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ABSTRACT

A method of constructing laminated Mylar containers for cryogenic-liquid targets is described.

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INTRODUCTION

The increasing popularity of liquid-hydrogen targets in physics research has emphasized the need for containers with maximum beam transparency (i.e., thin walls and low Z) and suitable strength at cryogenic temperatures. Fabrication of a Mylar container satisfying these requirements is described here. Figure 1 shows the steps in assembly of a target.

FORMING DOMES

Domes are formed by using Mylar[1] under a combination of heat and pressure in a mold. Figure 2 shows the mold in which the domes are formed. The thinner the Mylar, the less is the heat used, and the shallower the mold, the less pressure. For example, if one uses a 7.5-mil sheet of Mylar, the temperature should be about 350°F before the pressure is applied; for two sheets, the temperature should be about 375°F. The pressure used may vary from 60 to 150 psi depending on the depth and diameter of the mold and the thickness of the Mylar. It is important that the pressure be increased very slowly up to about 35 psi for the single sheet, otherwise the sheet may burst. If the side radius of the mold is sharp, temperatures to 415°F and pressures to 150 psi should be used for complete formation.

LAMINATING DOMES

Laminated domes are used for extra strength. In laminating, two sheets of Mylar are used and smoothly sandblasted where the lamination is to occur. The sheets are then formed in the mold. In removal from the mold, the sheets are carefully separated, and a 50/50 mixture of Epon 815[2] and Versamid 140[3] is applied in the center of the bottom half. The two halfs are put together and placed in the mold again. The epoxy is then squeezed out to the edges with a soft cloth. The dome is cured for two hours at a temperature no higher than 140°F. (Domes lose their shape if a higher temperature is used).

FORMING BODIES

In forming bodies, Mylar is wrapped on a mandrel with an overlap of about 1/4 in. per inch of diameter. The mandrel consists of metal tubing with two or more layers of Mylar wrapped on it to build up the surface diameter and for easy removal of the Mylar body. All surfaces bonded with Epoxy resin must be lightly sandblasted. If one layer of Mylar is used, the overlap may be held with transparent tape and the Epoxy squeezed out evenly with the fingers. If two or more layers of Mylar are used, No. 12 waxed string is wrapped tightly around the Mylar on a lathe to squeeze out the Epoxy evenly. Mold-release compound[4] may be brushed on the outer surfaces of the Mylar shim near the bonded joint to prevent any fracturing of the Mylar when removed from the mandrel. It is best to cure the body by letting it set overnight on the mandrel at room temperature; this facilitates removal of any excess Epon by the use of alcohol. The body is then removed from the mandrel and cured for 2 hr at 140°F.

CALCULATING THE BODY DIAMETER

The body diameter depends upon the diameter of the dome. If the inner diameter of the dome mold is 6.115 in., shrinkage of the dome will be 10 mils. If one 10-mil sheet is used for the dome, the inside diameter of the dome or outside diameter of the body will be 6.085. The diameter of the mandrel is determined by subtracting the thickness of the body plus the overlap at the joint. Therefore, if one 10 mil layer is used for the body, 30 mils are subtracted from 6.085, leaving 6.055 for the outside diameter of the mandrel. A 6 in. o.d tube can then be built up with two layers of 10-mil and one of 7.5-mil Mylar for the completed mandrel. If the body diameter turns out to be too large for the dome, the body can be shrunk by heating to 167°F for 1 hr (about 10 mils shrinkage on a 6-in diameter).

ASSEMBLY OF THE DOME AND BODY

The excess Mylar on the dome aids in its application to the body. It may be cut off with scissors after curing. For the joints between the dome and body, an area must be sandblasted about 3/8-in. wide for a 6-in.-diam. target. A 50/50 mixture of Epon 828 and Versamid 125 is used for this bonding. If a metal ring (stainless steel) is used to hold the two entry tubes, it is important that the Mylar body be inserted on the inside of the ring. This protects the joint when the target is under pressure. The assembly should be cured for 2 hours or more at less than 140°F.

ACKNOWLEDGMENT

The author wishes to acknowledge the contribution of Mr. Edwin F. McLaughlin to this project.

FOOTNOTES

*This work was done under the auspices of the U.S. Atomic Energy Commission.

[1]Mylar is a product of E. I. Du Pont de Nemours Co., Wilmington, Delware.

[2]Epon is an epoxy resin produced by the Shell Chemical Co., Emeryville, California

[3]Versamid is a plasticizer produced by General Mills, Inc., Kankakee, Ill.

[4]Ram Mold Release No. 225 is produced by Ram Chemicals, Gardena, California.

