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Minimum Operational Performance Standards (MOPS) For Airborne Separation Assistance System (ASAS)

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FOREWORD

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1 PURPOSE AND SCOPE

1.1 Introduction

This document contains Minimum Operational Performance Standards for ***Airborne Separation Assistance Systems***[1]**.** These standards specify system characteristics that should be useful to designers, manufacturers, installers and users of the equipment.

Compliance with these standards is recommended as one means of assuring that the equipment will perform its intended function(s) satisfactorily under all conditions normally encountered in routine aeronautical operation. Any regulatory application of this document is the sole responsibility of appropriate governmental agencies.

Section 1 of this document provides information needed to understand the rationale for equipment characteristics and requirements stated in the remaining sections. It describes typical equipment operations and operation goals, as envisioned by the members of Special Committee **186**, and establishes the basis for the standards stated in Sections 2 through 3. Definitions and assumptions essential to proper understanding of this document are also provided in this section.

Section 2 contains the Minimum Performance Standards for the equipment. These standards specify the required performance under standard environmental conditions. Also included are recommended bench test procedures necessary to demonstrate equipment compliance with the stated minimum requirements.

Section 3 describes the performance required of installed equipment. Tests for the installed equipment are included when performance cannot be adequately determined through bench testing.

Section 4 describes the operational performance characteristics for equipment installations and defines conditions that will assure the equipment user that operations can be conducted safely and reliably in the expected operational environment.

This document considers functional requirements consisting of: airborne surveillance and separation assurance processing (ASSAP), and cockpit display of traffic information (CDTI) as described in the ASA MASPS, DO-289 Operational performance standards for functions or components that refer to equipment capabilities that exceed the stated minimum requirements are identified as optional features.

The word “function” as used in this document includes all components and units necessary for the system to properly perform its intended function(s). For example, the “function” may be implemented in hardware or software, as appropriate, and the function may be partitioned within the hardware and software as is most convenient for a particular implementation.

If the functional implementation includes a computer software package, the guidelines contained in RTCA Document No. DO-178B, *Software Consideration in Airborne Systems and Equipment Certification*, should be considered.

[1] Bold-italic text in this Guide pertains to the specific equipment described in the MOPS and provides guidance on what type of text needs to be developed.

1.2 System Overview

Describe the system, in general terms, to establish a basic understanding that will support the information to follow in this section. It is important that the Committee define the equipment being specified in the context of the overall system. In preparing material for paragraph 1.2, 1.3 and 1.4, the Committee should consider that a system may comprise airborne and ground elements each having hardware, software, procedural, etc., aspects.

The systems supporting both ground based and aircraft-to-aircraft applications consist of ground systems and the Aircraft Surveillance Applications (ASA) system (Figure 1-1). The ASA system consists of five major subsystems, of which this STP MOPS specifies one subsystem. The five subsystems of ASA are: a surveillance transmit processing subsystem (STP), a surveillance subsystem (including ADS-B and TIS-B transmit and receive), a surveillance data processing subsystem, Airborne Surveillance and Separation Assurance Processing (ASSAP), and a display subsystem Cockpit Display of Traffic Information (CDTI). ASA also interfaces with other aircraft systems. Figure 1-1 provides an overview of the system architecture and depicts the interfaces between functional elements for an ASA aircraft participant. Note that the ADS-B transmit and receive subsystems are specified in RTCA DO-260() and RTCA DO-282() for the 1090 and UAT systems, respectively.

The Surveillance Transmit Processing (STP) subsystem prepares the required surveillance information from on-board aircraft sensors for the ADS-B Transmit Subsystem. Traffic Information Service Broadcast (TIS-B) messages are processed to include similar surveillance information obtained through ground surveillance systems. TIS-B messages are broadcast by the TIS-B Transmit Subsystem. ADS-B Rebroadcast (ADS-R) provides traffic information to equipped aircraft based on ADS-B transmission from aircraft on independent data links (1090ES and UAT).

