

Current and Future Developments in Civil Aircraft  
Non-destructive Evaluation from An Operator's Point of View

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### INTRODUCTION

In June 1988, the first International Conference on aging aircraft was held to address NDT aging aircraft issues. From this meeting, a research program was initiated and funded by the FAA. As a result of this program, a lot of work has been done to study current NDT practices in the aviation industry and secondly, to research and develop new NDT methods to improve the reliability and efficiency of in-service inspection of aircraft structures and powerplants.

The following is an overview of current and future developments in civil aircraft NDT, as viewed by an air carrier and the concerns for NDT in the future.

The current philosophy at Northwest Airlines is best represented by Aircraft Maintenance Operation's Vision and Mission Statement as shown below:

#### OUR VISION

Everywhere in the operation everyone will see and feel a difference. Our facility and work place will be safe, clean, and well-organized. There will be a noticeable sense of pride and trust where all are challenged professionally and enjoy coming to work. A strong spirit of working together will be evident, embraced with constant unrestricted communication and performance development. A commitment to empowering individuals will be obvious as work groups concentrate on their customers and measure their own performance.

The organization will be lean and effective, conveying a real commitment to trust, respect and training. Everyone will be recognized for their leadership and vision, with a focus on continuous improvement and innovation. The leaders will be honest, competent, and forward-looking, while being inspiring teachers, coaches and change-makers.

There will be an obvious interest in people, their needs and well-being, their community involvement and development-through support, encouragement and recognition. We will have a labor-management committee for early problem solving and creative solutions within the bounds of the contract.

The Aircraft Maintenance Operations group will have a reputation for producing a quality product expeditiously and efficiently, while controlling costs and reducing waste. This group's accomplishments will be the example within the company and the industry that others will strive to attain.

This dynamic, forward-thinking vision will continue to challenge our strategic direction, stretching the organization to new levels of excellence.

#### **OUR MISSION**

To provide safe, clean, reliable aircraft from major maintenance to support Northwest Airlines' strategic operating plan.

We at Northwest Airlines feel it is imperative to have a Vision/Mission Statement in order to institute a dynamic structure to drive Operational Process Improvement and to develop an interactive communication process. This in turn will help to identify, analyze, and pursue opportunities to improve work processes.

As a part of the research programs, the airlines have been host to many groups of people conducting research, in order to assess the conditions of the "actual" test environment or the "real world". It soon became apparent that many of these groups did not understand what the NDT process consisted of and what events drove the airlines into performing a NDT Inspection.

The following is an overview of the four events which initiate NDT Inspection on aircraft:

- (1) Service bulletins (S/B) / Airworthiness Directives (AD's)
  - Service Bulletins
    - S/B Original Equipment Manufacturer (OEM) generated inspections in which compliance is not mandatory.
  - Airworthiness Directives
    - AD FAA mandated/approved inspections (usually generated from S/B).
- (2) Damage Assessment / Repair Assessment
  - Assessment of damage on aircraft prior to repair/rework or replacement.
  - Monitor temporary repairs until permanent repair is accomplished.
  - Repair assessment program (RAP). Assessing existing repairs on aircraft.
- (3) Monitor Inspections
  - Monitor existing defects on aircraft.
  - Monitor defects existing in repair area.

(4) Operator Generator Inspections

- Confirmation of indications found by other methods of inspection (visual).
- Additional inspections conducted by operator which are not required by OEM or FAA.

Of the four events listed above, items (1) through (3) are all performed in accordance with OEM's NDT Procedures of Inspection methods generated by operators and approved by OEM. Item (4) in most cases also uses the above NDT criteria.

### OVERVIEW OF CURRENT NDT METHODS

Current methods used by operators include:

- Magnetic Particle
- Dye Penetrant
- Radiography (X-ray/Isotope)
- Ultrasonic
- Eddy Current

Equipment associated with these methods are generally portable for ease of use in a hangar or flight line environment.

Method of choice depends on a multiple of factors including: application, access, material type, speed, environment in which the test is to be performed, power requirements, etc. Of the three most popular methods of choice (radiography, ultrasonic and eddy current), eddy current is usually the most preferred method due to its simplicity of use, ease of interpretation and speed. Ultrasonics would follow eddy current due to its sensitivity in detecting small flaws. This sensitivity, at the same time, causes difficulty in interpretation. Next would be radiography. Radiography reduces the amount of opening time required for visual and other methods of inspection, but is very expensive due to the cost of the equipment and hangar down time.

## FUTURE CONCERNS/DEVELOPMENTS FOR NDT

The following is a list of concerns from an operator's point of view, which need to be addressed as a part of the aging aircraft research program.

Research needs to be a coordinated effort between the operators, research facilities, NDT equipment manufacturers, OEM's, and other industries (i.e. military, nuclear research) in order to produce reliable NDT techniques and valid studies.

Composite inspection techniques need to be researched and developed in order to address future inspection demands for advance composite components. Major structural composite items will require NDT inspection to detect disbonds, moisture intrusion and impact damage.

Training programs need to be standardized to establish consistency throughout the aviation industry. Programs should consist of formal classroom training, which is tailored to the aviation industry. Formal training should also include other conditions which effect the results of an inspection, such as: temperature of item tested, damaged area, areas previously reworked, different configurations found on aircraft. The inspector must have the knowledge and the capability to adapt to these conditions in order to perform a valid test.

### CLOSING REMARKS

Implementation of advanced NDT methods developed through programs like these and their success will depend largely on a cooperative effort between OEM's - equipment vendors - research facilities - and aircraft operators. New NDT methods must then be validated on actual aircraft, approved by the OEM and implemented into its inspection program. This process must be completed before the operators can utilize such methods to comply with AD's required on aircraft.

Cooperative efforts such as these will assist operators to continue to provide safe aircraft to the flying public.