Nondestructive Inspection For Aviation Safety Inspectors

Online Job Aid

April 2013

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NONDESTRUCTIVE INSPECTION (NDI) ONLINE JOB AID

1. Introduction. You, an aviation safety inspector (ASI), can use this Nondestructive Inspection (NDI) online job aid as a tool in the certification, audit/evaluation, and surveillance of NDI organizations. We, the Aircraft Maintenance Division (AFS-300), designed this job aid to provide a standardized approach to evaluate an NDI organization.

2. Scope.

A. Using this job aid provides you with a standardized approach to assess compliance. You don't need to address all questions in the checklist in all situations, nor is it necessary to have an affirmative response to all questions. You may exercise your own judgment to determine compliance based on the NDI organization's ability to present reasonable and defensible responses to the issues contained in this job aid.

B. We provide this job aid as a tool for you to use when preparing to evaluate an NDI organization. However, you shouldn't use this job aid as a pass/fail checklist form during onsite visits.

3. Terminology. Industry often uses the terms Nondestructive Inspection (NDI), Nondestructive Evaluation (NDE), and Nondestructive Testing (NDT) interchangeably. However, for the purpose of this job aid, we use the term NDI.

4. Organization of the Job Aid. We organized this job aid in two parts: Part I, NDI Evaluation Process, and Part II, NDI Methods.

- Part I includes a general section to record pertinent information about the facility. This part also includes questions applicable to the NDI organization for audit and surveillance for each of the five elements described in Paragraph 5 below.
- Part II includes specific questions for the six most commonly used methods: visual inspections, liquid penetrant inspections, magnetic particle inspections, eddy current inspections, ultrasonic inspections, and radiographic inspections.

5. Elements of an NDI Organization. We organized this job aid around five elements used to assess an organization's ability to perform NDI functions. These five elements comprise a systematic NDI evaluation process that you can use to evaluate any NDI organization, from manufacturing to maintenance. We define the five elements as follows:

- **Documentation.** Documentation pertains to written procedures, processes, specifications, and/or methods that air operators or air agencies use to perform and control NDI activities.
- **Organization.** A corporation or other similar entity established to provide or receive NDI services.
- **Environment.** The general physical condition of the NDI facility (e.g., housekeeping, storage, safety, consumable management, equipment);
- **Calibration.** The process by which an item is checked against a standard.
- **Training.** Training ensures that NDI inspectors are qualified to perform NDIs. An NDI organization should maintain records in order to document the training and retraining of NDI personnel, including the methods used.

  NOTE: These five elements represent the underlying system that an NDI organization needs to have in place for satisfactory NDI operations.

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NDI Evaluation Process

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Part I

NDI Evaluation Process

Section A: General

Facility/Location:_____

_____

Dates: Started **Completed**

Inspectors	Facility Representatives	Title

Certificated NDI Inspectors	
Non-certificated NDI Inspectors (trainees)	
Repairmen	
Total Employees	

Facility Description: _____

_____

Work Performed:

☐ Visual	☐ Liquid Penetrant	☐ Magnetic Particle
☐ Eddy Current	☐ Ultrasonic	☐ Radiographic
☐ Other		

Section B: Documentation

	YES/NO	N/A	REMARKS
1. Does the facility have a manual specific to the NDI organization?			
2. Does the NDI manual contain an organizational chart detailing roles and responsibilities of individual functions?			
3. Does the NDI manual contain appropriate specifications or references to procedures and processes contained in other documents, such as original equipment manufacturer (OEM) NDI manuals?			
4. Are the specifications or referenced manuals current?			
5. Does the NDI manual define a Quality Management System (QMS) to ensure all activities are carried out per specified procedures?			
6. Does the facility have an approved/accepted document that defines duties and responsibilities of management personnel?			
7. Does the facility have an approved/accepted document for internal audit?			
8. Does the facility have an approved/accepted Quality Manual (QM)?			
9. Does the manual contain procedures for NDIs outsourced to vendors?			
10. Are manuals and procedures available to and used by the qualified personnel?			
11. Does the manual contain controls for managing NDI products, materials, and consumables?			

