

Productivity Enhancement in Remote Visual Inspection (RVI)

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imagination at work

Productivity Enhancement in Remote Visual Inspection (RVI)

Abstract

An historical review of Remote Visual Inspection (RVI) technology illustrates how this modality has evolved over the past several decades with inspection productivity enhancement as its primary driver.

Current state-of-the-art inspection methods and test protocols will be used to demonstrate how ergonomics, industrial design, digital connectivity, technical advances and industry-specific mandates have pushed the development, application and acceptance of RVI as a credible and viable inspection technique.

This presentation will give real-world examples of efficiency gains through the application of RVI to plant maintenance and component inspections at nuclear power plants, oil refineries, chemical process facilities and aircraft engines.

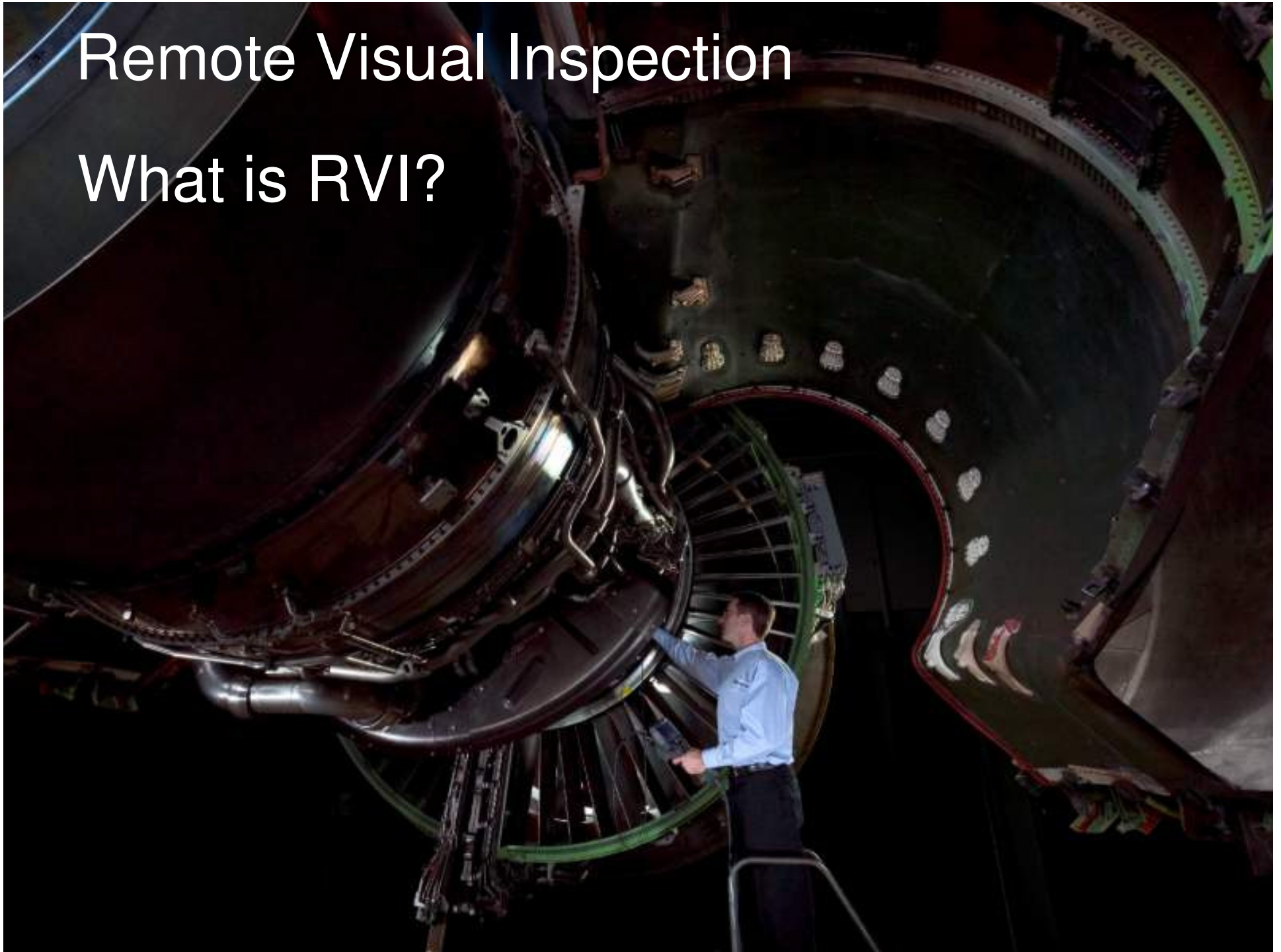
Data capture, including measurement, reporting and archiving will be addressed as the final step in the inspection process including recent and expected advances in this area.

