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PREPARATION OF T-156 TRACK AND T-142 PADS WITH RESTRAINING BAND

CONTRACT DAAE07-82-C-4097

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by _____

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) T-156 blocks and T-142 pads were produced which contained a treated nylon fabric band near the outer perimeter of each pad (block). The band is intended to act as a restraint member within the rubber. Laboratory tests indicated that pads and blocks with the restraining band deflected less under load, particularly in the sidewall area, than did pads and blocks which had no restraining band.		

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1.0 INTRODUCTION

This report, prepared by The Goodyear Tire & Rubber Co., under Contract DAAE07-82-C-4097, describes the development and manufacture of T-142 pads and T-156 shoes containing a fabric restraining band near the periphery of the road-contact pad rubber.

2.0 OBJECTIVE

The objective of this work was to produce T-142 pads and T-156 blocks containing a restraining band which would reduce stress within the rubber when the rubber is under load, thereby decreasing the amount of chunking.

3.0 CONCLUSIONS

Laboratory analysis of T-156 blocks containing a restraining band showed that the band did provide improved sidewall stiffness. Production of the T-156 blocks and T-142 pads was very labor intensive and required extreme care in handling in order to produce acceptable parts. Alternate preparation methods would be required to make the concept production feasible.

4.0 RECOMMENDATIONS

4.1 Mold Design

Different mold designs for the T-142 pad should be investigated which would reduce the tendency to distort the shape of the restraining band during molding. In particular, the position of the mold parting line could be changed, possibly to a top-edge parting line, so as to reduce flow of rubber next to the fabric.

4.2 Precut Fabric

If large quantities of reinforced T-142 pads or T-156 blocks are required, it may be economically advantageous to have fabric strips produced to the desired width rather than cutting the strips from a wide piece of rubber coated fabric.

5.0 DISCUSSION

5.1 Background

T-156 blocks and T-142 pads fail in field service due largely to excessive chunking. It is felt that the chunking is caused by high stress levels within the block/pad rubber when the rubber is under load.

By incorporating a reinforcing band near the periphery of the blocks and pads, sidewall deflection and rubber stress should be decreased. Less rubber fatigue and, consequently, less chunking would be the desired result.

5.2 Materials

5.2.1 Restraining Band

The material requirements felt necessary for this application were:

- o High strength
- o Good flex-fatigue strength
- o Excellent bond-ability to SBR compound
- o "Open" weave construction for good mechanical interlock of band to rubber.
- o Good shrinkage properties during molding

Materials considered for use as a restraining band included nylon, aramid, fiberglass and polyester. Based on the self-imposed requirements outlined above, nylon was chosen as giving the best balance of properties. Characteristics of the specific fabric used are given in Table 5-1.

5.2.2 Rubber

The rubber used in the T-142 pads was SM8493, Goodyear's QPL compound for Mil-T-11891 B. For the T-156 blocks, SM8622 was used on the roadside, SM8611 on the roadwheel side and SM7541 on the bushings.

5.3 Fabrication

All pads and blocks were compression molded. Because of the tendency for the fabric band to move with the flow of the uncured rubber, preparation of the preforms for compression molding was the most difficult aspect in the performance of the contract. Several different preform shapes, fabric widths, and fabric placements were tried for both the T-142 pad and the T-156 block before suitable preform-fabric combinations were arrived at.

5.3.1 T-142 Pad Fabrication

The rubber (SM8493) used in molding the T-142 pads was extruded in the shape of the cross section shown in Fig. 5-1. The elliptical shaped extrusion had a major axis of 9.0", a minor axis of 3.25" and a height of 2.75".

Using a 60" calender, a 28" width of fabric was coated on one side with 0.01" of SM8493 and coated with 0.08" thickness of SM8493 on the other side. The coated fabric was cut into strips 1.9" wide.

Strips of SM8493, 2.75" wide by .15" thick were also prepared on the calender for use in building the T-142 preforms.

