



ENGINES DIVISION - Bedek Aviation Group

AN AFFORDABLE AND ACCURATE OPTICAL REMOTE MEASUREMENT TECHNIQUE FOR JET ENGINES INSPECTION*

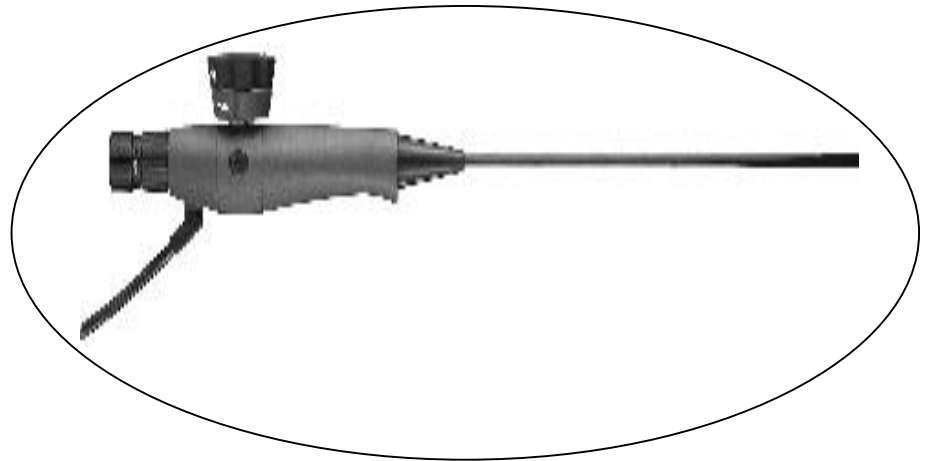
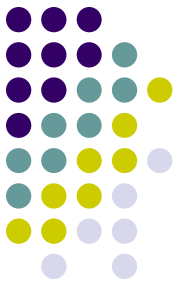
By:

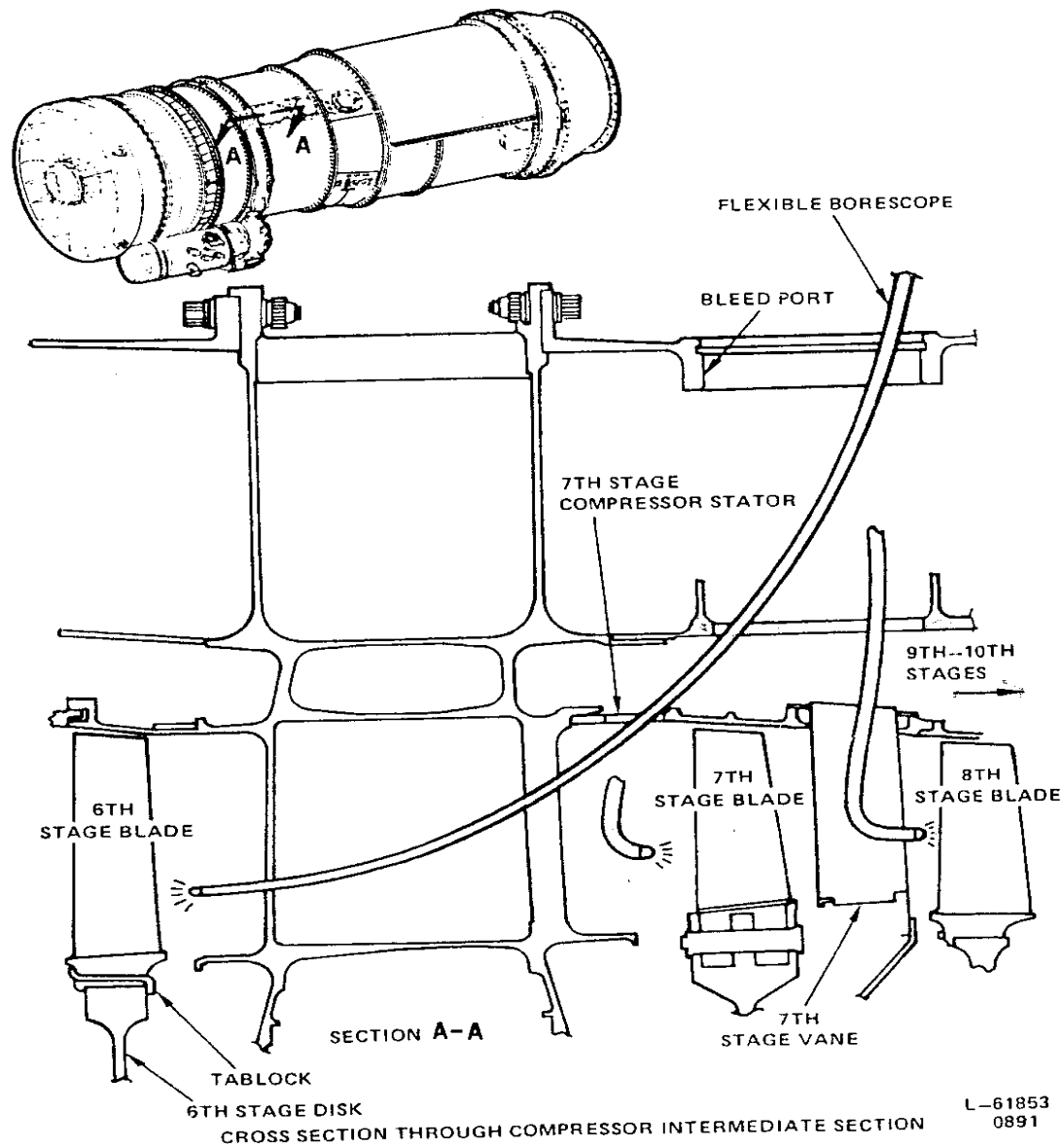
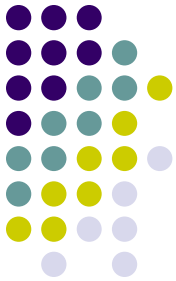
Julian Bughici