Outline

- RVI timeline & inspection productivity
 - Image Quality
 - Portability and ease-of-use
 - Measurement
 - Reporting process
- Digital Era and Data Management
 - Capture formats
 - Storage Media
 - Connectivity & Remote Collaboration
 - Menu-directed Inspections
 - Interactive Reporting
- Conclusion

Remote Visual Inspection

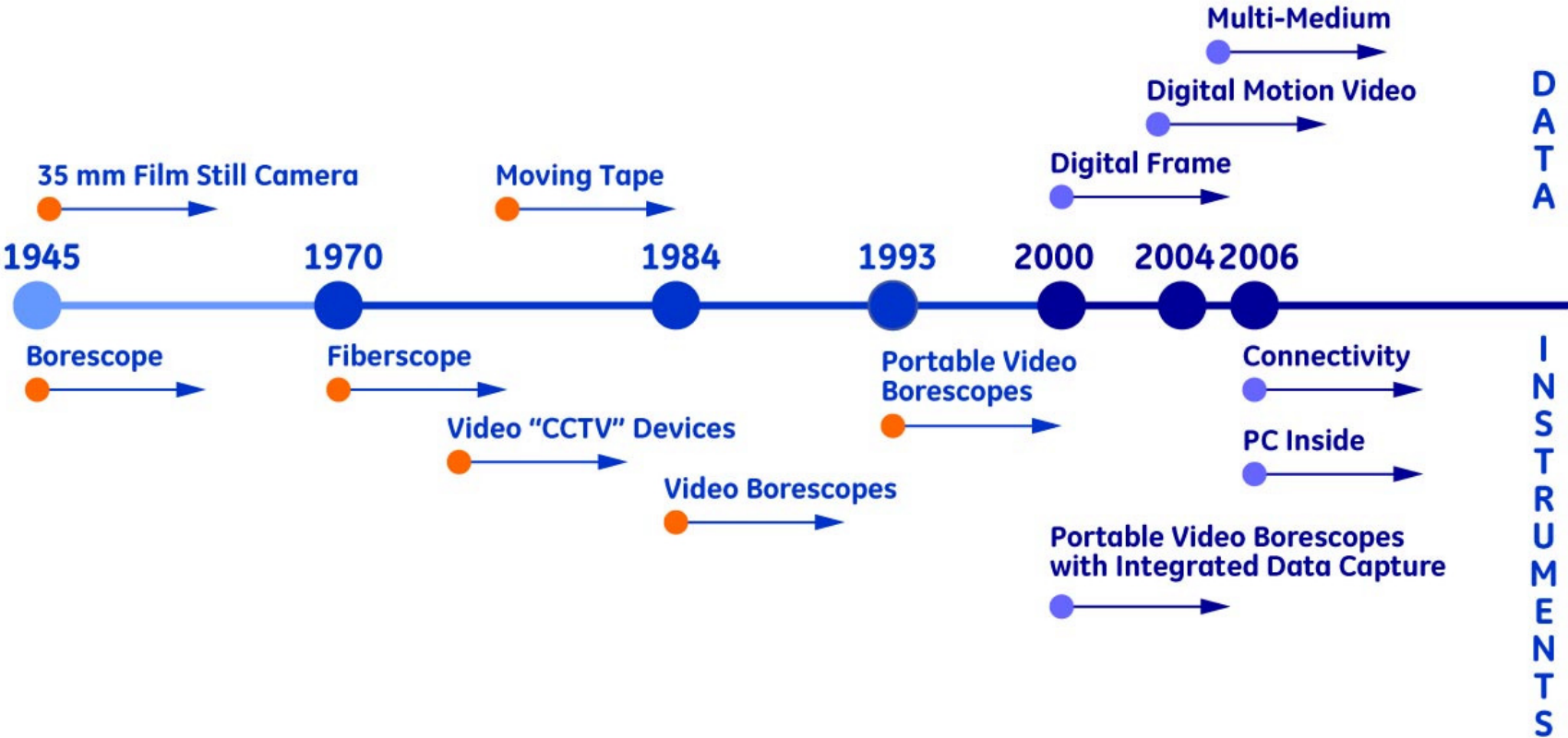
What is RVI?



