Delta Airlines MD-88 Engine-Inlet Nose-Cowl Tool

Delta Airlines had the choice of buying replacement nose-cowls for the engine inlets for their fleet of MD-88 aircraft or making them in their repair facility in Atlanta, GA. They estimated they could save thousands of dollars and months of lead time if they made the required tooling and cowlings in-house. It was decided that Delta's Bond Shop would do the work since they had some experience using epoxies.

In order to fabricate the nose-cowls, Delta had to make a string of intermediate transfer tools to end up with a high-temperature epoxy autoclave-quality laminating mold. This paper describes the procedure for making these intermediate tools.

Two intermediate tools had to be made before making the high-temperature epoxy mold. A female-transfer tool off the engine inlet and a male-transfer tool out of the female tool were made. The male tool was to replicate the shape of the actual engine inlet. A laminated high-temperature epoxy tool could have been made directly off of the engine inlet, but extra working surfaces and flange areas were desired, and these surfaces could be made on the transfer tools.

It was decided to make the two intermediate transfer tools using a fast, low cost, light weight construction method employing epoxy tooling dough. The transfers could have been made out of solid laminates if the tools were to be kept for a long time, but since the tools were only to be used once, it made more sense to use the tooling-dough method.

Fig. 1. Engine Inlet with Epoxy Surface Coat Applied

Figure 1 shows the MD-88 engine inlet as it was prepared for pulling the female-transfer tool. The top hemisphere has already been coated with mold release and PTM&W PT1554 A/B aluminum-filled surface coat has been applied.

Once the surface coat reached the "tacky" stage (when you can leave a finger print on the surface without it sticking to your finger), two plies of style 7500 (10 ounces/sq. yard) fiberglass were laminated behind the PR1525 surface coat using PTM&W PT2125 A/B epoxy laminating system.

Fig. 2. Preparing RT_2C Tooling Dough for Mixing

At that point it was ready to apply the tooling dough. Figure 2 shows the PTM&W RT_2C epoxy tooling dough system being proportioned at a 1:1 ratio for mixing. The material can be mixed either by hand or in a dough mixer, depending on how much material will be mixed. Once mixed, the dough was rolled flat to a thickness of 1-inch and applied to the back of the laminate, Figure 3.

Fig. 3. RT_2C Tooling Dough Applied to Epoxy Laminate

Fig. 4. Epoxy Laminate Applied to Back of RT_2C

Figure 4 shows the workmen applying two more plies of 7500 cloth and laminating resin to the back of the RT_2C tooling dough. Figure 5 shows them finishing the last ply to complete the tool. This construction method of fiberglass, tooling dough, fiberglass makes a strong, light-weight sandwich structure

Fig. 5. Smoothing The Finished Laminate

Fig. 6. Finished Female-Transfer Mold

After an overnight cure at room temperature, the female-transfer tool was demolded, Figure 6. The entire process was repeated to make the male-transfer tool by laying-up into the female tool. The finished male tool is shown in Figure 7.

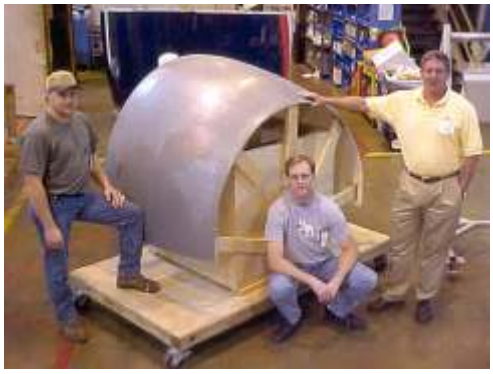

Fig. 7. Finished Male-Transfer Mold

It took four men 4-hours to make each transfer tool. The female tool was later used as a holding fixture for the newly fabricated engine inlet cowling. The male tool was used to fabricate a low-temperature-curing epoxy prepreg tool in an autoclave at 25 psi and 150° F. A wet lay-up high-temperature epoxy tool could have been made instead of the prepreg at a much lower cost off of the same male-transfer tool.

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