ADS-B, TIS-B and ADS-R messages are received by the ADS-B/TIS-B Receive Subsystem at the receiving ASA Aircraft/Vehicle (A/V). The ADS-B/TIS-B Receive Subsystem processes these messages and provides ADS-B, TIS-B, and ADS-R traffic reports to ASSAP.

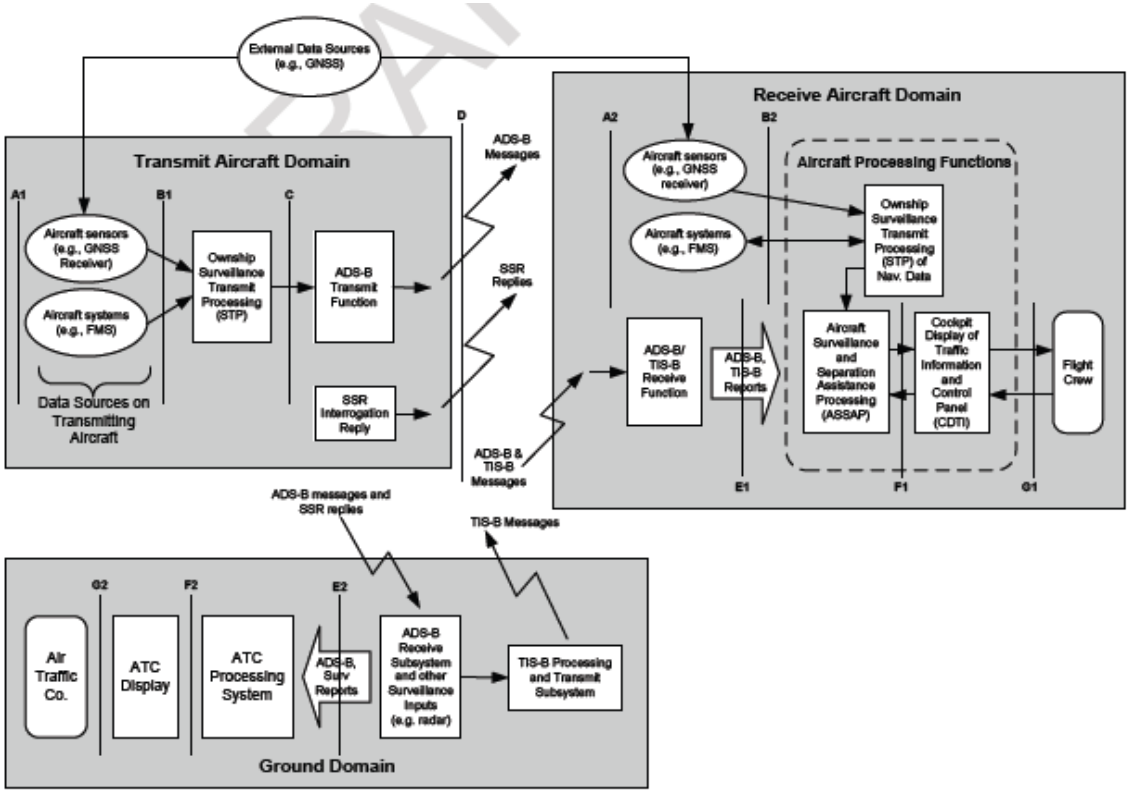


Figure 1-1 Overview of ASA Architecture

1.3 Operational Application(s)

As illustrated in Figure 1-1, ASAS is a critical subsystem of the end-to-end system defined in the Minimum Aviation System Performance Standards (MASPS) for Aircraft Surveillance Application (ASA), (RTCA DO-289). ASAS consists of the ASSAP and CDTI subsystems. ASSAP subsystem represents the surveillance and application-specific processing functions of ASA. ASSAP surveillance processing consists of track processing and correlation of ADS-B, TIS-B, ADS-R, and TCAS reports. The standards defined in this version of the ASAS MOPS have been scoped to support the five applications defined in the ASA MASPS which are as follows:

- Enhanced Visual Acquisition (EVAcq)
- Conflict Detection (CD)
- Airport Surface Situational Awareness (ASSA)
- Final Approach and Runway Occupancy Awareness (FAROA)
- Enhanced Visual Approach (EVApp)

A description of each of the supported applications follows:

Enhanced Visual Acquisition: Cockpit Display of Traffic Information (CDTI) provides traffic information to assist the flight crew in visually acquiring traffic out the window. The CDTI can be used to initially acquire traffic (that the pilot might not have known about otherwise) or as a supplement to an ATC traffic advisory. This application is expected to improve both safety and efficiency by provided the flight crew basic traffic awareness leading to better maneuver decisions.

Conflict Detection (CD): The CDTI is used to alert the flight crew of nearby traffic. The alert may prompt the flight crew to exercise see-and-avoid procedures or to contact ATC. Conflict avoidance maneuvers are not suggested by this application. This application is expected to improve safety by alerting the flight crew about potential conflicting traffic and by providing information that can aid the flight crew in making visual, out-the-window maneuver decisions.

Airport surface Situational Awareness (ASSA), and Final Approach and Runway Occupancy Awareness (FAROA): In these applications, the CDTI is used by the flight crew to make taxiing decisions based on traffic and to determine runway and final approach occupancy. The applications will support the flight crew in making decisions about taxiing, takeoff and landing. They are expected to increase efficiency of operations on the airport surface and reduce runway incursions and collisions. Enhanced Visual Approach: The CDTI is used to assist the flight crew in acquiring and maintaining visual contact during visual approaches. The CDTI is also used in conjunction with visual, out-the-window contact to follow the lead aircraft during the approach, i.e., during conduct of the visual separation task. The application is expected to improve both the safety and the performance of visual approaches. It could allow for the continuation of visual approaches when they otherwise would have to be suspended due to the difficulty of visually acquiring and tracking the other aircraft.

Enhanced Visual Approach (EVApp): The Enhanced Visual Approach (EVApp) application is an extension of the current visual approach procedure. In this application, the CDTI is used by the flight crew to detect and track the preceding aircraft more effectively. The complete application description is included in Appendix G. EVAcq is considered to be a coupled application, as it applies only to the preceding aircraft.

1.4 Intended Function

The intended function of equipment built to the specifications in this MOPS is to **perform the processing** that supports the requirements of the applications described in section 1.3. The equipment will perform its intended function(s), as defined by this document and the manufacturer and its proper use will not create a hazard to other users of the National Airspace System.

1.5 Operational Goals

Add words referring to ASA MASPS. Do we need this section??

1.6 Assumptions

Describe the assumptions made, because of inadequate or non-existent information, having a bearing on stated requirements. Where possible, include a statement regarding the sensitivity of each assumption.

Potential topics:

- Issue S6: Justification for the equipage required for air-to-air applications (DO-260 vs. DO-260 A). How do we deal with ADS-R being restricted to DO-260A rebroadcast. [Don, ?]

- Issue SP1: Justification for acceptable safety impact of not displaying 1090ES targets with duplicate addresses. Currently, DO-260 A relies on the reception of unambiguous addresses to assemble state reports received on multiple squitter messages. But there have been cases where duplicate addresses were observed. This could happen if the installer left a default value or entered the wrong value.
    - Ruy AI #24: What is the safety impact of displaying none in such a case? Determine frequency and apply it to the fault tree analysis.
    - Allen Branch AI#23: Obtain FAA's risk assignment for not displaying a target for these applications. [AIR-130 safety risk??]

- Issue S5: Justification for not defining surface maps in ASSAP.
    - Don AI#1: As long as the applications in ASSAP do not provide alerts for Runway or Surface conflicts, ASSAP does not need to have a surface database. In order to carry out conflict detection for occupied runways or runway crossings, ASSAP will need a runway database. In order to do alerts in other movement areas, ASSAP would need detailed surface movement databases.