TABLE 5-1 Specification of Fabric Used for Reinforcing Band

Weave Type	Leno
Weight (oz/sq yd.)	8.25
Count	
Warp (Ends/in)	17 ± 1
Fill (Picks/in)	9 ± 1
Gage (in.)	0.033
Tensile	
Warp (Pounds)	500
Fill (Pounds)	425
Adhesive	Proprietary

The preforms were built up in the following manner:

The coated fabric was wrapped around the top edge of the extrusion with the 0.01" side next to the rubber extrusion. The length of the fabric strip was such that there was a 1.5" overlap of the wrapped fabric. In order to provide a smooth fabric overlap, 1.5" of the 0.08" thick SM8493 was trimmed from the end of the coated fabric that was next to the extrusion. The ends of the coated fabric were wiped with solvent naptha to freshen the rubber surfaces and insure good adhesion of the rubber to itself and to the coated fabric. A strip of the 2.75" wide by 0.15" thick SM8493 was then wrapped around the tubing/coated fabric combination. The length of the strip was adjusted for each individual preform so that the total uncured preparation weight was 3.70# plus or minus .05#.

Vulcanization of the T-142 pads in a compression mold followed preform preparation. Exact positioning of the preforms in the mold was required in order to get acceptable finished pieces. Since the T-142 mold is split near the vertical center of the part (see Fig. 5-2) there was a tendency for the fabric to flow out the parting line along with the rubber. By preparation of the preforms as described above, displacement of the fabric band during vulcanization was minimized and final fabric location was as shown in Fig. 5-2.

After molding, the flash was trimmed from the molded parts and a preservative was applied to protect the metal from corrosion.

5.3.2 T-156 Block Fabrication

Three rubber extrusions were required for each T-156 block produced. One piece of SM8611 extrusion, as shown in Fig 5-3 was required for the road-wheel side of the block. Two pieces of SM8622 as shown in Figures 5-4 and 5-5 were required for the road side of the block. The cap stock of SM8622, around which the fabric was wrapped (Fig. 5-5) was 7.25" long, 3.5" wide and 1.5" thick.

The fabric used was coated on one side with 0.01" of SM8622 and on the other side with 0.08" of SM8622. The coated fabric was cut into strips 1.3" wide. Strips of SM8622, 1.5" wide and 0.15" thick were also prepared for use in building the T-156 blocks.

In an operation similar to that described for the T-142 pad preparation, the coated fabric was wrapped around the SM8622 "cap" extrusion. A 1.5" overlap of the fabric was made with the tab of 0.08" gage SM8622 trimmed off to provide a smooth overlap. The 1.5" wide by 0.15" thick strip of SM8622 was wrapped around the tubing/coated fabric combination. The length of the strip was such that the total weight of the preform was 1.75 lb.

The T-156 blocks were then cured in compression molds. The SM8622 and SM8611 base stocks were positioned next to the T-156 block metal and the fabric wrapped SM8622 was carefully positioned on the SM8622 base stock so as to minimize distortion of fabric band during mold closure and vulcanization. Since the mold parting line was not in the vicinity of the pad portion of the block, flow of the fabric with the rubber was

not as great a problem with the T-156 blocks as it was with the T-142 pads. Final fabric location was as shown in Fig 5-6.

After buffing off the excess flash, the T-156 blocks were assembled into six rolls of twenty-six shoe assemblies each.

5.4 Testing

5.4.1 Adhesion

5.4.1.1 Adhesion of the fabric to the rubber was tested by curing two each T-142 pad and T-156 block samples with a one inch wide piece of the rubber coated fabric laid across the top surface of the pad (block). Twenty-four hours after curing, the fabric strip was pulled from the pad (block) with the force required for separation measured and recorded. The minimum adhesion value for the T-142 pads was 130 pounds per inch fabric width and the minimum for the T-156 blocks was 120 pounds per inch fabric width.

5.4.1.2 Adhesion of the rubber to the pad and block metal was checked per MIL-T-11891 B. The minimum adhesion value for the T-142 pads was 195 pounds per inch of rubber width and for the T-156 blocks, the minimum adhesion value was 155 pounds per inch width for the roadside and 115 pounds per inch width for the roadwheel side.

5.4.2 Rubber Deflection

In order to determine if the fabric band was effective in decreasing sidewall deflection, T-156 blocks with and without fabric bands were loaded in compression to 20,000 pounds on a Tinius Olson machine. The load was applied to the road-side of the blocks and third flex readings of total displacement in the compression direction and sidewall deflection 0.625" below the pad surface on one of the long sides of the "pad" diamond (see Fig. 5-6) were taken at 5000 lbs, 10,000 lbs, 15,000 lbs and 20,000 lbs. The results are given in Table 5-2.

