FAA-FPI

History and Introduction

Presented to: DOD Working Group

By: Alfred L. Broz

Date: November 1, 2006

Alfred L. Broz, Ph.D.
Chief Scientist
Technical Advisor
NonDestructive Evaluation (NDE)

Tel: (781) 238-7105
Fax: (781) 238-7898

FAA ANE 105N
12 New England Executive Park
Burlington, MA 01803-5213

Federal Aviation Administration

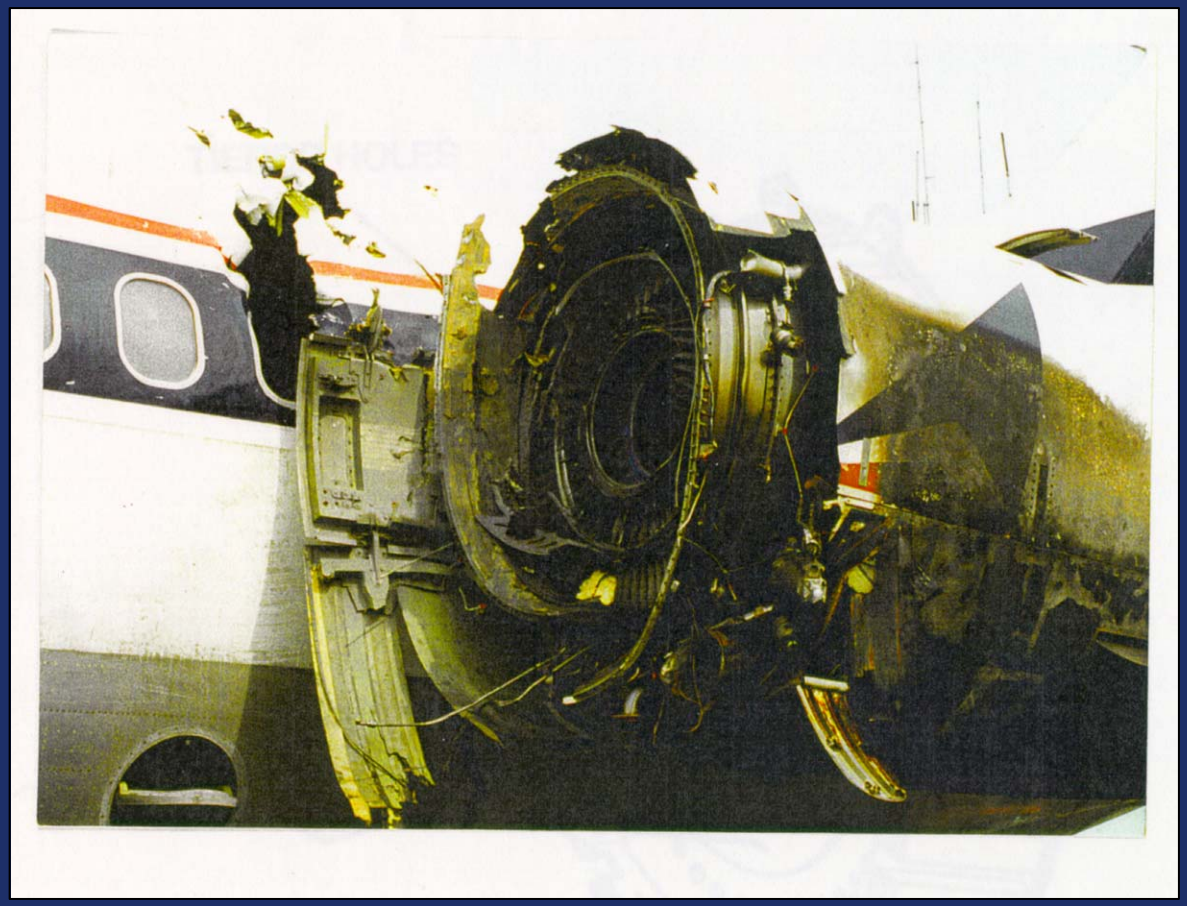
Internet: Alfred.L.Broz@faa.gov

FPI History

- **This presentation is based on the documented missed opportunities for FPI to find critical cracks in components**

United Airlines
Flight 232
Sioux City, Iowa

Delta Air Lines
Flight 1288
Pensacola, Florida



Fluorescent Penetrant Inspection Process Technical Review Team

Team Formed: September 12, 1996

Team Charter: Review and evaluate 6 facilities that perform FPI of high energy rotating engine components.