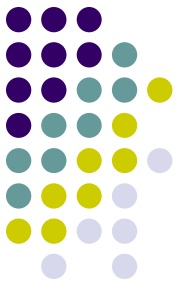
Engine Test Facilities Engineer

IAI-Bedek Aviation Group , Engines Division

BORESCOPE EQUIPMENT

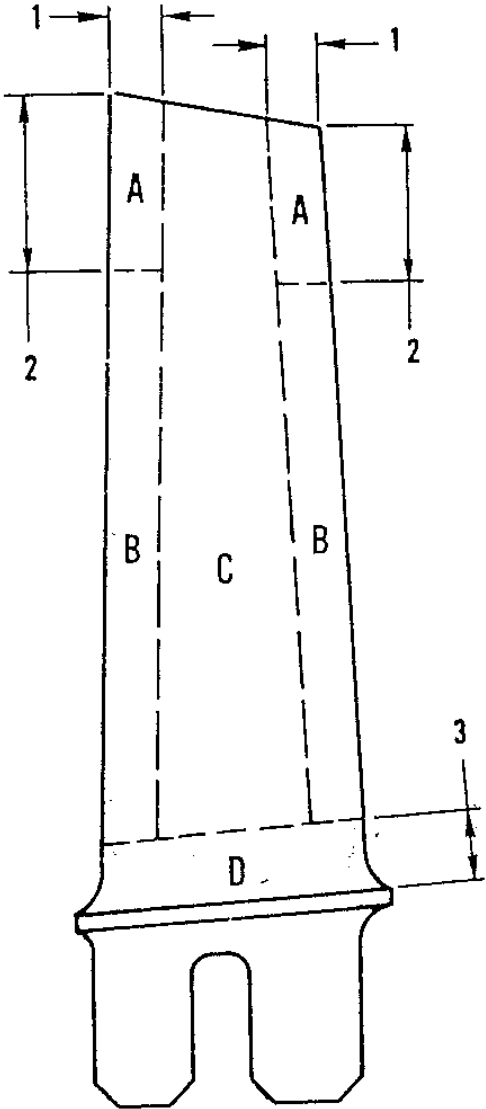




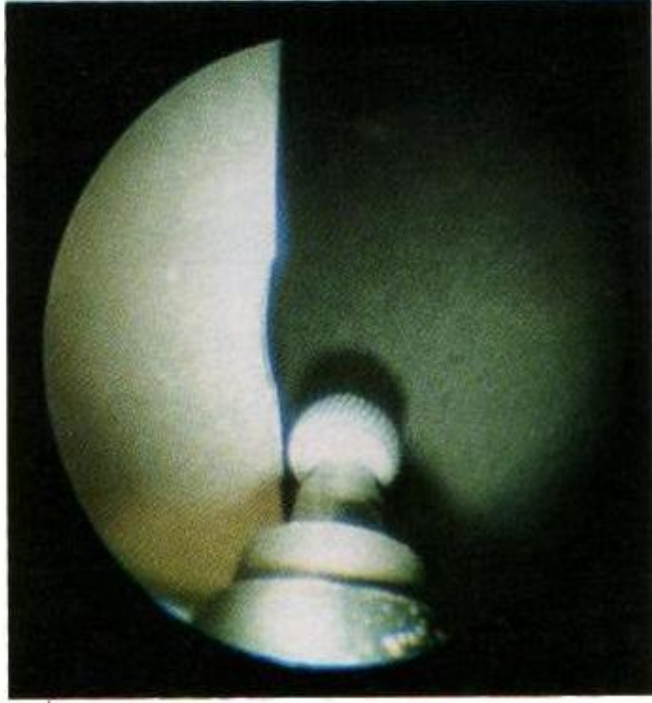
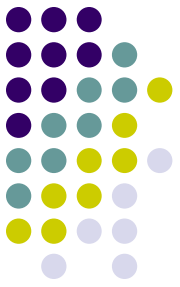


BLADE AREA	PERMITTED DAMAGE LIMITS
A	ANY TYPE OF DAMAGE UP TO 1/8 in (3.175 mm) MAXIMUM
B	ANY TYPE OF DAMAGE UP TO 0.020 in (0.508 mm) AND DENTS * UP TO 0.047 in (1.194 mm)
C	ANY DENT * NO TEARS OR CRACKS
D	NO DAMAGE IS PERMITTED

* DENTS MUST BE SMOOTH
AND ROUNDED WITHOUT
CRACKS, TEARS OR MATERIAL
REMOVED.



L-79398
0689

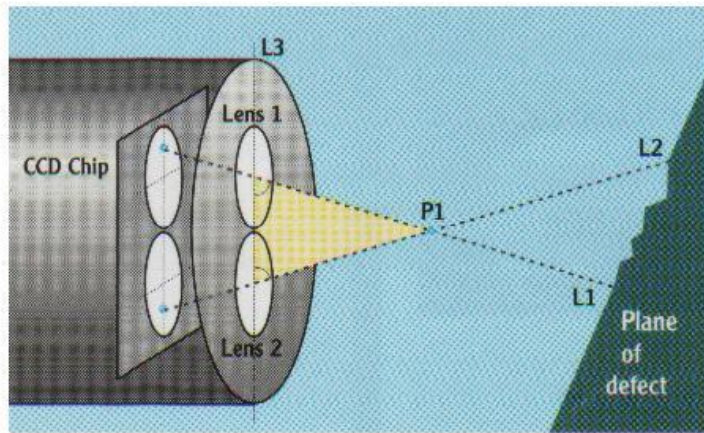


HOW TO MEASURE DEFECTS ?

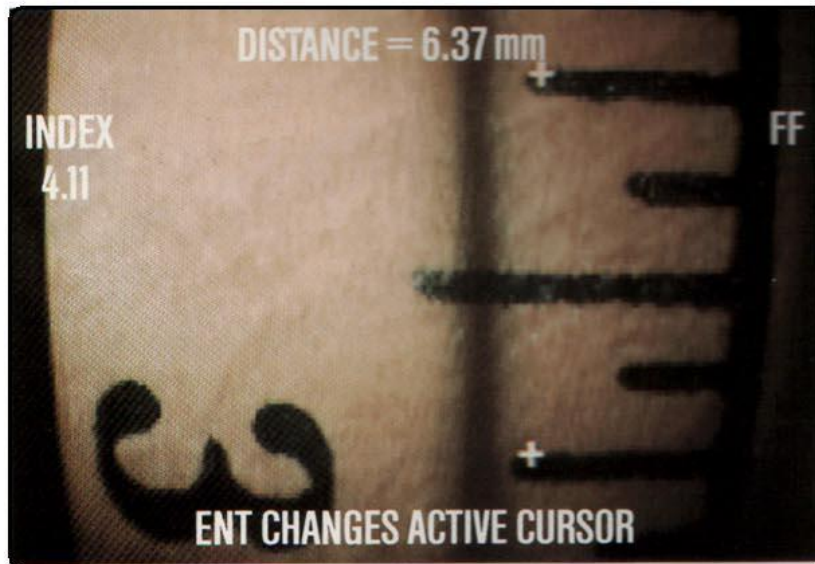




- **NOTE:**
- **The only two known systems that include measurement**
- **capabilities are provided by Olympus and Everest. The both are based on techniques that permit to use triangulation method , find**
- **the distance to the object and then calculate magnification and the actual size.**



OLYMPUS STEREO MEASUREMENT.