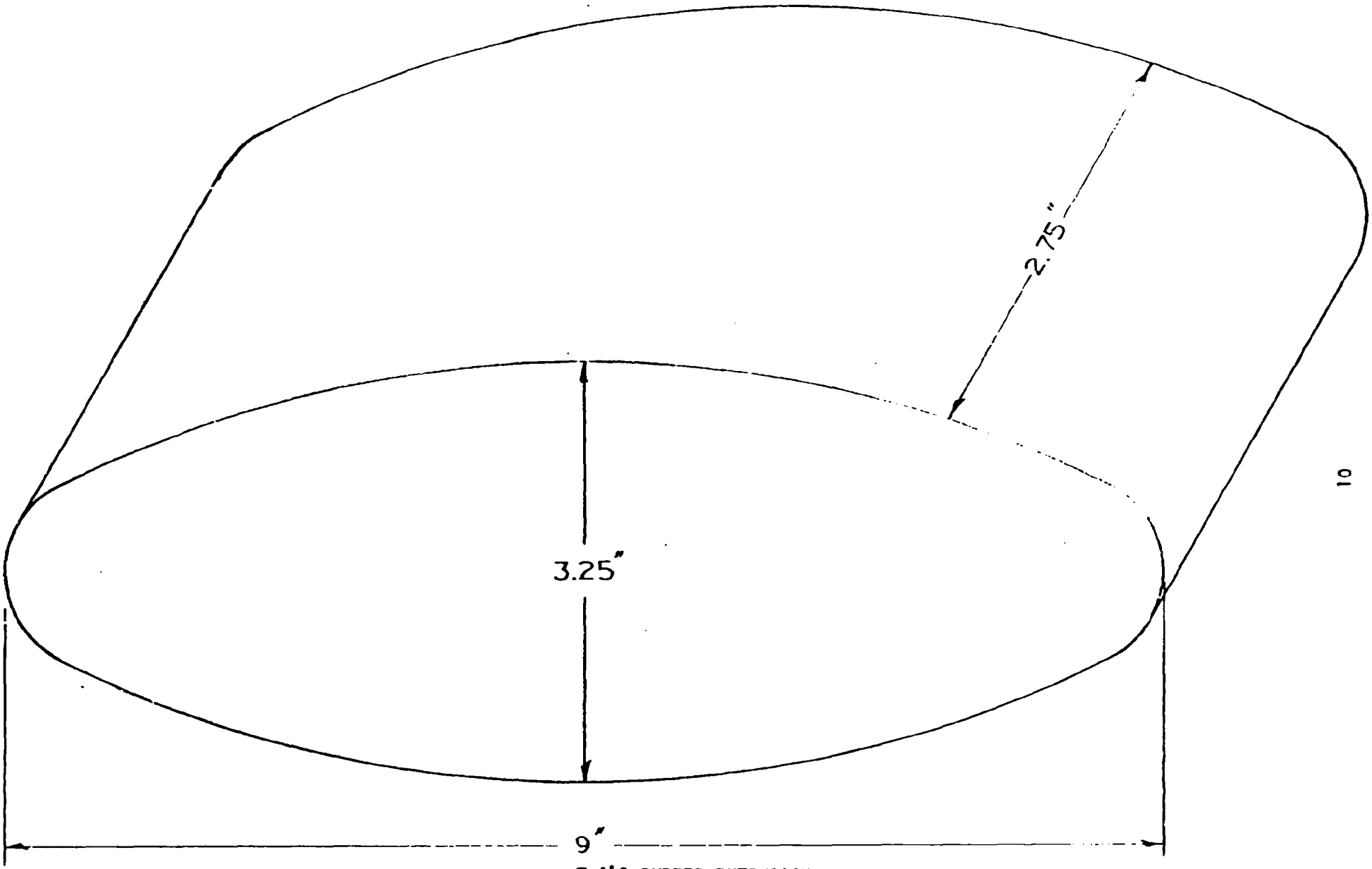
As seen in the last row of data, the T-156 blocks containing the restraining band had only 72% of the sidewall deflection and 88% of the compression deflection of the blocks with no restraining band. It appears, therefore, that the restraining band does contribute to the stiffness of the T-156 shoes, particularly in the sidewall area. It is expected that the same effects would be seen with the reinforced T-142 pads.

