General Considerations to Support Effective Understanding of EASA Part 145 Inspection Techniques

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The following Subject Areas are covered in this paper :

- Optimising Lighting for Aircraft Inspection - General Visual & Detailed Visual Inspections
- How Does a 145 Organisation Manage a Corrosion Prevention & Control Program (CPCP)?
- Considerations Related to Aircraft MSG 3 Inspections – Accidental Damage (AD) Environmental Damage (ED) and Fatigue Damage (FD)
- What is the Relationship Between Airworthiness Directives (AD,s) Service Bulletins (SB's) & Alert Service Bulletins (ASB's)
- MSG 3 Aircraft Inspection Considerations

Optimising Lighting for Aircraft Inspection - General Visual & Detailed Visual Inspections

Introduction to Performing Effective Inspection

It is extremely important to ensure maintenance is conducted under proper lighting conditions. This is true both for area lighting, that which illuminates the full working area, and task lighting, that directed toward specific work activities. Improper or insufficient lighting can lead to mistakes in work tasks or can simply increase the time required to do the work.

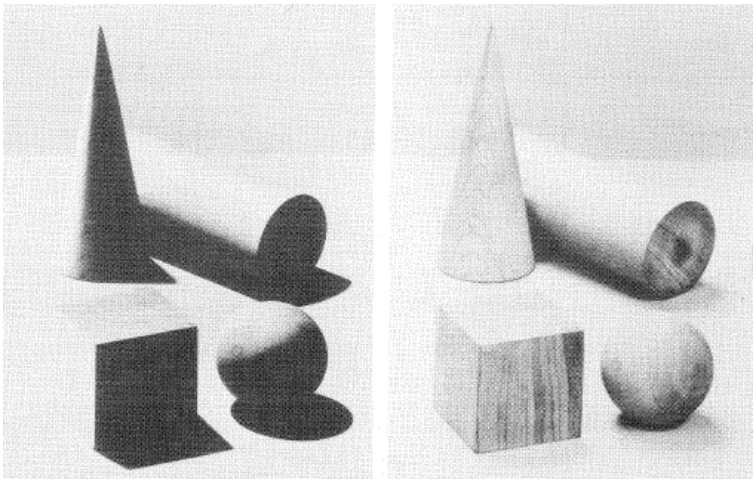
Please consider the No 1 lighting challenge which we face when performing an effective Aircraft Inspection – GLARE !

Glare is the loss of visual performance or discomfort produced by an intensity of light in the visual field greater than the intensity of light to which the eyes are adapted.

Glare may come directly from a light source or be reflected.

Note - Reflected light from bright sources produces glare which can both cause discomfort and reduce visibility of key features of the maintenance task.

The glare tends to obscure or mask part of the visual task.



Types of Glare

There are two types of glare direct and indirect. Direct glare occurs when people look directly at light sources And Indirect glare is caused by light that is reflected to the eye from surfaces of the task area which are in the visual field

Controlling Glare - To Control Direct Glare

- Position lighting units as far from the operator's line of sight as practical
- Use several low-intensity lights instead of one bright one
- Use lights that produce an even light distribution and position workers so that the highest light level comes from the sides, not front and back
- Use lights with diffusers.
- Use indirect lighting
- Use light shields, hoods and visors at the workplace if other methods are impractical

Note Concerning LED Lighting - LEDs are an energy efficient and long lasting source of light. However, they create hot spots of focused light, which are very intense and bright. Hence, diffusers need to be used for an even distribution of the light

Controlling Glare - To Control In- Direct Glare

- Avoid placing lights in the indirect-glare
- Use lights with diffusing or polarizing lenses
- Use surfaces that diffuse light, such as Flat paint, non-gloss Paper, and textured finishes
- Change the orientation of s workplace, task, viewing angle, or viewing direction until maximum visibility is achieved

Concerning GVI & DVI Inspection and Lighting Requirements

In the case of GVI type of Inspections then Standard GVI rules will apply – adequate lighting (The Inspector decides what means adequate!) performed within touching distance of the selected area.

Note - In every case of performing a DVI you must be able to answer the following question -

- What makes this task a DVI task
- What Criteria must I reference to perform this DVI task
- What Lighting do I need to ensure that I can perform the DVI task in the most correct way

How Does a 145 Organisation Manage a Corrosion Prevention & Control Program (CPCP)?

