

Installation Of TSO'd Product Considerations and Guidance



Federal Aviation
Administration



Liz Brandli and Andy Shaw

Conference Date: August 21, 2013

Agenda

- Introduction
- Installation Considerations
- Related Guidance
- Environmental Qualification
- New Software Guidance
- Discussion, Q&A



Introduction

TSO

- Applicant for TSO Authorization (TSOA) is only required to show compliance to TSO requirements (including MOPS)
- TSOA applicant is not required to show compliance to installation requirements (e.g. 1301, 1309, etc.)
- Non-required TSO functions have no TSO requirements associated with them.
- TSOAs can be granted with numerous Open Problem Reports (OPRs) as long as TSO requirements are met.



Installation Considerations (1)

- STC/TC Applicant must ensure
 - the TSO holder used methods of compliance appropriate for the installation
 - data collected during the TSO process contains all the required data to show compliance for airworthiness requirements
 - TSO documentation provided to STC/TC Applicant is complete.
 - all additional functions of article not addressed by MPS are identified as non-TSO functions.



Installation Considerations (2)

- Functional Failure Classifications as part of the FHA may be higher for rotorcraft vs. fixed wing
 - Differences lead to higher Design Assurance Levels for rotorcraft
 - Environmental conditions are typically more severe for rotorcraft vs. fixed wing and require testing appropriate for the expected environment
 - **HIRF environment:** More severe since rotorcraft operate in closer proximity to HIRF sources.
 - **Temperature:** The green house effect due to larger areas of glass than fixed-wing.
 - **Vibration Spectrum:** More severe compared to fixed wing.
 - **System separation:** is more challenging due to smaller size compared to fixed wing aircraft.



Installation Considerations (3)

– SW/AEH Open Problem Reports

- Ensure Open Problem Reports (OPRs) for TSO'd equipment are reviewed and assessed prior to STC/TC installation approval.
- Sufficient detail from TSO manufacturer needed so that potential safety or operational effects can be assessed.
- OPRs accepted at TSO authorization could affect airworthiness compliance for a particular installation.
- Example issues being found during Installation reviews:
 - Non-compliances to the TSO MPS
 - Non-compliances to 1301 and 1309
 - » Safety
 - » Functional Limitations



Installation Considerations (4)

- Typically TSO system level safety assessments by themselves are not complete enough; or in some cases, sufficient for installation approval.
 - Aircraft level safety assessments need to be performed in concert with the system level assessments.
 - Primary purpose of FHA is to set defined failure classifications which drive design assurance levels and design
 - Assumptions at the TSO level should be clearly defined and validated at Installation.
 - Applicants are using equipment reliability to define failure classification
 - Starting with the equipment's reliability and design level, and then defining the failure classification based on that information is not appropriate



Related Guidance (1)

- It is the responsibility of the STC/TC applicants to show compliance and certify that they have complied with the applicable airworthiness regulations and requirements
 - § 27/29.1301,
 - § 27/29.1309, etc.
 - AC 21-50, Installation of TSOA Articles and LODA Appliances
 - AC 21-46, Technical Standard Order Program
 - Order 8150.1C + Chg 1, Technical Standard Order Program
 - Order 8110.4C + Chg 5, Type Certification



Related Guidance (2)

- TSO Applicants may apply for the following:
 - Fully compliant TSOs
 - Incomplete TSOa
 - It is the responsibility of the TSO and TC/STC Holders to evaluate the installation of the incomplete system at a Product level when showing compliance to the airworthiness regulation.
 - TSOs with Deviations
 - Any alternative method or criteria used to meet performance criteria specified in the TSO
 - Applicant shows that factors or design features providing an equivalent level of safety (ELOS) compensate for the standards requested to deviate
 - FAA Headquarters Engineering Division (AIR-100) approval is required for any deviation from the TSO MPS, except the ACO may grant deviation for...example SW levels developed to DO-178B in lieu of earlier versions
 - Non-TSO Functions
 - Covered on next slide



Related Guidance (3)

– Non-TSO Functions

- TSO manufacturers must declare **All** Non-TSO functions in the application package in order to be accepted
- Non-TSO functions will be acknowledged in TSOA/LODA authorization letter
- Acknowledgement of declared non-TSO function data is not an installation design approval.
 - Installers must address non-TSO functions in their showing of compliance to applicable airworthiness regulations and requirements.
- Changes made to non-TSO functions continue to require STC/TC applicant to show compliance to airworthiness regulations and requirements.