5.5 Shipping

Ninety-eight of the T-142 pads were shipped to Yuma Proving Grounds, Yuma, Arizona. Six rolls of twenty-six shoe assemblies each were sent to Aberdeen Proving Grounds, Aberdeen, Maryland. Two T-142 pads and two T-156 shoe assemblies were sent to U.S. Army Tank Automotive Command, Warren, Michigan.

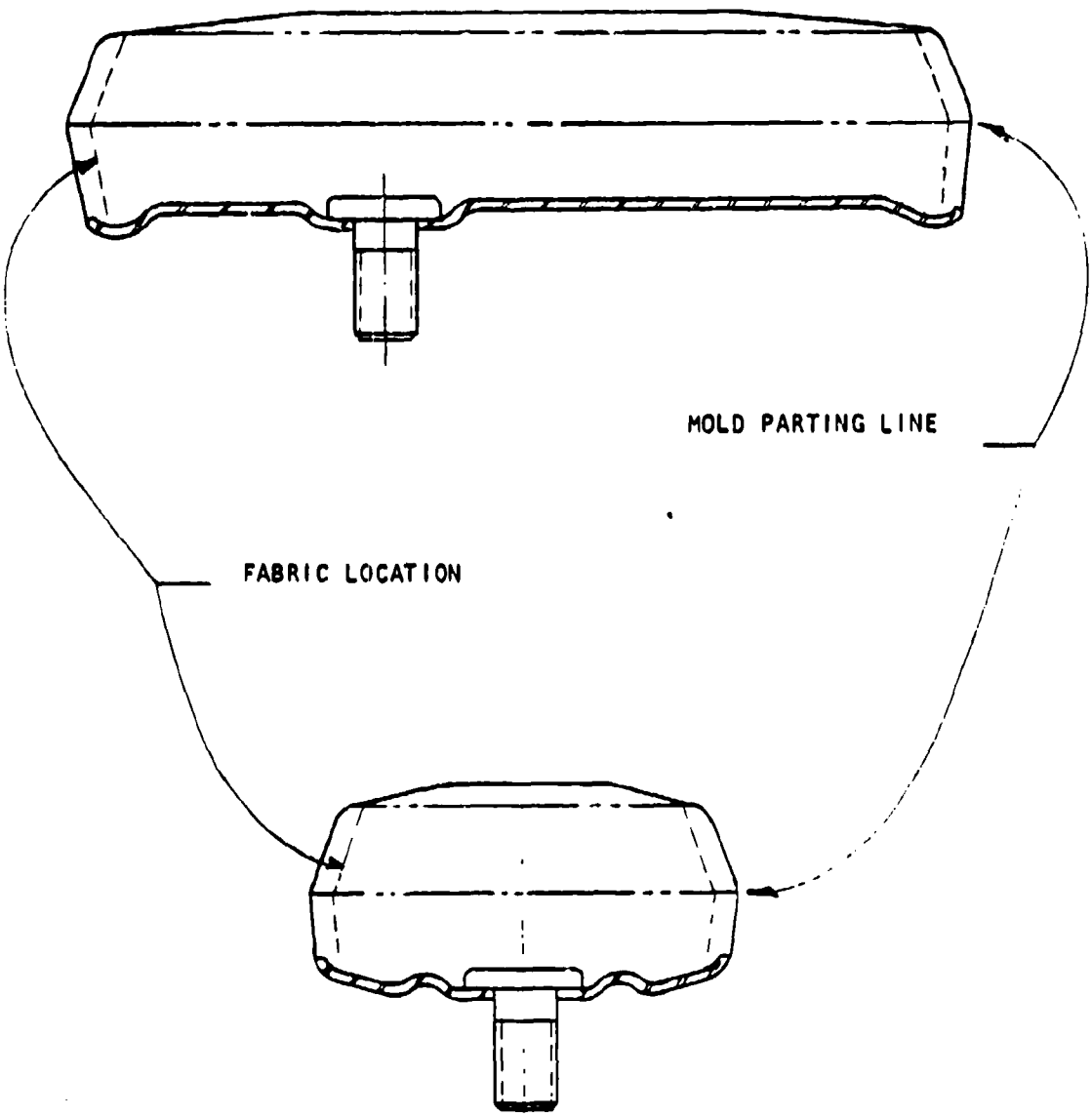
TABLE 5-2 Deflection of Fabric Band Reinforced vs Non-reinforced T-156 Shoes