RVI and how it is used

- Optical and electro-optical methods which allow images to be viewed and captured from otherwise inaccessible locations
- Can serve as a stand-alone inspection technique
- Or can complement conventional test data (vibration, pressure, flow) or NDT (ultrasonic, eddy current, radiographic) disciplines
- Often used for root-cause failure analysis and as a key support technology for engine trend monitoring
- Provides a vision system for remote tooling, in-situ welding, blade-blending, loose-parts retrieval or other remote operations

A Brief History of RVI Time



Typical applications in aerospace

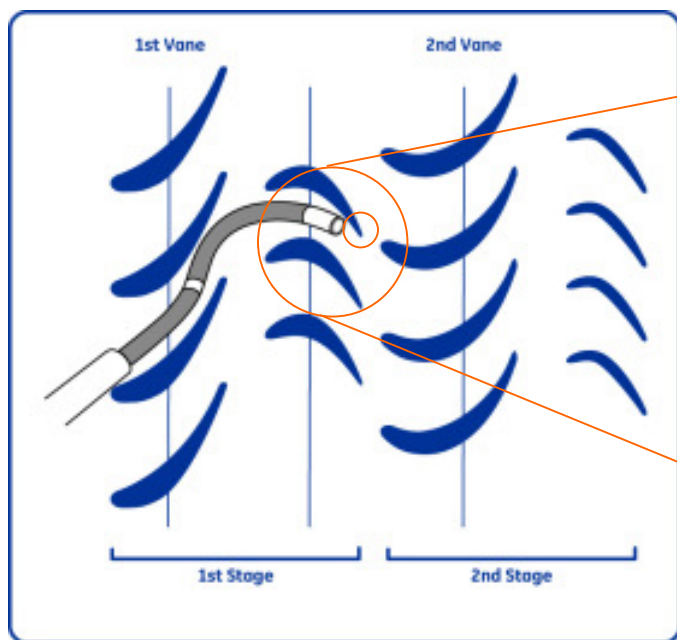


Aviation

Application: F100 “Hook and Drag” Inspection

Inspection: F100 2nd Stage Turbine Stator Vane

RVI Tool: Videoborescope



Leading Edge



Trailing Edge

Stage 1 Turbine Blade

Portability, ease-of-use & image quality



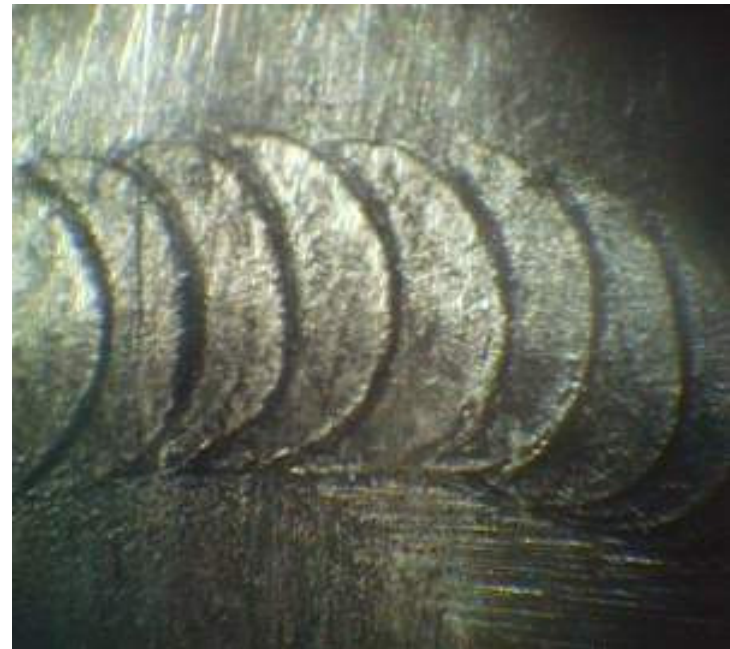
Digital Data Management

- Still Image Capture (Frame Grabbing)
- Text Overlay (non-destructive file)
- Audio & Motion Video Capture
- Data Storage/Recall, Transfer & Reporting

Still Image Capture (Frame Grabbing)