SHADOWPROBE® Measurement

The ShadowProbe provides the information needed to determine the exact distance away from the object by projecting a shadow across the image on the screen. The position of the shadow on the screen reveals the distance to the object, from which the computer can then calculate magnification and actual size.

EVEREST

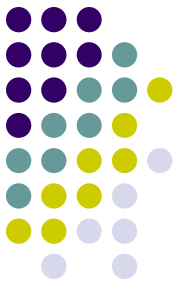
OUR SOLUTION :

The system provides a straightforward capability to measure, linear dimensions, on a captured digital image.

The technique is based on a comparative measurement between a known reference dimension value and the required dimension.

By optical means the system projects an accurate pattern with a known linear dimension on the inspected surface.

The image is captured and analyzed by a dedicated software program.

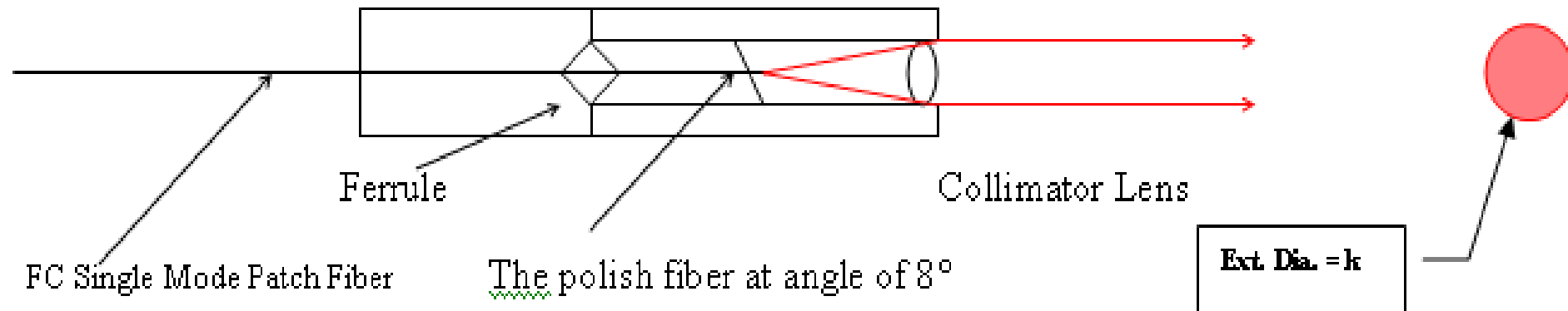




- **The reference laser pattern in the system is in the form of a circular spot of a known diameter, which is constant within a range of working distances.**



1. Collimated Laser ($\lambda=660\text{nm}$) Spot by Single Mode Fiber





EQUIPMENT ACCURACY

- EQUIPMENT:

- 1. Single Mode pigtail Diode
- 2. Wavelength 660nm , Pmin 6.0mW, Ptyp 7.5mW, Pmax 9.0mW
- 3. 250mA Precision Constant Current Laser Driver
- 4. 660nm Single Mode Fiber, Mode Field Dia. 4.0μm, Cladding 125μm NA= 0.12
- 5. Collimated Lens: E.F.L=5.0mm , N.A=0.15 , B.F.L=4.36mm
- Glass(Corning) CO550 , Design Wavelength 1550nm.