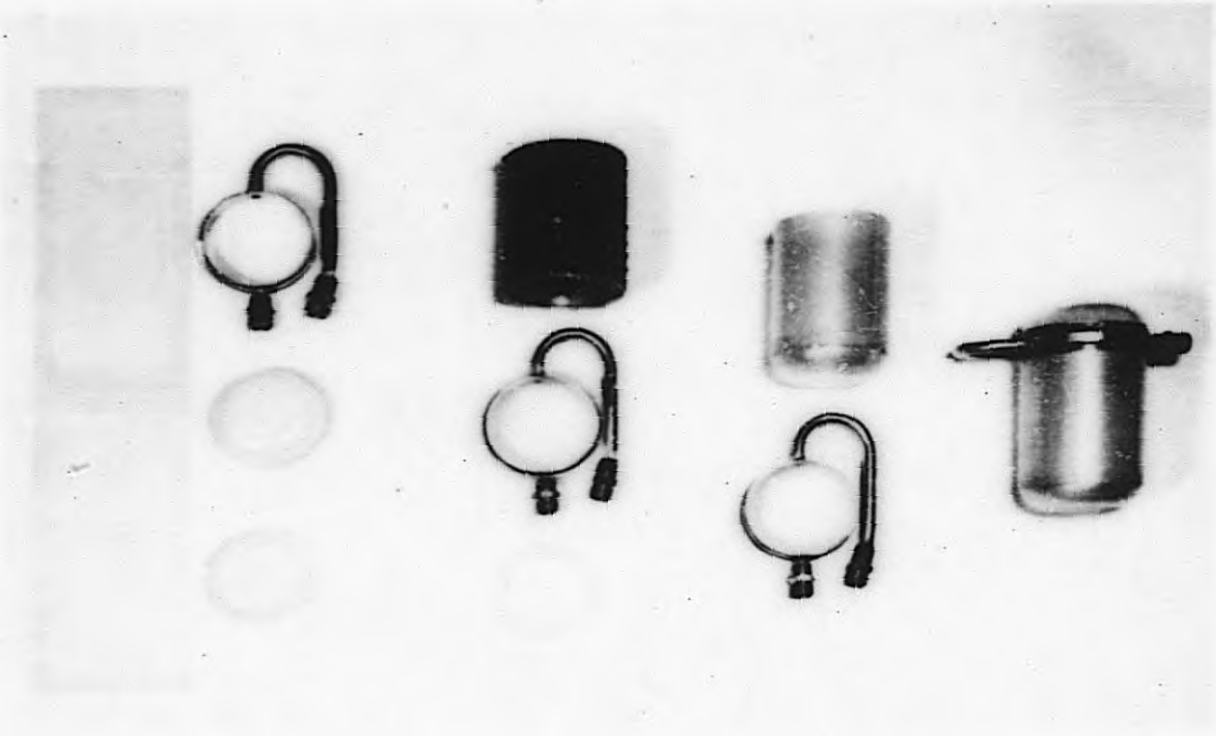

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Fig. 1. Steps in constructing a Mylar target. (a) Sheets of Mylar for fabricating; (b) formed domes, and stainless steel ring with entry tubes; (c) dome applied to a ring, and mandrel with formed body of target; (d) dome applied to body; and (e) assembled target.

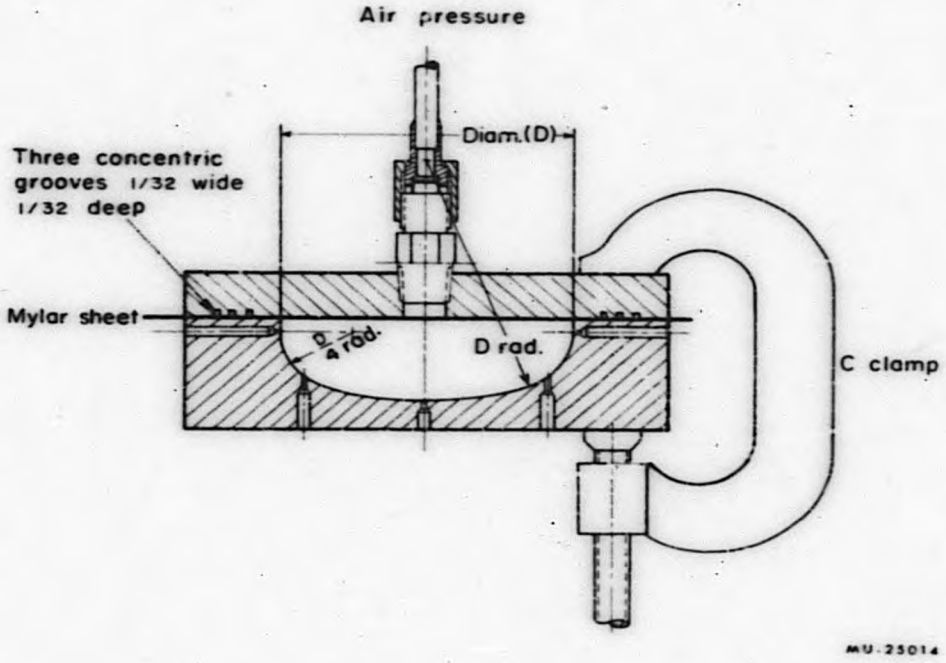

Fig. 2. Cross section of a mold for forming Mylar domes.

END