Section C: Organization

	YES/NO	N/A	REMARKS
1. Is there a separate NDI organization within the facility?			
2. Does the NDI manager or equivalent have direct line authority to the NDI qualified personnel?			
3. Are NDI requirements provided to the NDI inspection personnel by use of written procedures?			
4. Does the NDI manager, or equivalent, review the quality assurance system to monitor compliance to the FAA-approved data?			
5. Are proper shift change procedures in place to ensure communication of inspection status and to ensure inspections are properly performed and interpreted?			
6. Are documented procedures in place for inspector override authority; i.e., does the person with override authority meet or exceed the qualification of the inspector who documented the original discrepancy?			
7. Are procedures in place for qualified personnel to perform required vision exams; i.e., per qualification program requirements?			
8. Does the manual contain procedures for NDIs outsourced to vendors?			

Section D: Environment

	YES/NO	N/A	REMARKS
1. Is the size of the work area sufficient to perform the NDIs?			
2. Is there adequate work area for storing and separating NDI materials (e.g., equipment, chemicals, supplies)?			
3. Is there a method for controlling and segregating nonconforming NDI equipment and materials?			
4. Are appropriate manuals, procedures, and other documentation available for use by qualified personnel?			
5. Are adequate parts handling systems (e.g., cranes, hoists, lifts) available to the inspectors?			
6. Do routing documents specify the operations needed and in what sequence to do so?			
7. Is adequate protection provided to parts during handling and routing?			
8. Is metal-to-metal contact of finished surfaces prevented during handling?			
9. Are obsolete documents removed from inspection areas?			
10. Are materials with expiration dates managed using appropriate procedures?			

Section E: Calibration

	YES/NO	N/A	REMARKS
1. Is there a procedure for calibrating inspection devices to certified standards?			
2. Are there procedures for segregating functional and nonfunctional equipment?			
3. Is there a method for controlling and segregating nonconforming NDI equipment and materials?			
4. Are procedures in place to ensure repaired equipment is recalibrated?			
5. Are reference standards properly labeled, stored, and used?			
6. Are the calibration methods documented?			
7. Are setup verifications performed on all shifts, as appropriate?			
8. Are numerical values and signatures required for all calibration parameters?			

Section F: Training

(Classroom, On-the-Job Training (OJT), and Demonstration of Performance)

	YES/NO	N/A	REMARKS
1. Are training requirements identified in the NDI manual for the methods used?			
2. Are training, qualification, requalification, and certification done in accordance with criteria such as: • Recommended Practice SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing. • Airlines for America (A4A) Specification 105, Training and Qualifying Personnel in Nondestructive Testing Methods . • AIA-NAS-410, Aerospace Industries Association, National Aerospace Standard, NAS Certification & Qualification of Nondestructive Test Personnel • FAA Advisory Circular (AC) 65.31 (current edition), Training Qualification, and Certification of Nondestructive Inspection (NDI) Personnel. • Other:_____			
3. Are there procedures for maintaining training records for NDI personnel, and are they current and easily accessible?			
4. Is there a procedure to include OJT requirements for each qualification level in accordance with industry-accepted standards, and is OJT recorded?			
5. Is there a procedure to include demonstration of performance and its recording to meet the 6-month proficiency requirement?			
6. Is all data pertinent to individual training/qualification/requalification on file, including grandfathering or documentation for individuals previously qualified?			
7. Is there a procedure for recertification/decertification of NDI personnel in the case of an unsatisfactory performance, a past-due eye exam, or a 6-month period of inactivity?			
8. Are qualified personnel available for all required techniques and at all the required levels called for in the manual?			