Determine whether systemic problem exists in available guidance or its implementation.

Recommend corrective action.

Conclusion

General:

The observations documented in this report indicate poor quality assurance practices at most of the reviewed FPI facilities

Recommendations

- **Conduct Research and Development Programs**
  - **Perform studies to evaluate the critical parameters in the FPI process**

Why is FPI important to aviation?

- A typical U.S. commercial air carrier will have over 30,000 parts in its inventory that will require FPI at some time in its life

- Over 90% of metal components will be inspected using FPI at least once during its lifetime

What are the safety implications?

- **Failures of the FPI process have contributed to catastrophic events**
  - Sioux City
  - Pensacola
- **NTSB recommendations have included reference to improved FPI**
  - A98 11 through 15 – Recommendations related to improvements to FPI and identification of research needs
- **Simplification of the specification process will lead to improved reliability and safety**

CASR Background

- **Extensive network in place with civil aviation**
  - Major U.S. air carriers including interactions with Air Transport Association NDT Working Group
  - NDE organizations at aircraft and engine OEMs
  - Industry committees such as the SAE NDE Committee K, ASNT Aerospace Committee, and the joint Commercial Aircraft Composites Repair Committee (CACRC)

Engineering Assessment of FPI

- The Center for Aviation Systems Reliability (CASR) was established in 1990 to provide results that address the inspection needs of commercial aviation and lead to safety improvements through their implementation
- In September 2001, CASR partnered with industry to begin a new research program entitled Engineering Assessment of Fluorescent Penetrant Inspection
- This website was established to document the results of this and other Federal Aviation Administration (FAA)-funded programs working to improve the reliability of the Fluorescent Penetrant Inspection (FPI) process

http.www.cnde.iastate.edu

Choose the FPI Research Option.

Program Structure

Engineering Studies

- Twelve studies identified
- Results to be published as FAA documents and on CASR website

Baseline Programs

- Industrial Advisory Board functions including limited data analysis and interpretation
- Generation of guidance materials
- Fabrication of samples
- General ISU laboratory and measurement support

Engineering Tools

- Performance checks and standards
- Fluorometry devices
- Performance verification kit
- Guidance materials
- Technology transfer workshops

Partners

- Iowa State University
- Boeing – Long Beach
- Boeing – Seattle
- Delta Air Lines
- United Airlines
- Pratt & Whitney
- Rolls Royce
- General Electric
- Sherwin Inc.
- D&W Enterprises
- FAA

Approach

- **Define factors for which engineering data is deficient**
  - Change in process, e.g., environmental changes
  - Change in applications
  - Data not available in the public domain
- **Design engineering study that provides quantitative assessment of performance**
  - Brightness measurements
  - Digital recording of UVA indication
  - Probability of Detection
  - Complete study using either lb or shop facilities as appropriate
- **Distribute results through use of the World Wide Web**
- **Support changes to industry specifications as warranted**
- **Utilize results to update/create guidance materials**
- **Transition process to airlines for internal self-assessment**

Technical Results

Spot Meter Spot Size versus Brightness, October 2002

ATA FPI Workshop Presentations

Engineering Studies Plan

Year One Status

Drying Study Final Report – May 2003

ATA NDT Forum – Status Presentation – September 2003

Publications

FAA Reports Link

Study of the Factors Affecting the Sensitivity of Liquid Penetrant Inspections: Review of Literature Published from 1970 to 1998

ES – 9 Drying Study 5-5-2003

Engineering Studies of Cleaning and Drying processes in Preparation for Fluorescent Penetrant Inspection

Commercial:

- **Take advantage of the opportunity to tour the FAA's Airworthiness Assurance Non destructive Testing Validation Center (AANC).**

- **Samples from a 747 and smaller**