	Sidewall Deflection				Compression Deflection			
	5000#	10,000	15,000	20,000	5000	10,000	15,000	20,000
Sample								
#1 W/Band	.077	.200	.314	.400	.078	.185	.283	.356
#2 W/Band	.067	.175	.273	.348	.075	.185	.278	.350
#3 W/Band	.058	.157	.255	.330	.077	.185	.282	.350
Ave W/Band	.067	.177	.281	.359	.077	.185	.281	.351
#4 W/O Band	.090	.246	.386	.482	.090	.220	.327	.400
#5 W/O Band	.090	.250	.400	.504	.085	.207	.313	.385
#6 W/O Band	.099	.258	.407	.506	.087	.210	.320	.395
Ave W/O Band	.093	.251	.398	.497	.087	.212	.320	.393
Ave Defl. with Band ÷ Ave Defl without Band	72%	70%	71%	72%	88%	87%	88%	89%



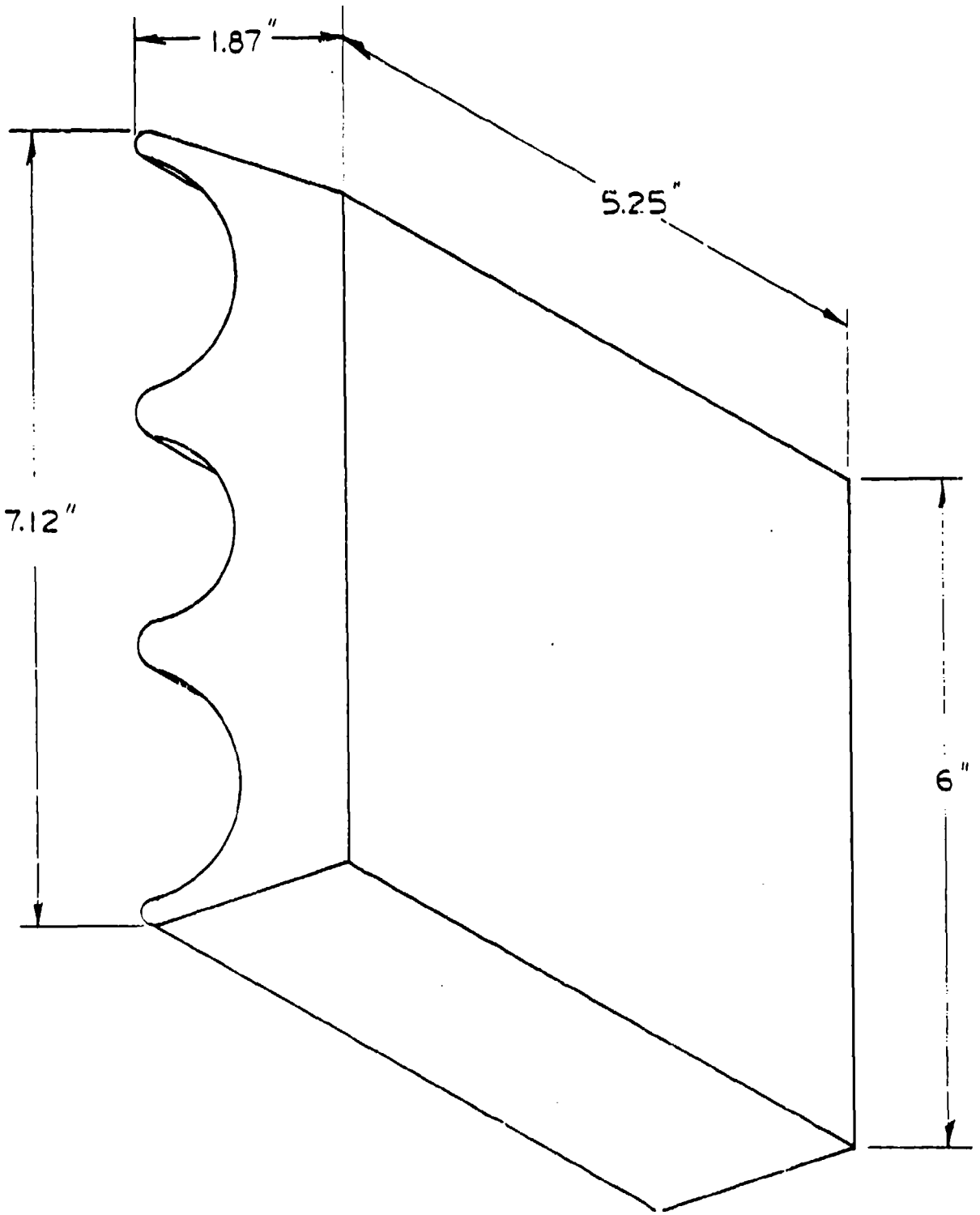
T-142 RUBBER EXTRUSION

Fig. 5-1



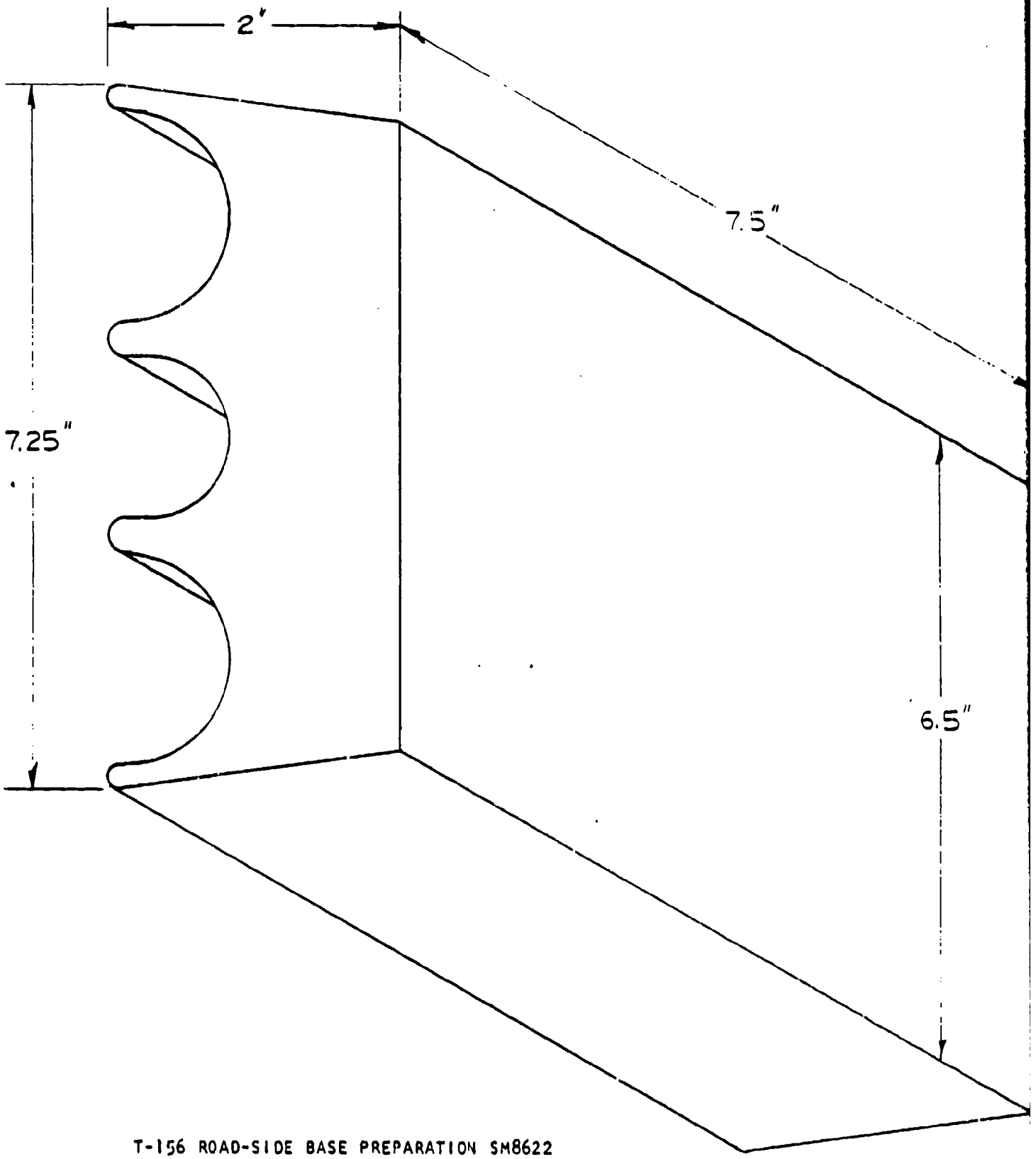
T-142 PAD WITH FABRIC REINFORCEMENT

Fig. 5-2



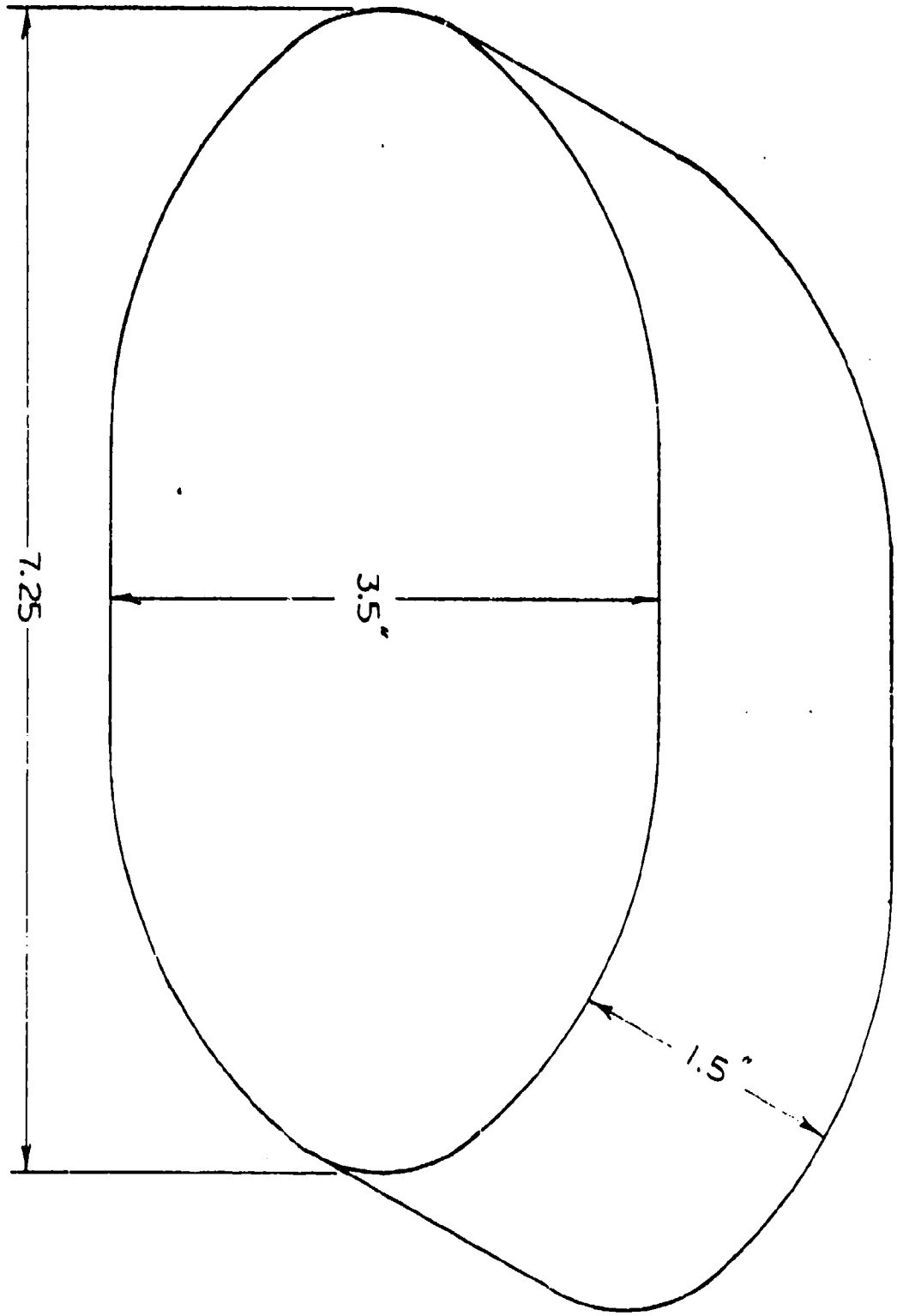