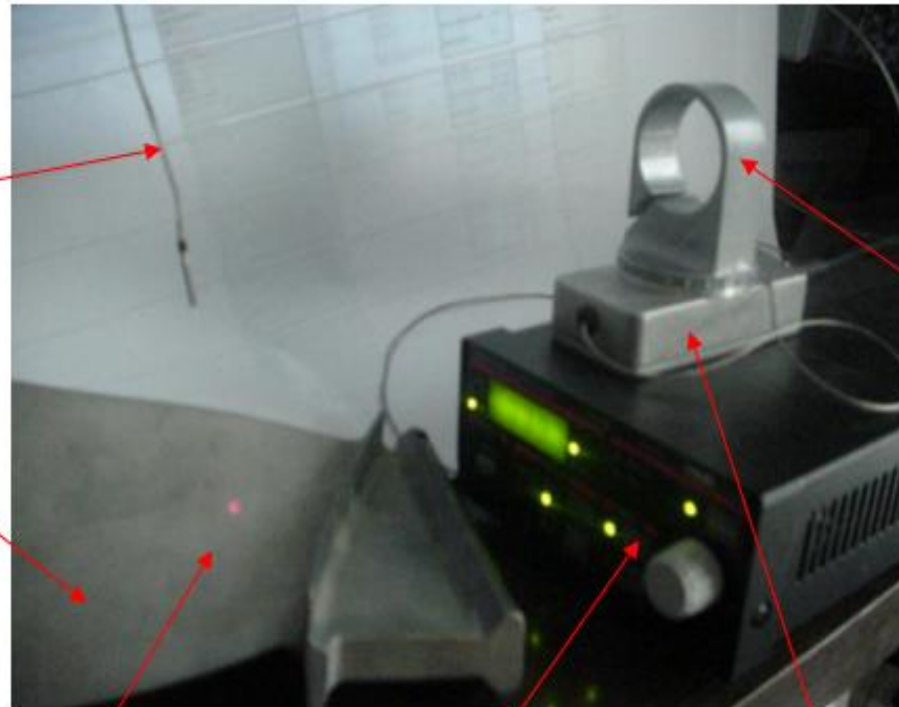
- DIVERGENCY:

- $\emptyset = \lambda / \pi \times NA \times E.F.L = 660nm / 3.14 \times 0.12 \times 5mm = 0.35mRad$