- <u>Justification for deviations from ASA MASPS requirements:</u>
    1. Issue AP5: NIC/SIL parameters. Joel AI#47 ("Possible Strategy to Improve Availability of Surveillance Data to support ASA Applications": [Joel]
        - It may be possible to re-assess the ASA MASPS requirements for the situational awareness applications, and judge that accuracy (NACp) is sufficient, rather than an integrity containment bound.
        - ASA MASPS Requirements for EV Acquisition and Conflict Detection (CD) integrity risk are 99%. If the 99% ASA MASPS integrity risk requirements are correct, then these applications requirements should be satisfied with a NACp check, when a "valid" position is reported (i.e., no NIC or SIL check should be required).
    2. Issue AP6, AP7: NACv parameters
        - Don: Tracking of surface traffic may have issues when velocity is below 50Kts. The ASA Apps have requirements for velocity to be accurate (3m/s for ASSA & FAROA. Figure out threshold where that accuracy is not needed for slow targets. [Don]
    3. Issue SP15: Should NACp be extrapolated or not?
        - The strawman functional architecture paper proposed a method for extrapolating the quality (NAC) to meet the following ASA MASPS requirement: "ASSAP shall (R3.188) deliver track reports to the CDTI for all aircraft of sufficient quality for at least enhanced visual acquisition, extrapolated to a common time that is within 1 second of the time the data is delivered to the CDTI, with at least a 1 Hz rate." Also see usability requirement (R3.288 c).

- Joel recommended that NACp not be extrapolated because degradation was implicitly taken into account in the analyses for the 5 applications within the scope of this MOPS and additional advanced applications. If we take this approach, this should be explicitly stated in the MOPS.

4.

1.7 Test Procedures

The test procedures specified in this document are intended to be used as one means of demonstrating compliance with the performance requirement. Although specific test procedures are cited, it is recognized that other methods may be preferred. These alternate procedures may be used if they provide at least equivalent information. In such cases, the procedures cited herein should be used as one criterion in evaluating the acceptability of the alternate procedures.

The order of tests specified suggests that the equipment be subjected to a succession of tests as it moves from design, and design qualification, into operational use. For example, compliance with the requirements of Section 2 shall have been demonstrated as a precondition to satisfactory completion of the installed system tests of Section 3.

a. Environmental Tests

Environmental test requirements are specified in Subsection 2.3. The procedures and their associated limits are intended to provide a laboratory means of determining the electrical and mechanical performance of the equipment under environmental conditions expected to be encountered in actual operations.

Unless otherwise specified, the environmental conditions and test procedures contained in RTCA Document No. DO-160C, *Environmental Conditions and Test Procedures for Airborne Equipment*, will be used to demonstrate equipment compliance.

b. Bench Tests

Bench test procedures are specified in Subsection 2.4. These tests provide a laboratory means of demonstrating compliance with the requirements of Subsection 2.2. Test results may be used by equipment manufacturers as design guidance, for monitoring manufacturing compliance and, in certain cases, for obtaining formal approval of equipment design.

c. Installed Equipment Tests

The installed equipment test procedures and their associated limits are specified in Section 3. Although bench and environmental test procedures are not included in the installed equipment test, their successful completion is a precondition to completion of the installed test. In certain instances, however, installed equipment test may be used in lieu of bench test simulation of such factors as power supply characteristics, interference from or to other equipment installed on the aircraft, etc. Installed tests are normally performed under two conditions:

1. With the aircraft on the ground and using simulated or operational system inputs.

2. With the aircraft in flight using operational system inputs appropriate to the equipment under test.

Test results may be used to demonstrate functional performance in the intended operational environment.

d. Operational Tests

The operational tests are specified in Section 4. These test procedures and their associated limits are intended to be conducted by operating personnel as one means of ensuring that the equipment is functioning properly and can be reliably used for its intended function(s).