Introduction to Corrosion Prevention and Control Programs (CPCPs)

In 1993 MSG-3 was amended to include assessment of damage to aircraft structures caused by corrosion. Since then, CPCPs have been incorporated into maintenance programs using MSG-3 guidance.

With additional development during the early 1990s by type certificate holders (TCHs) with the assistance of aircraft operators and regulatory authorities in addition FAA Airworthiness Directives (ADs) were issued to reflect various requirements.

Corrosion Prevention and Control Programs (CPCP) Obligations

A Corrosion Prevention and Control Program should be established to maintain the aircraft's resistance to corrosion as a result of systematic (e.g. age-related) deterioration through chemical and/or environmental interaction. This Program applies to damage tolerant and safe-life structures.

The program is expected to allow control of the corrosion on the aircraft to Corrosion Level 1 or better. The CPCP should be based on the Environmental Deterioration (ED) analysis, assuming an aircraft operated in a typical environment.

If corrosion is found to exceed Level 1 at any inspection time, the corrosion control program for the affected area must be reviewed by the operator with the objective to ensure Corrosion Level 1 or better.

Note on Corrosion Levels

Level 1 Corrosion is the damage occurring between successive inspections that is local. and can be reworked/blended-out within allowable limits as defined by the manufacturer in a structural repair manual (SRM), service bulletin, etc.

Level 2 Corrosion is damage occurring between successive inspections that require rework or blend-out that then exceeds the manufacturer's allowable limits, requiring a repair or complete/partial replacement of a principal structural element.

Level 3 Corrosion is damage found during the first or subsequent inspection(s) which is determined by the operator to be a potential airworthiness concern requiring expeditious action.

General Comments

- A CPCP requires a method to notify the Relevant Competent Authority as well as the aircraft's manufacturer regarding findings as well as any data associated with such damage.

- The definitions for different corrosion levels have changed over time, causing issues for air carriers with mixed fleets so to check carefully the applicable documentation relevant to your aircraft type.

- Across Industry there are some differences in reporting requirements for the three corrosion levels.

- A potential issue exists related to "successive blending" (i.e., blending performed in a series versus multiple blends at different times) of corroded areas.

Note on Level 1 Repetition

If a Level 1 area is blended a second time, it becomes Level 2 (However, successive blends after the second blend (up to five in a row) may remain defined as Level 1.)

Question – How does your organisation track successive level 1?

Are you tracking blending very well or not at all? This information may have to be built into maintenance program revisions. Operators CAMO's may be required to show they are recording these blending repairs especially if they wish to take advantage of successive blending allowances.

Concerning Damage Tolerance (DT)

With Level 1 repairs, the amount of material loss during the blending process does not affect the strength requirement; therefore, this would not require DT considerations.

However, a Level 2 corrosion repair that would necessitate a major repair to restore the structural integrity and function of the structure may require a DT inspection or task. – How is this managed?

Considerations Related to Aircraft MSG 3 Inspections – Accidental Damage (AD) Environmental Damage (ED) and Fatigue Damage (FD)

Background to MSG3 Significant Structural Inspection (SSI) Program

Using MSG 3 Maintenance Philosophy we have 3 drivers for Structural Deterioration.

- **Accidental Damage (AD)**
- **Environmental Damage (ED)**
- **and Fatigue Damage (FD)**

Requirements for detecting Accidental Damage (AD), Environmental Deterioration (ED), Fatigue Damage (FD), and procedures for preventing and/or controlling corrosion form the basis for the MRB structural maintenance.

Note 1 - All FD inspection requirements may not be available when the aircraft enters service. (In such cases the manufacturer shall propose, prior to the entry of the aircraft into service, an appropriate time frame for completing the FD inspection requirements.

Note 2 - If the need arises, procedures should be developed for any new material (e.g., new composite material) whose damage characteristics do not follow those previously understood procedures.

Non-metallic Structure

Also susceptible to damage and/or deterioration (e.g., Disbonding and Delamination).

Note 3 - Such structure that is classified as an SSI will require inspections to ensure adequate strength throughout its operational life.

Further Considerations related to Non Metallic Structure

- Susceptibility to Long-term Deterioration (Should be assessed with regard to the operating environment.
- Likely candidates for inspection include areas such as:
    - Major attachments
    - Joints with metallic parts
    - Areas of high stress levels

Note about Composite Materials – Accidental Damage

The consequence of a composite damage may not be readily apparent and may include internal damage, e.g., disbonding or delamination.