- **FOR A 30 MM WORKING RANGE THE SPOT DIA. IS CHANGING**

- ***+/- 0.005 MM (IF WE CALIBRATE AT 15 MM)***

MEASUREMENT PORTABLE KIT



FLEXIBLE
OPTIC FIBER

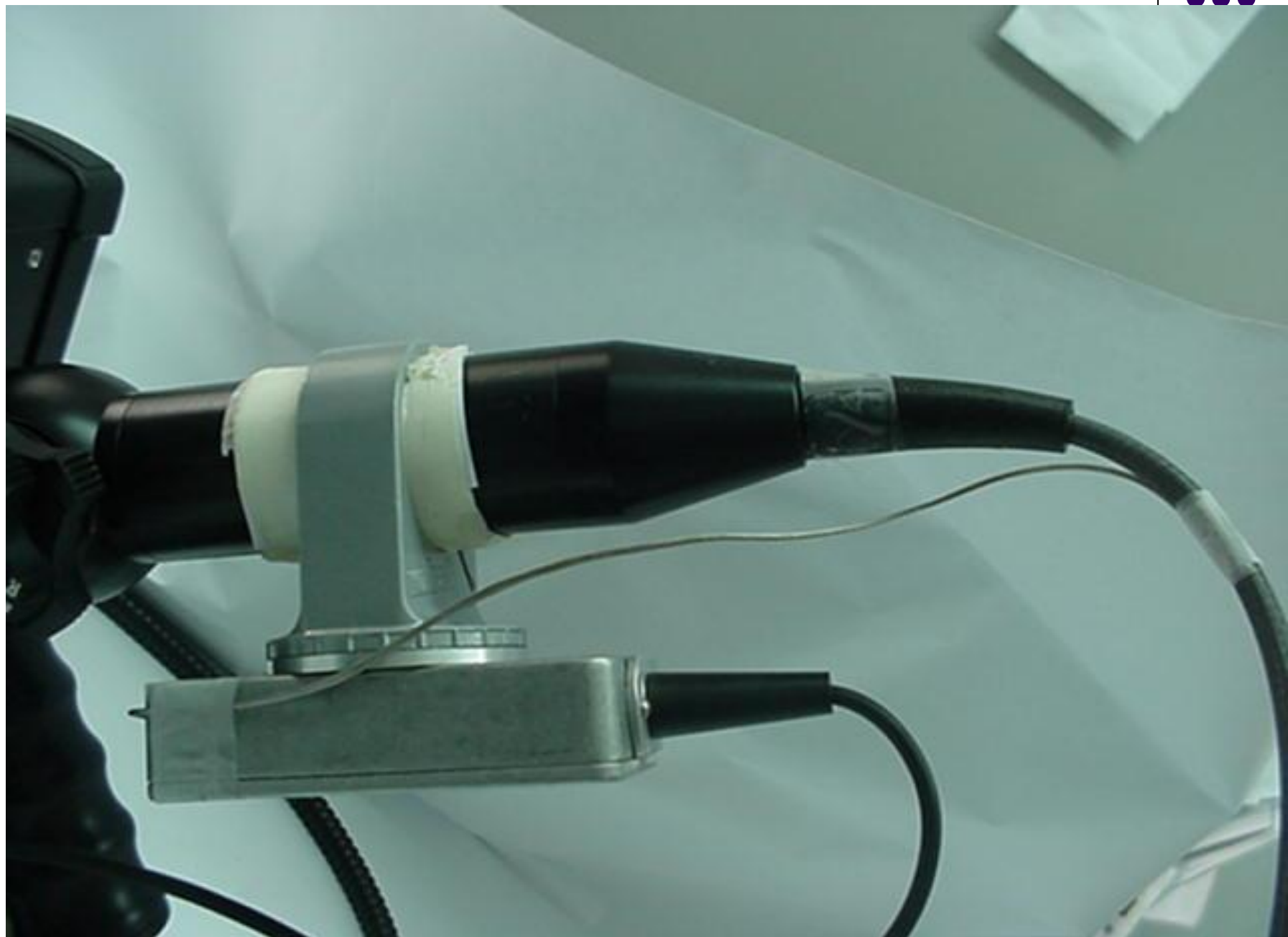
FIXTURE FOR
BORESCOPE

COMPRESSOR BLADE

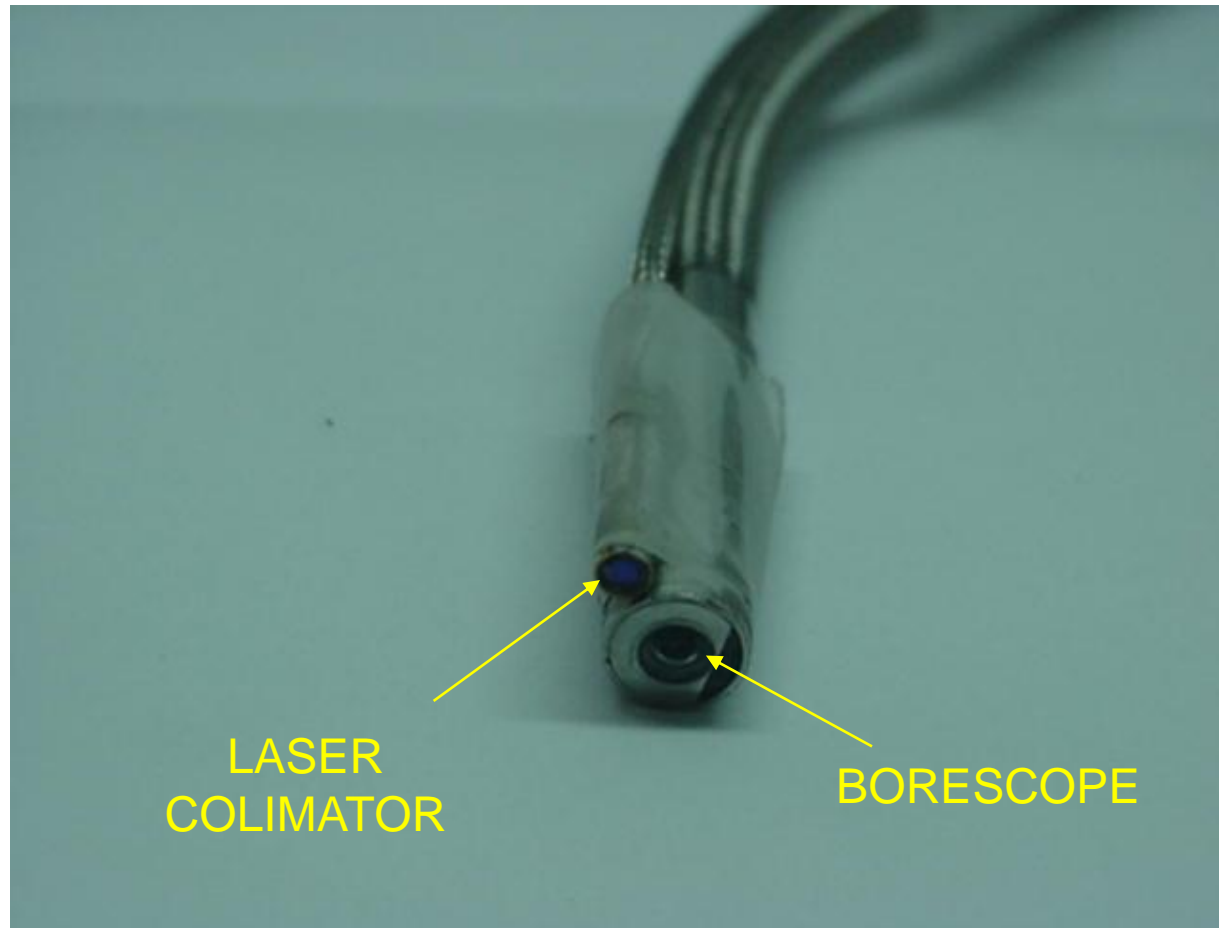
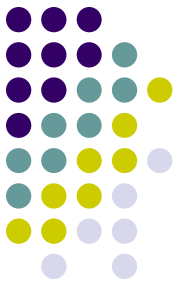
LASER SPOT

