

To: Don Morgan
Reno FSDO

From: Teresa Marian

SUBJECT: Probable failure of Canopy Bow (P/N 512004-02) and Windscreen Bow (P/N 512004-01)
Thunder Mustang

Don,

My assessment for both the canopy and windscreen bows: the lack of sufficient consolidation during the manufacturing process resulted in poor quality solid laminates.

One can only surmise that the plies were layed up in a female mold (OML) packing in as many layers as would accommodate the space and either closed off with a vacuum bag or a drop-in male backup tool that provided the overall contour of the IML. Observed were the delaminated plies and sporadic large void spaces internal at the ply interface (glossy empty pockets) were evident in each part. Also there is the appearance of uneven wetting of the plies; some areas exhibit resin richness (white flocking at failed layers). With the layup being resin rich, the lack of consolidation from the tooling and maybe a slight exothermic reaction due to the thickness of the buildup could have resulted in a less than ideal structural element. Reviewing the assembly instructions, photos of both bows showed the same visual external appearance – poor quality laminate. A comparison was made using the failed pieces, the supplied photos along with the assembly manual:

- A. Don't believe there was any analysis done on either structure in the event of the aircraft flipping over and landing on the canopy and bow structures. The assembly manual discusses the cosmetic aspects of the bow to preserve the graphite weave and surface but no mention of "Structure". Looking at similar airframes at PRS (6-6-18), the canopy/windscreen bow are all similar.
- B. The selection of the materials – a hybrid structure similar to the seat construction (having energy absorbing capabilities) with some graphite for stiffness would have been a better option. It appears that the bows were there to attach the windscreen and the canopy to the fiberglass skirt that attached to the fuselage. Graphite was the "theme" of the Thunder Mustang.
- C. The method of attachment of the windscreen and canopy to the bow with the use of screws may have resulted in point load failure at impact. There was a combination of shearing adjacent to the screws and peeling of layers just under the depth of the drilled holes. The assembly manual indicated the holes drilled to a depth of .5". A better option to preserve the structural effectiveness of the bows and to attach the canopy to the bow would have been bonding.
- D. The windscreen was modified at some point as it was molded as one piece or bonded together. It did not have the two metallic vertical strips to support/align the three piece windscreen. It is not known if the metallic elements had any structural implications.