Creates digital still images from a video signal

- Maps out the video image information to create a digital image file

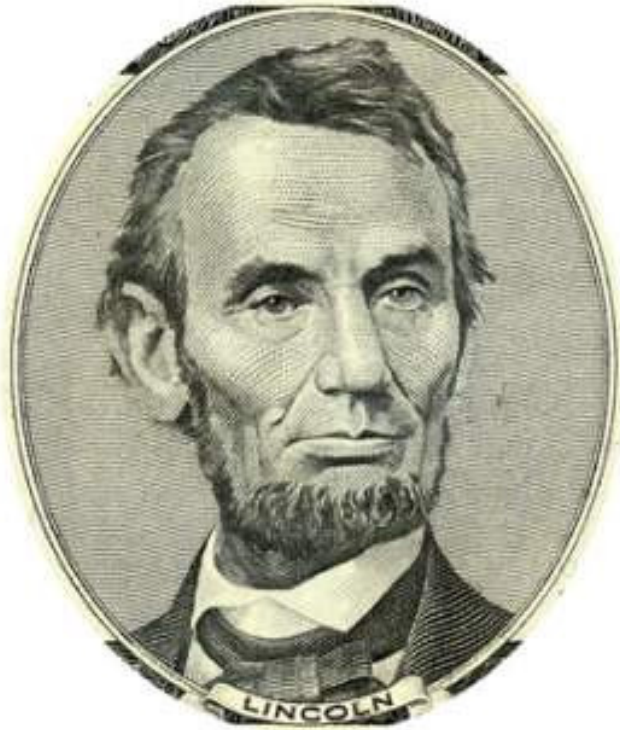


Still Image Capture (Frame Grabbing)

- Uncompressed Files (lossless resolution)
 - Maps out each pixel location
 - BITMAP (.bmp)
 - TIFF -Tag image File Format (.tif)
- Compressed Files (lossy resolution)
 - Uses compression coding to group pixels together
 - JPEG-Joint Picture Experts Group (.jpg)
 - GIF- Graphics Interchange Format (.gif)

Image Quality Comparison

BITMAP



JPEG (low quality)



Motion Video Capture

Digital Video Formats

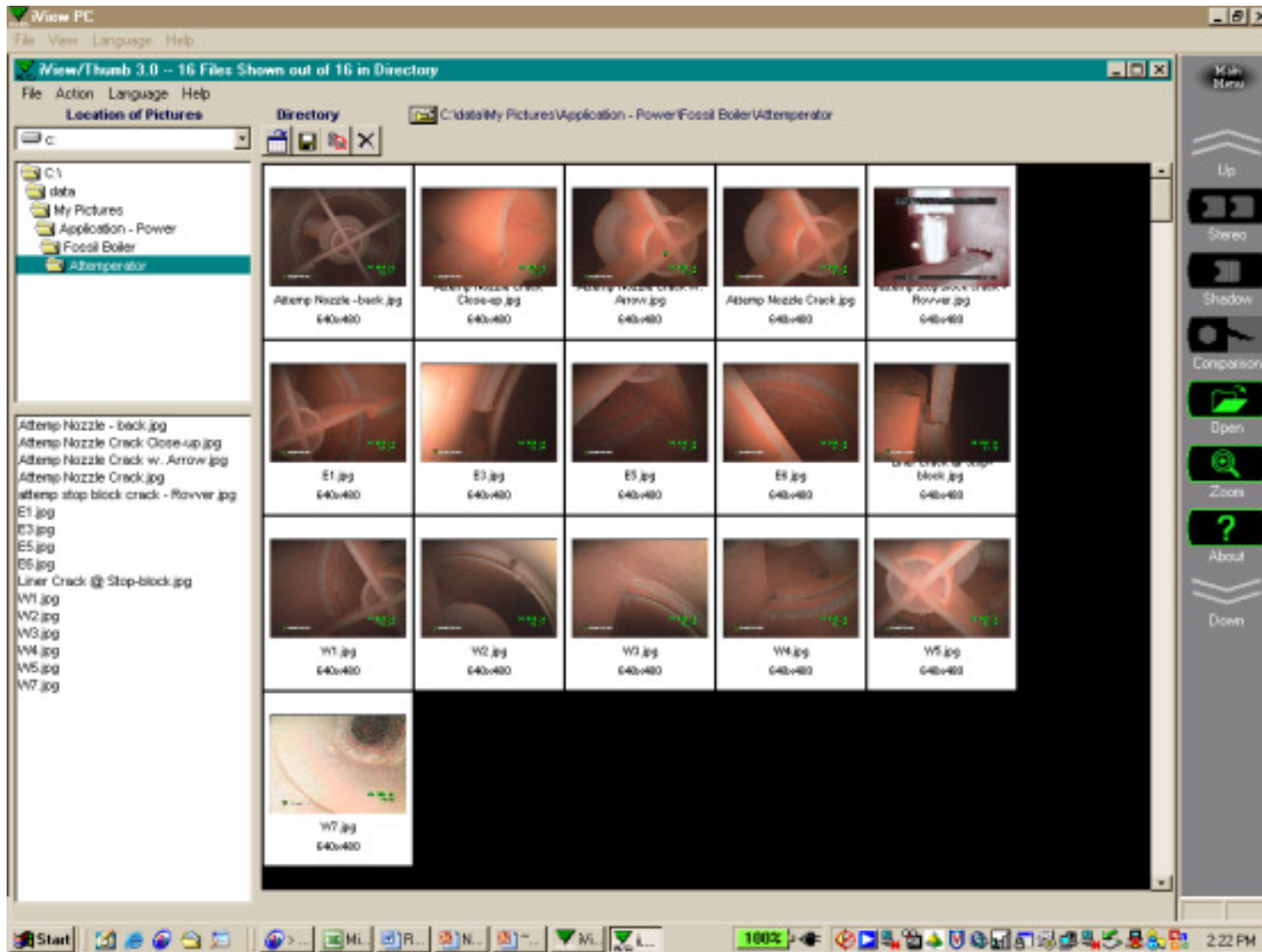
- AVI (.avi) Standard format for PCs
- Quicktime (.mov) proprietary format for Apple
- MPEG (.mpg) Moving Picture Experts Group
 - MPEG I, II, III and IV