LASER SOURCE
DRIVER

LASER DIODE BOX



LASER WITH BORESCOPE




DEFECTIVE BLADE

- By optical means the system projects an accurate pattern with a known linear dimension on the inspected surface.



- The technique is based on a comparative measurement between a known reference dimension value and the required dimension.



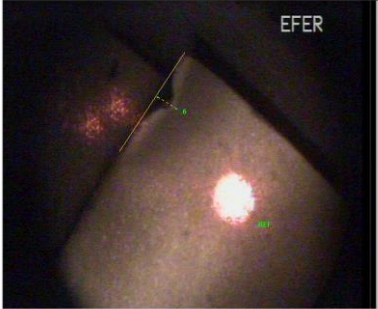
 **A dedicated image analyzer software is used to measure , record and archive the picture with dimensions and relevant inspection information.**



BORESCOPE INSPECTION REPORT.



BORESCOPE INSPECTION REPORT.



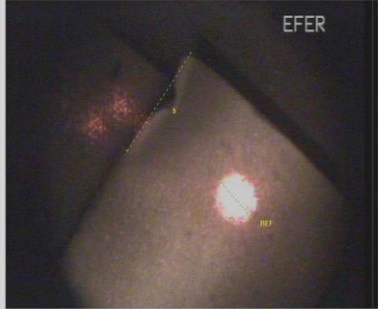
Date
2/9/2003
Engine Type
CANADA 303
Engine S/N
721507
Customer
CCX

NOTES

STAGE 7 BLADE TIP CURL
LONG 3.3 mm
DEEP 0.6 mm

Length: 6 Reference: 1.25 Units: mm

BORESCOPE INSPECTION REPORT.



Date
2/9/2003
Engine Type
CANADA 303
Engine S/N
721507
Customer
CCX

NOTES

ST7

Length: 3 Reference: 1.25 Units: mm

BORESCOPE INSPECTION REPORT.

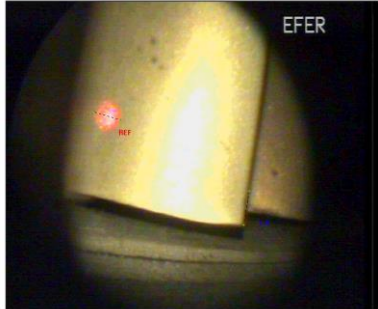


Date
2/9/2003
Engine Type
CANADA 303
Engine S/N
721507
Customer
CCX

NOTES

Length: 3.7 Reference: 1.25 Units: mm

BORESCOPE INSPECTION REPORT.