Structural Significant Inspection (SSI) Methodology

MSG 3 Aircraft Structural Analysis Procedures identify tasks for are designed to relate the scheduled maintenance tasks to the consequences of structural damage remaining undetected.

Each structural item is assessed in terms of its:

- Significance to continuing airworthiness,
- Susceptibility to any form of damage, and
- The degree of difficulty involved in detecting such damage.

Structural Significant Inspection (SSI) Zonal Inspections

Some parts of the inspection requirements for SSIs and most of the items categorized as Other Structure can be provided by the zonal inspections.

Note - Tasks and intervals included in the zonal inspections should be based on operator and manufacturer experience with similar structure.

- For structure containing new materials and/or construction concepts, tasks and intervals may be established based on assessment of the manufacturer's recommendations.

- Thresholds are normally established as part of the damage tolerance certification requirements. These are subject to change as service experience, additional testing, or analysis work is obtained.

Development of Structural Scheduled Maintenance Tasks - Inspection Thresholds

The inspection threshold for each SSI task is a function of the source of damage.

Accidental Damage (AD)

The first inspection (threshold) Normally corresponds to a period equal to the defined repeat inspection interval, from the time of first entry into service.

Accidental Damage – Causes

- Ground and cargo handling equipment,
- foreign objects,
- erosion from rain & hail,
- lightning,
- runway debris,
- spillage,
- freezing, thawing, etc..,
- Human error during aircraft manufacture, operation or maintenance that are not included in other damage sources.

Environmental Deterioration (ED)

The initial inspection thresholds for all levels of inspection are based on:

- Existing relevant service experience,
- Manufacturers recommendations, and/or
- A conservative age exploration process.

Structural deterioration as a result of a chemical interaction with its climate or environment.

Assessments are required to cover:

- Corrosion,
- Stress corrosion,
- Deterioration of non-metallic materials.

Note: Corrosion may or may not be time/usage dependent.

For example,

- Deterioration resulting from a breakdown in surface protection is more probable as the calendar age increases;

- Corrosion due to galley spillage is a randomly occurring discrete event.

Fatigue Damage (FD)

FD Detection - Inspections related to FD detection in metals are applicable after a threshold, which is established during the aircraft type certification process.

At the time, the fatigue related inspections are implemented, sampling can be used, where it is applicable and effective.

Inspections directly related to fatigue damage detection will occur after a threshold(s) to be:

- Established by the manufacturer and
- Approved by the appropriate regulatory authority.

Which is characterized by:

- The initiation of a crack or cracks due to cyclic loading and subsequent propagation.
- A cumulative process with respect to aircraft usage –

Note Concerning - Widespread Fatigue Damage (WFD)

The likelihood of the occurrence of fatigue damage in an aircraft's structure increases with aircraft usage.

The design process generally establishes a design service goal (DSG) in terms of flight cycles/hours for the airframe.

Any cracking that occurs on an aircraft operated up to the DSG:

- Will occur in isolation (i.e., local cracking),
- Originate from a single source, such as a random manufacturing flaw (e.g., a mis-drilled fastener hole) or a localised design detail.

What is the Relationship Between Airworthiness Directives (AD,s) Service Bulletins (SB's) & Alert Service Bulletins (ASB's)

Airworthiness Directives

Airworthiness Directives (ADs) are legally enforceable rules issued by the Regulatory Authority of the Type Certificate Holder, (TCH) Supplemental Type Certificate Holder (STCH) or Original Equipment Manufacturer (OEM) (may also be issued by other Regulatory Authorities)

Now Consider the Following Statements :

- Airworthiness Directives (AD,s) are Mandatory

- If an Aircraft is not in compliance with AD requirements its Certificate of Airworthiness is not valid and the aircraft shall not fly legally.

- AD,s are only issued by Regulatory Authorities – most usually the authority of the State of Design of the Aircraft or Product

Service Bulletins & Alert Service Bulletins

A Service Bulletin is a notice to an aircraft operator from the Aircraft Engine or component manufacturer informing of a product change or improvement.

An alert service bulletin is issued when an unsafe condition shows up that the manufacturer believes to be a safety related.

Now Consider the Following Statements

- Service Bulletins are NOT Mandatory – The Organisation Responsible for Continuing Airworthiness (CAW Organisation or CAMO) is responsible to develop an assessment policy and to determine the appropriate / necessary action or response.