Connectivity / Data Storage & Recall

Ethernet, USB II, Solid State Memory, Wireless, CD & DVD



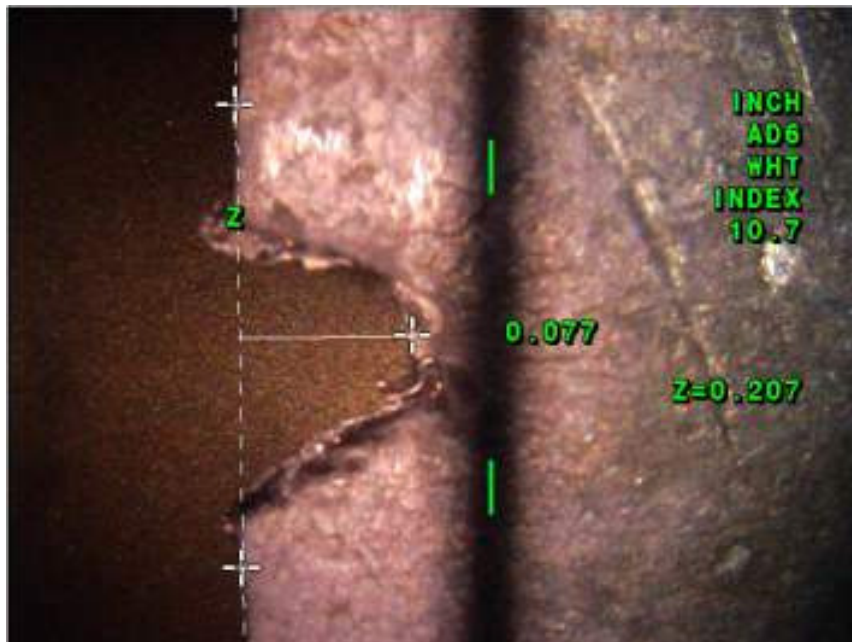
PC-based Digital Data Archiving



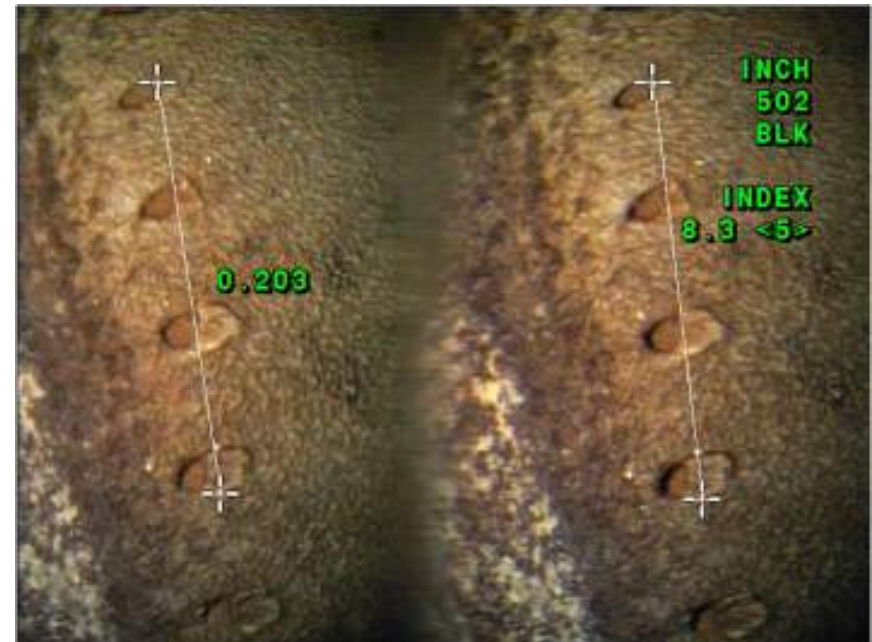
Digital Data Reporting

- Written Reporting
 - Still image prints
- Video Taped Reporting
 - Entire inspection in sequence
- Integrated Reporting
 - CD-ROM/DVD : Random access
 - Easy to Navigate & Manage

In-situ Measurement Methods



ShadowProbe®



StereoProbe®

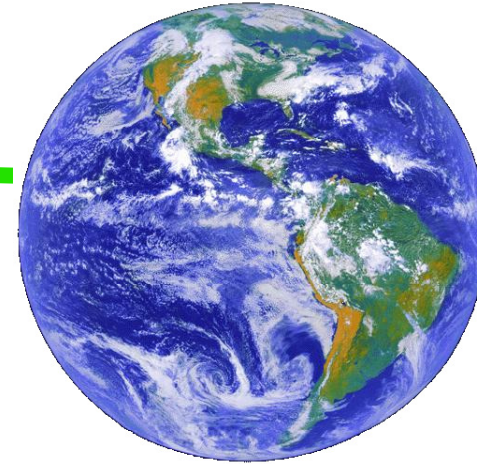
Customer Quote:

“As a result of using the borescope’s measurement capability, the aircraft was not removed from service. No delays or cancellations were incurred, and the engine remained in service without a premature shop visit. As a point of reference, the cost associated with engine removal, transportation and a shop visit to replace the damaged blade is ~US\$60K.” (indirect costs not included)

Remote Control and Collaboration Over High-speed Network (or dial-up)



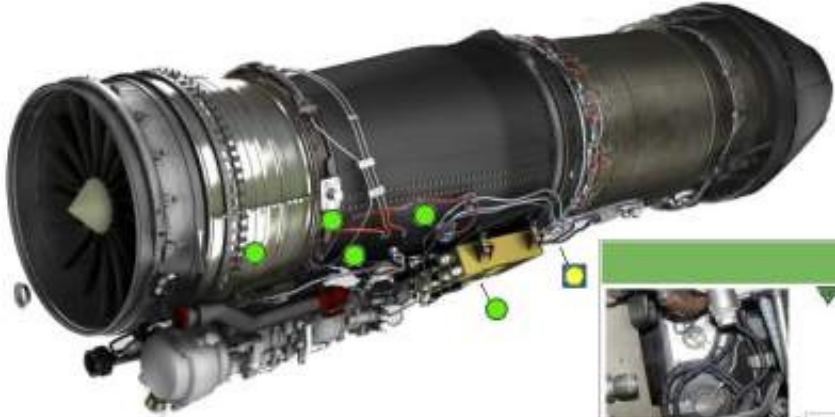
High Speed
Connection













MDI with GUI and interactive, random-access reporting



MDI interactive, random-access reporting



Click the desired port [] to view the corresponding images and video.

Port One (1)	Port Two (2)	Port Three (3)
 Stage 2 Fan Leading Edge	 Stage 3 Fan Trailing Edge	 360 Degree VSV Lever Arm Inspection
 Stage 2 Fan Leading Edge	 Stage 3 Fan Trailing Edge	 360 Degree VSV Lever Arm Inspection
 Stage 2 Fan Leading Edge	 Stage 3 Fan Trailing Edge	 VSV Lever Arm Inspection





Turbine Port

Conclusion

RVI is a Proven Technology that....

- Provides valuable qualitative and quantitative inspection results
- Increases productivity and shorten inspection time
- Straight-forward data and documentation

Digital Data Enablement....

- Makes it more cost-effective and easier to gather data
- Makes it simpler to report and transfer data
- Makes it more practical to archive and randomly access data
- Remote data sharing & collaboration
- Menu-directed inspections are now possible

Questions