T-156 ROADWHEEL SIDE PREPARATION SM8611

Fig. 5-3



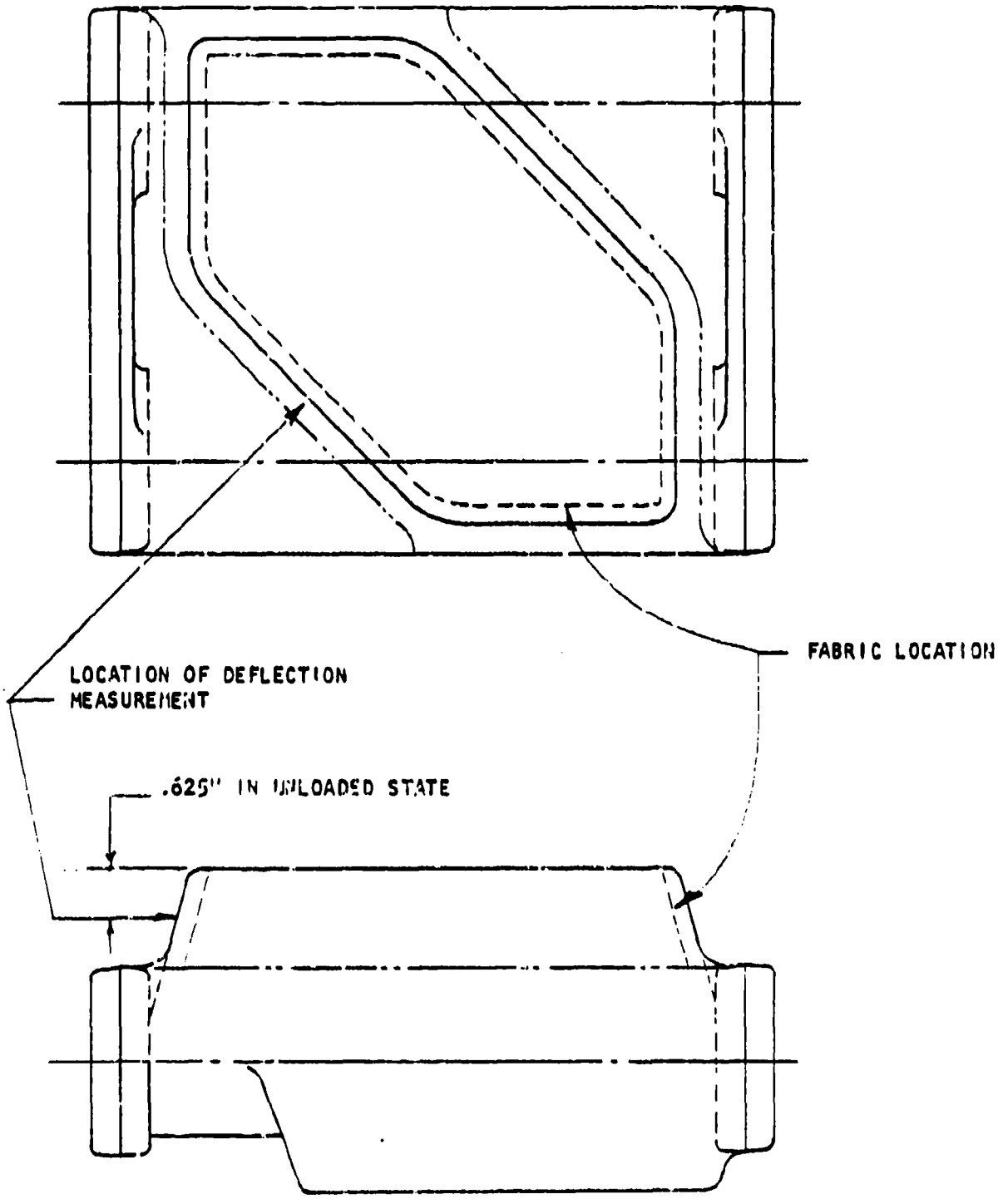
T-156 ROAD-SIDE BASE PREPARATION SM8622

Fig. 5-4



T-15G RUBBER EXTRUSION CAP STOCK

Fig. 5-5



T-156 BLOCK WITH FABRIC REINFORCEMENT

Fig. 5-6

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