

# Porous Laminated Protective Head Shield

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## Introduction

A 4-year-old female patient suffering from akinetic epilepsy and subject to falls which resulted in bruises and cuts of the head was referred to the laboratory by the Pediatric Clinic, Walter Reed Army Hospital, for a protective head shield.

The patient had previously been fitted with a football helmet which she found excessively heavy and warm. The problem was to design a head shield which would offer head protection, be light in weight and cool. It appeared that a shield constructed from a porous laminate, lined with foam rubber in strategic areas, would have the desired characteristics.

It is the purpose of this report to describe the design and fabrication of such a shield.

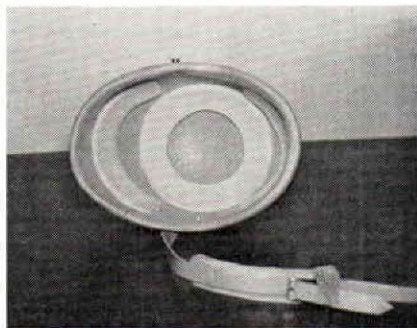
## Design and Fabrication

It was not possible to obtain a plaster-of-Paris wrap of the patient's head. A mannikin head, 2 inches larger in circumference than the patient's head, was used instead as a model for preparing a nylon-reinforced wax check socket. The check socket was heated in warm water to make it pliable and then fitted over the patient's head and reshaped by hand to achieve the desired fit. The check socket was then trimmed to the contours of the patient's head around the forehead, ears, and the hairline.

A positive mold was prepared by pouring a mixture of plaster-of-Paris and water into the nylon wax check mold. After the plaster had set, the check mold was removed and the positive mold smoothed with wire gauze. Two layers of orthopedic stockinet were pulled down over the mold and tied off to increase the size of the head shield for a comfortable fit. Then, one layer of  $\frac{3}{8}$  inch foam was form-fitted over the stockinet without stretching, as this thickness was used for padding in the final head shield. A polyvinyl alcohol (PVA) sheet was pulled down over the entire mold for separating the plastic resin from the foam rubber.

Five layers of nylon stockinet were pulled down over this layup and tied off. One layer of nylon Ban-Lon 100/2 200 needle stockinet<sup>1</sup> was applied on the outer surface for a smooth appearance.

<sup>1</sup> Wm. H. Horn Co., Philadelphia, Pa.



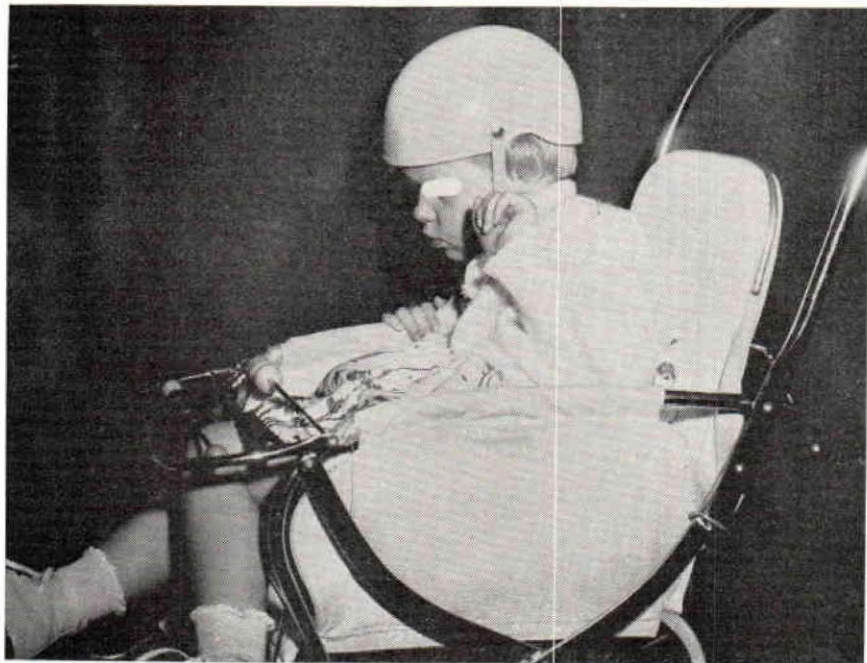
The resin used was 125 gms. of Laminac 4110<sup>1</sup> and 2.25 gms. of Luperco ATC<sup>2</sup>. It was mixed thoroughly and color paste was added to give a pleasing flesh tone. Trichloroethylene<sup>3</sup>, 54 gms., and Naugatuck's Promoter #3<sup>4</sup>, (6 drops per 100 gms. of resin) were then added. The entire surface of the layup was brush-coated with this mixture and excess resin removed from the laminate by stringing down. This laminate was allowed to air-cure for approximately 30-45 minutes. A moist PVA sheet was stretched over the layup, the resin allowed to harden at room temperature, and then placed in a 100°C. oven for an additional 45-60 minutes. The cured laminate was cut off the mold, trimmed, and the foam rubber removed. The first two layers of stockinet were left in place.

A strip of foam rubber, 1 $\frac{1}{4}$  inches wide and  $\frac{3}{8}$  inch thick, was fastened to the inner surface of the front part of the helmet to form a sweat band, and this was covered with horsehide to prevent chipping and peeling of the foam. Other foam strips were placed 1 inch apart around the inner circumference of the shield. A chin strap was riveted into place just in front of the ears, and a foam piece covered with horsehide for use as a chin rest, with buckle for adjustment, was incorporated in the chin strap.

Photographs of the fabricated head shield and of the patient wearing it are shown in Figures 1 and 2.

#### Comment

The patient has been wearing the helmet for approximately five months without incident. Comments by the patient and her mother are very favorable.



<sup>1</sup> Laminac 4110, Rohm & Haas Co., Philadelphia 5, Pa.

<sup>2</sup> Luperco ATC, Lucido Division, Wallace & Tiernan, Inc., Buffalo, N. Y.

<sup>3</sup> Trichloroethylene, Fisher Scientific Co., Silver Spring, Md.

<sup>4</sup> Promoter #3, Naugatuck Chem. Div., U.S. Rubber Co., Naugatuck, Conn.