily obtained. By controlling the rate of submerging the part into the liquid plastisol, a gradual variation in coating thickness and, consequently, a neat appearance will result. Some experimentation and practice are required to become familiar with this method of controlled coating thickness.

D. Plastisol Straps

Leather straps have normally been attached to braces by riveting or sewing, causing discontinuity in the brace appearance. When using plastisol as a brace covering material, it is possible to make the straps a continuous part of the plastisol coating, Figure 16. This is accomplished by attaching a temporary piece of metal to the brace for the dipping process in such a way that a continuous coating is obtained on both the brace and the attached metal. When the piece of metal is removed, an integral strap of plastisol will remain attached to the brace and brace covering. A little careful trimming and sanding give the strap and coating a neat appearance, and little or no trace of the special process is evident. Strap thickness can be controlled by selection of the thickness of the preliminary metal strap.

Another method of forming plastisol straps is to cut them from plastisol sheets which can be formed on metal plates. The sheets can be easily stripped



Figure 16—Continuous Plastisol Straps.

from the metal plates if no primer is used. The straps are then attached to the brace by normal procedures such as riveting and sewing.

IV. PRELIMINARY CLINICAL EVALUATION

During the past five years several hundred patients have been fitted with braces either totally or partially covered with a plastisol material. A large percentage of these patients have been enthusiastic about this new material; however, several common complaints were indicated by some of the patients when questioned about its acceptability. The complaints about the original plastisol were (1) high coefficient of friction, (2) hardness of the plastisol coating, and (3) failure of the plastisol coating due to splitting or crumbling.

Analysis of these complaints led to changes in the plastisol formulation. One change reduces the coefficient of friction. Another change gives a softer material by causing a foaming action during the curing cycle. Third, a study of the complete coating process pointed out necessary procedure improvements to reduce the causes of coating failures. Most of the coating failures were due to improper curing and improper metal preparation. In response to these initial patient complaints, Barley-Earhart Corporation developed the regular and foam type hot dip Plastisols BE 2-40 and BE 2-41. We then established the proper coating procedures for making full use of the properties of these new formulations.

At least 40 patients have been fitted with hand splints or leg braces covered with the improved plastisol formulations. Of these patients only 14 have been available for evaluation of this material, 9 of whom had previously worn leather covered braces. The format of the interview with the 14 patients is as follows:

- A. Objective Information—Name; sex; age; height; weight; occupation; number of hours spent on feet per week; disability; type of brace worn; when first received braces; kinds of coating materials previously used; and how often coatings had to be replaced.
- B. Evaluation (only for those who have worn both plastic and leather)— Which retains its original function longer; which is lighter; which has better original appearance; which maintains its appearance longer; which causes the least irritation; which is less sticky when not prespiring; which is less sticky when perspiring; which is easier to keep clean; which has the least tendency to pick up odor; which causes the most perspiring; and under what conditions do the braces irritate most.

Of the 9 patients who have previously worn leather braces, 7 were very pleased with the plastisol, one was indifferent, and one definitely preferred

leather. However, the patient who preferred leather showed a positive reaction to the plastisol in the patch test. On the other hand, one patient who had been reacting to his leather covered braces found no skin irritations from the plastisol. This patient also reacted to the leather in the patch test. All the patients indicated that the plastisol maintained its original appearance longer, was easier to keep clean, and had less tendency to pick up odor. The majority of the patients indicated that the plastisol had a better original appearance, was less sticky when perspiring, and was as light or lighter than the leather. Most of the patients indicated that the leather was less sticky when the skin was dry. All patients indicated that any brace causes irritation under hot and sweaty conditions, but the plastisol had less sticking effect.

Because of the limited number of patients who have been interviewed concerning this new material, the results of this survey are inconclusive and serve only as a guide for planning future clinical evaluations which will be contained in the final report on this subject.

V. SUMMARY AND CONCLUSIONS

Basic and clinical studies of plastisol, carried out at The University of Michigan Medical Center during the past five years, indicate that this polyvinlchloride-based material is a satisfactory replacement for leather as a covering for braces and splints, Figure 17. Clinical applications have shown that patients enthusiastically approve this change in most instances.

Plastisol-covered braces have the advantage of being nonabsorbent and nonreactive to body oils, waste, or detergent, Figure 18, 19. Although occasional erythema may develop from plastisol, as with leather, it will usually disappear shortly after the material is removed. Material tests show that the



Figure 17—Felt covered and Plastisol covered Hand Splints.



Figure 18-Plastisol in Dishwater.



Figure 19-Plastisol Against Diaper.

thickness and density of the coating are easily controllable. In addition, plastisol requires no stitching. Clinical experience has shown the material to be cosmetically appealing to patients because of the pleasing color and neatness of the completely encapsulated brace sections.

A simplified process for applying the plastisol coating to metal braces has been developed and standardized. Equipment requirements have been reduced to a few catalogue items easily chosen on the basis of size of the coated device; thus excellent results can be obtained even with a limited budget. Plastisol, then, offers lower initial cost, maintains its original appearance, and functions much longer than leather.

A disadvantage associated with a plastisol coated brace is that it does not "breathe," so that the skin it covers tends to become moist. On the other hand, this means that the plastisol coating will not absorb odor-causing perspiration, which is a significant problem with leather. Another disadvantage of plastisol is that a brace requiring a thick covering will be slightly heavier than the same brace covered with leather.

This study has shown that optimum results can be obtained on a wide variety of braces through the controllability of the various steps in the coating process. This ease of control makes it possible to vary the coating thickness, softness, and density, even in the coating of a single part.

On the basis of the lower cost of plastisol coating, the ease with which it is applied to assistive devices, and its ready acceptance by patients, this process is recommended for general use in rehabilitation centers elsewhere.



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PLASTISOL STRENGTH VS CURING TIME AT DIFFERENT OVEN TEMPERATURES



Note: Thicker coatings or metal parts require additional curing time. For example:

Aluminum	Coating Thickness			
Thickness	.040-075"	.075100"	.100125"	
.080"	8-12 min	10-15 min		
.125"	9-15 min	12-17 min	14-20 min	
.250"	10-16 min	13-18 min	15-20 min	
	Cure time required in a 195°C oven.			

CHART 2a

DOUBLE DIP COATING THICKNESSES & CURE TIMES (Foam Plastisol under Regular Plastisol Skin)

Coating thickness vs preheat time in a 195°C oven

Aluminum	Preheat Time in 195°C Oven				
Thickness	5 min	IO min	15 min	20 min	
.080"	.120"	.160"	.190"	.195"	
.125"	. <mark>125</mark> "	.170"	.210"	.230"	
.250"	.110"	.180"	.230"	.280"	
	Final coating thickness using a 195°C. Preheat oven.				

Higher preheat oven temperature gives a thicker foam underlayer.

Recommended curing time in a 185°-190°C oven

Aluminum	Final Coating Thickness				
Thickness	up to.100"	.100150	.150 & up		
.080"	5-7 min	6-9 min	8-II min		
.125"	5-8 min	7-9 min	8-11 min		
.250"	6-8 min	7-10 min	8-12 min		
	Cure time required in a 185- 190°C oven				

Note: Excessive cure time and/or temperature will cause sagging of the coating.

CHART 2b