Part II

NDI Methods

Audit and Surveillance

Audit/evaluation and surveillance are significant components of an ASI's responsibilities. Audit/evaluation includes verifying that the certificate or approval holder meets all regulatory requirements and operates in compliance with its manuals and operating procedures. Surveillance includes ensuring that the certificate or approval holder is maintaining compliance during day-to-day operations of the air agency for the certificate that they hold. There is limited specific regulatory guidance that focuses on NDI.

Section A: Visual Inspections

A visual inspection is the process of using the eye, either alone or with the help of various aids, as the sensing mechanism to determine the condition of a unit under inspection.

	YES/NO	N/A	REMARKS
1. Do written procedures define the visual inspection process, including specific targets?			
2. Are precautions taken to ensure that procedures that can adversely affect visual inspection are not performed prior to the inspection process; e.g., cleaning, paint striping, disassembly?			
3. Is adequate lighting available for performing the detailed inspection that is required?			
4. Does the organization utilize a training program for visual inspection?			
5. Does the organization require vision testing to ensure that visual inspectors possess binocular vision with good visual acuity?			
6. Does the organization utilize a maintenance program to ensure borescopes, fiberscopes, and other remote viewing equipment are properly stored, maintained, and calibrated?			
7. Do job procedure task cards specify the use of visual tools, such as flashlights, calipers, micrometers, rulers, and magnifying devices when required?			
8. Do inspectors have proper training for the instruments they are using?			

Section B: Liquid Penetration Inspections

A liquid penetrant inspection is used to reveal surface breaking cracks in solid, nonporous materials. While both fluorescent and nonfluorescent techniques are available, most aviation applications involve the use of fluorescent penetrants in a bulk process. A liquid penetrant inspection requires a series of steps involving pre-cleaning, application of the penetrant, removal of excess penetrant, application of developer, examination under appropriate light, and post-cleaning, if needed.

	YES/NO	N/A	REMARKS
1. Do written procedures define the penetrant inspection process, including specific targets?			
2. Is the proper light (black light or visible light) used for the penetrant inspection?			
3. Are light intensity readings taken per process specification verification requirements with specific readings recorded, and are they signed for?			
4. Are gauges, thermometers, and timers used to control the process adequate, easily accessible, and utilized?			
5. Are proper dwell times, dry times, and temperatures followed per standard practices detailed in process specifications?			
6. Is the examining area free of interfering debris and *stray* fluorescent materials and white light reflectors?			
7. Are tanks protected from possible contamination?			
8. Are procedures in place to ensure precleaning and postcleaning are performed properly? Have cleaners been trained for proper cleaning techniques?			
9. Is the correct penetrant sensitivity being used per job procedure cards?			
10. Are test panels used to verify system performance? Have the test panels been cleaned and checked for contamination?			
11. Is the penetrant solution compared to a standard for brilliance and color or sent for chemical analysis per manufacturers recommendations?			
12. If dry developer is used, is it dry, fluffy, and free of fluorescence?			
13. Are process controls in place for each step of the procedure, and are they checked at regular intervals?			

Section C: Magnetic Particle Inspections

A magnetic particle inspection is used to find surface and near-surface defects in ferromagnetic materials. Fluorescent and nonfluorescent, wet and dry methods are available. However, most aviation applications involve using the wet fluorescent method in a batch processing system, which is the most sensitive. Parts are usually magnetized in at least two directions at right angles to each other, and demagnetization of the part is required.

	YES/NO	N/A	REMARKS
1. Is the correct light type (visible or black light) used with intensity values checked and recorded per standard practices?			
2. Are reference standards available and used to measure magnetic field strength?			
3. Do procedures specify demagnetization of the part, and are the parts checked with a field meter?			
4. Is the examining area free of interfering debris and *stray* fluorescent materials, including white light reflectors?			
5. Are appropriate maintenance procedures for the inspection equipment followed as recommended in the equipment manuals or as required by the facility's calibration program?			
6. Is bath concentration measured using established procedures and results documented? Is suspension checked for contamination at established intervals?			
7. Can the magnetization equipment obtain the required amperage specified by the procedures?			
8. Is the equipment capable of adequately demagnetizing the part?			
9. Is there a documented cleaning process to be followed prior to inspection?			
10. After processing, are parts cleaned to remove evidence of magnetic substances?			