Related Guidance (4)

- System Safety Assessment and Design Assurance Levels
 - Design Assurance Levels are driven from and need to be validated through the System Safety Assessment process.
 - § 27/29.1309
 - AC 20-174
 - ARP 4754A



Related Guidance (5)

– Open Problem Reports

- DO-178B/C requires that the Software Accomplishment Summary (SAS) contain a summary of unresolved problem reports, including:
 - A description of each problem.
 - Any associated errors.
 - Functional limitations.
 - Operational restrictions.
 - Potential adverse effects on safety
- Order 8110.49 Change 1 – Oversight of Problem Reporting
- The same OPR information contained in the SAS should be provided to the installer so that the installer can make an assessment as to whether or not the OPR affects safety or requires an operational limitation.
 - A new AIR-120 Policy is coming in 2014 to clarify expectations for OPRs



Related Guidance (6)

- Open Problem Reports (continued)
 - DO-248C DP #9 – Assessment and Classifications of Open Problem Reports
 - Not assessing OPRs at installation could result in a non-compliance to § 27/29.1301 and/or § 27/29.1309



Env. Qual. (1) ... Assessment

- Through the System Safety and Environmental Assessment
 - All potential hazards are to be identified and categorized
 - The scope of required environmental, ground, and/or flight test certification is identified and potentially limited
 - Operational environment verification for equipment performance can be properly scoped.



Env. Qual. (2) ... Installation Considerations

- Is the equipment a potential source (e.g. clocked processor, transmitter) of radiated and/or conducted electromagnetic interference?
 - EMI emissions bench testing (e.g. DO-160, Section 21) should be conducted
 - EMC aircraft testing should also be conducted
- What are the electrical power requirements for the equipment?
 - Equipment must be accounted for in the aircraft ELA
 - Equipment must be connected to the appropriate buss
 - Equipment must not pose a hazard to the aircraft electrical system
- Does the equipment have its own battery
 - Are there any hazards with the battery?
 - Rechargeable lithium technology batteries present special concerns



New SW/AEH Guidance (1)

- AC 20-115C Airborne Software Assurance has been published
 - Recognizes RTCA DO-178C, Software Considerations in Airborne Systems and Equipment Certification
 - Recognizes:
 - DO-330 - Software Tool Qualification
 - DO-331 - Model-Based Development and Verification Supplement
 - DO-332 - Object-Oriented Technology and Related Techniques Supplement
 - DO-333 - Formal Methods Supplement
 - Provides guidance for re-using or modifying legacy software previously approved using DO-178, DO-178A, and DO-178B.
 - Existing DO-178() processes can still be used within certain boundaries:
 - » Software level is appropriate with respect to its installation
 - » MBD, OOT, FM, and/or PDI files have not been introduced
 - » Software plans and development environments have not changed



New SW/AEH Guidance (2)

- AC 20-115C Airborne Software Assurance continued
 - Provides guidance for legacy software tools: For software previously approved using DO-178 or DO-178A: Qualify new or modified tools using DO-330.
 - For software previously approved using DO-178B, and where there is no intention to claim software compliance to DO-178C, existing DO-178B processes for new or modified tools may be used.
 - In some circumstances, the version specified by the TSO may be used; however, other factors may require DO-178C.
 - Introduction of MBD, OOT, FM, PDI (per the AC)
 - Aircraft level requirements
 - Contractual requirements
 - Deviation approved by the ACO (DO-178C recommended)

Note: It is highly recommended that all applicants upgrade to DO-178C. And when establishing new software life-cycle processes, DO-178C is required.



Discussion

