

PPG Industries, Inc.



PPG Aerospace Transparencies ***Failure Analysis Report***

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July 1, 2014

TO: Mr. Clint Crookshanks National Transportation Safety Board- NTSB

RE: Evaluation of a Right Hand, Main Windshield for Beech E-90; P/N 50-420069-32 CHG.A; S/N 95061H3863; CA125920

Introduction and Background

Correspondence indicates that the Beech E-90 aircraft was at FL190 when the windshield fractured. A precautionary landing was made at KEAU without incident. The subject windshield was received from Bemidji Aviation Services for evaluation due to a fractured glass ply. The windshield was received at PPG on January 27th, 2014. PPG Aerospace completed manufacture of the windshield in March 1995.

Summary of Key Findings

- The peel adhesion chip originated 1.5" (38 mm) from the forward glass edge and 1.8" (45 mm) from the bottom edge of the windshield (see Figure B for view with measurements).
- The inner glass ply failed with the fracture origin located 2.1" (53 mm) from the forward edge of the unit and 4.5" (114 mm) from the bottom edge (see Figure A and Figure B for view with measurements).
- The moisture seal appears to have been eroded and repaired around the entire periphery of the windshield

Conclusion

The inboard glass ply fractured due to a peel chip that formed on the inner surface of the glass. The peel chip developed outside of the heated area and localized adhesion of the vinyl interlayer initiated a chip in the glass surface as a result of the differences in coefficient of expansion between the inboard glass ply and vinyl interlayer. The peel adhesion chip propagated, becoming wider and deeper due to mechanical and thermal stress encountered in service, until the center tension of the thermally tempered glass was penetrated causing spontaneous fracture. The windshield design was improved in 2001.

Reported by:



Mr. Adam Kennamer Product Support Engineer

PPG Industries, Inc.



Adam Kennamer Product Support Engineer



Detailed Failure Analysis

Figure A: The outboard overall view of the windshield as received.

- 1. Failure origin of the inner glass ply.
- 2. Close up of the trademark label showing the PN and SN.





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Detailed Failure Analysis (continued)

Figure B: Magnified inboard view of the glass fracture and peel chip origin. The fracture origin was identified using Wallner lines on the fracture face of the glass. The black arrows indicate the propagation direction of the fracture. The peel chip cannot be recognized in this view however the location is shown for point of reference.







Detailed Failure Analysis (continued)

Figure C: Outboard view of the bottom edge of the windshield. The appropriate lighting was necessary to achieve the photo of the peel chip. As noted in the description, the peel chip originated outside of the heating area.





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Detailed Failure Analysis (continued)

Figure D: Magnified 20X view of the peel chip origin. This view shows the peel chip origination point and progressively getting wider and deeper due to mechanical and thermal stress encountered in service, until the center tension was penetrated that causing spontaneous fracture.





Detailed Failure Analysis (continued)

Figure E: Cross-sectional view of the windshield with related key components identified. The subject windshield is an all glass design. The cross section of the windshield from the inboard (inner) surface consists of Herculite glass/ vinyl/ Herculite glass.



Inboard (inner) Surface

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