- Alert Service Bulletins are NOT Mandatory – The CAW Organisation is again responsible. However please consider the next bullet which is an important point!

    - Because the issuer of Alert Service Bulletin has identified a Service Bulletin as Alert – Typically related to a Safety Issue it is expected that the CAW organisation will fully comply with the objectives in the stated and required time frame. (Note - Not doing so would be seen as a serious breach of organisational responsibility without due & valid reason)

So Why Not Just Make Alert Service Bulletins Mandatory?

Quite Simply because the Manufacture does NOT have the authority to do so ! (Only the Regulatory Authorities can “Mandate” such activity)

What does it Mean when we talk about adopting a Service Bulletin?

It means that the Regulatory Authorities, who are in receipt of all Manufacturers Bulletins which are related to a “Safety Concern” can decide to make a particular requirement “MANDATORY” in which case they issue an Airworthiness Directive requiring the actions referenced in the Service Bulletin to be accomplished with a time frame

- Note the AD timeframe maybe be different to the SB timeframe (The AD Timeframe always takes precedence)

Summary

Compliance with an A.D. is exclusively mandatory; compliance with a S.B. is not mandatory unless the service bulletin references or is accompanied by an airworthiness directive.

MSG 3 Aircraft Inspection Considerations

What is MSG 3?

MSG stands for Maintenance Steering Group (3 is the 3rd version of the process and has been around since 1980)

It provides a process which is used for developing scheduled maintenance tasks and intervals, which will be acceptable to the regulatory authorities, the operators and the manufacturers.

MSG 3 recognises the inherent reliability of aircraft systems and components, moreover it avoids unnecessary maintenance tasks and achieves increased efficiency.

MSG 3 is the process which is used to generate the Maintenance Review Board Report – MRBR

The MRBR is the source document which the Type Certificate Holder (TCH) uses to generate the Maintenance Planning Document (MPD)

The MPD consists of MRB tasks plus special tasks including Airworthiness Limitations and Certification Maintenance Requirements

The MPD is the source document for Aircraft Maintenance Program

The following are key features of MSG 3 underlying principles are that:

- Maintenance is only effective if the task applicable
- No improvement will be achieved in reliability by excessive maintenance
- Needless tasks can also introduce human error
- Few complex items exhibit wear out (general failure is random)
- Monitoring generally more effective than hard-time overhaul - Condition-based maintenance (sometimes known as CBM)
- Overall Reliability is only improved by modification
- Maintenance may not be needed if failure cheaper (providing safety is not compromised)

MSG 3 – Facts

- MSG 3 introduced 3 concepts On Condition (OC), Hard Time (HT) and Zonal Inspection Program (ZIP)
- MSG 3 Introduced 3 types of Inspections
    - General Visual (Part of the ZIP)
    - Detailed Visual (Not part of the ZIP – Instead driven be additional task considerations) and
    - Special Detailed Inspection – typically NDT
- MSG 3 Introduced 3 types of Structural Maintenance Triggers
    - Environmental Damage
    - Accidental Damage
    - Fatigue Damage
- MSG 3 Includes the Process known as CPCP Corrosion Prevention and Control Programs (CPCP)
    - The program is expected to allow control of the corrosion on the aircraft to Corrosion Level 1 or better. The CPCP should be based on the Environmental Deterioration (ED) analysis, assuming an aircraft operated in a typical environment.
    - If corrosion is found to exceed Level 1 at any inspection time, the corrosion control program for the affected area must be reviewed by the operator with the objective to ensure Corrosion Level 1 or better.

Quick Questions – What is the difference between GVI & DVI

General Visual Inspection (GVI) is a visual examination of an interior or exterior area, installation or assembly to detect obvious damage, failure or irregularity.

This level of inspection is made from within touching distance unless otherwise specified. A mirror may be necessary to enhance visual access to all exposed surfaces in the inspection area.

Detailed Visual Inspection (DVI or DET) is NOT part of the Zonal Inspection Program! – It is an intensive examination of a specific item, installation or assembly to detect damage, failure or irregularity.

Note Concerning DVI Inspections - Available lighting is normally supplemented with a direct source of good lighting at an intensity deemed appropriate. Inspection aids such as mirrors, magnifying lenses, etc. may be necessary. Surface cleaning and elaborate access procedures may be required.