Date
2/9/2003
Engine Type
CANADA 303
Engine S/N
721507
Customer
CCX

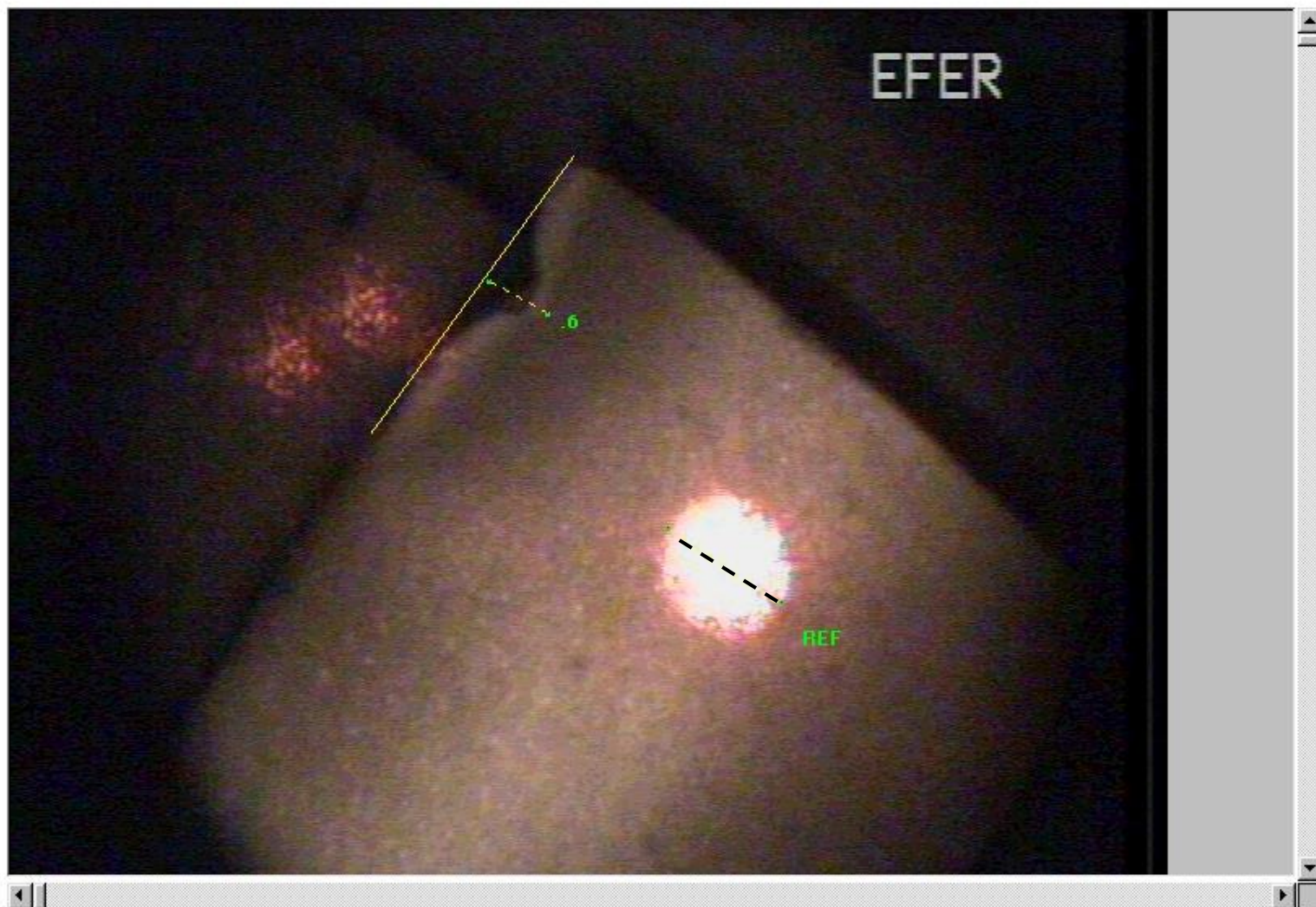
NOTES

LONG 1.4 mm

Length: 1.4 Reference: 1.25 Units: mm



BORESCOPE INSPECTION REPORT.



Date
2/9/2003
Engine Type
CFM56-3B1
Engine S/N
721587
Customer
CEX

NOTES

STAGE 7 BLADE TIP CURL
LONG 3.3 mm
DEEP 0.6 mm

length = .6

Reference: 1.25

Units: mm

THE FUTURE