Section D: Eddy Current Inspections

An eddy current inspection is used to find surface and near-surface defects in conductive materials. The aviation industry uses these inspections to detect certain defects (e.g., cracks, corrosion damage), verify thickness, and determine material characterization, such as metal sorting and heat treatment verification. The range of applications includes fuselage and structural inspection, engines, landing gear, and wheels. An eddy current inspection, which is the technique most often used after a visual inspection, involves intensive setup and calibration procedures with known reference standards of the same material as the part. Probes of appropriate design and frequency must be used.

	YES/NO	N/A	REMARKS
1. Are appropriate probes and instrumentation being used as called for in the written procedure?			
2. Are appropriate procedures being followed to set up the instrument using reference standards as required by the written procedure?			
3. Are recommended templates and guides being used?			
4. If protective tape is used during the inspection, is it also used during setup and calibration?			
5. Do qualified personnel have proper documented training for the instrument/equipment they are using (e.g., phased array, scanners)?			
6. Does the written procedure spell out frequency, probe type, scanning speed, and scanning direction?			
7. Does the written procedure spell out accept/reject criteria as well as calibration criteria for reference standard calibration?			
8. Are reference standards traceable to required blueprints and specifications?			

Section E: Ultrasonic Inspections

An ultrasonic inspection involves high-frequency sound waves from a transmitting transducer (single or multiple element) being transmitted into or onto the surface of a part to interrogate the material. The sound waves travel on or through the material, then return to either the same transducer or a different transducer. An ultrasonic instrument displays the input and return signals. Differences between the input and output signals are analyzed to determine the flaws, defects, changes in thickness, and other material characteristics. The received signals are compared to the signals of a reference standard. Usually a couplant is used between the transducer and material.

	YES/NO	N/A	REMARKS
1. Are appropriate transducers and couplants being used as called for in the written procedure?			
2. Are recommended maintenance and instrument calibration procedures being followed?			
3. Are recommended templates and guides being used?			
4. Are procedures in place to ensure glycerin is *not* used on aluminum materials, as it causes corrosion?			
5. Do qualified personnel have proper documented training for the instrument/equipment (e.g., phased array, scanners) that they use?			
6. Does the written procedure spell out frequency, transducer type, scanning speed, and scanning direction?			
7. Does the written procedure spell out accept/reject criteria as well as calibration criteria for reference standard calibration?			
8. Are reference standards traceable to required blueprints and specifications?			

Section F: Radiographic Inspections

Radiographic inspections use radiation energy to detect variations in x-ray attenuation in the object under inspection and can detect inclusions, voids, cracks, and changes in geometry or material properties. The aviation industry typically uses two types of radiation energy: x-rays and gamma rays. X-rays are produced by electronic generators, while gamma rays are produced by isotope sources. Radiographic inspections can be used to inspect most materials for both surface and internal flaws, but the orientation of the flaw and source is critical.

	YES/NO	N/A	REMARKS
1. Do written procedures define the x-ray inspection process, including specific equipment?			
2. Are required film types and other detectors available and properly handled and stored?			
3. Are procedures in place to ensure that recommended source to film/detector distances?			
4. Are procedures in place to ensure proper alignment of the x-ray generator with respect to the part being inspected?			
5. Are procedures in place to ensure that film processing chemicals and film are properly stored and used?			
6. Are adequate darkroom facilities available, and are they properly maintained and clean?			
7. Do job procedure task cards specify accept/reject criteria?			
8. Is there a program in place to monitor radiation exposure (film badges, dosimeters, survey meters)?			
9. Is film viewing equipment in good working condition with background illumination controllable to a maximum of 2.5 foot-candles of ambient light for reading films?			
10. Are films properly identified with date, location, aircraft, and component information?			