1.8 Definition of Terms

Define those terms used in this document that could have multiple meanings or are not normally used.

This section contains definition of terms used in this document that may have ambiguous or multiple meanings or that are not normally used in RTCA standards. See Appendix B for additional definition of terms and Section 2.4.1 for terms specific to test conditions.

SHALL: A mandatory requirement. An approved design must comply with every requirement, which can be assured by inspection, test, analysis, or demonstration.

SHOULD: A recommendation that would typically improve the equipment, but does not constitute a requirement.

MAY: A permission that would likely improve the equipment, but does not constitute a requirement.

CORRELATION:

TRAFFIC: One or more aircraft or surface vehicle(s). (Does not include own-ship)

TARGET: Traffic of particular interest to the crew.

SELECTED TARGET: Traffic that has become distinguishable (e.g., by being highlighted) as a result of being selected.

Note: Notes are in italic and are used for commentary and clarification of requirements and recommendations.

2 Equipment Performance Requirements and Test Procedures

2.1 General Requirements

General equipment requirements need not be tested in the test procedure subsection. If a requirement needs to be tested, it is not a general requirement and should be included in paragraph 2.2**.**

2.1.1 Airworthiness

In the design and manufacture of the equipment, the manufacturer **shall** (R2.1) provide for installation so as not to impair the airworthiness of the aircraft.

2.1.2 Intended Function

The equipment **shall** (R2.2) perform its intended function(s), as defined by the manufacturer, and its proper use **shall** (R2.3) not create a hazard to other users of the National Airspace System.

2.1.3 Federal Communications Commission Rules

All equipment **shall** (R2.4) comply with the applicable rules of the Federal Communication Commission.

2.1.4 Fire Protection

All materials used **shall** (R2.5) be self-extinguishing except for small parts (such as knobs, fasteners, seals, grommets and small electrical parts) that would not contribute significantly to the propagation of a fire.

Note: *One means of showing compliance is contained in Federal Aviation Regulations (FAR), Part 25, Appendix F.*

2.1.5 Operation of Controls

The equipment **shall** (R2.6) be designed so that controls intended for use during flight cannot be operated in any position, combination or sequence that would result in a condition detrimental to the reliability of the equipment or operation of the aircraft.

2.1.6 Accessibility of Controls

Controls that do not require adjustment during flight **shall** (R2.7) not be readily accessible to flight personnel.

2.1.7 Effects of Test

The equipment **shall** (R2.8) be designed so that the application of specified test procedures shall not be detrimental to equipment performance following the application of the tests, except as specifically allowed.

2.1.8 Design Assurance

Reference back to the ASA MASPS for design assurance requirements. This paragraph will discuss the appropriate design assurance level(s) that would be expected as a result of the function definitions and failure categorization(s) contained in Section 1 of the document. This should be based upon the criteria of AC 23.1309 and 25.1309-1b. This paragraph should address both misleading information and the loss of the function. MOPS should point to the latest revision of the RTCA Document No. DO-178() document as a method of establishing the appropriate software levels. A specific software level should not be established in the MOPS since the definitions of the levels could change in RTCA Document DO-178() after the MOPS is issued. The MOPS under development should also point to any hardware or system design assurance standards that are in effect at the time or writing (i.e., SAE ARP-4754).

The hardware and software **shall** [R2.9] be designed and developed such that the probability of providing misleading information (MI) and the probability of loss of function at interface F1 in Figure 1-1 are acceptable based on the overall allocated system integrity and continuity requirements, respectively (see RTCA DO-289[]). These requirements apply when the equipment is in its installed configuration for the most stringent operation supported. To demonstrate compliance, it will be necessary to conduct a safety assessment to evaluate the system's implementation against known failure conditions. This safety assessment should be based upon the guidance of AC 23.1309-1() for Part 23 aircraft, AC 25.1309-1() for Part 25 aircraft, AC 27-1() for normal category rotocraft, and AC 29-2() for transport category rotocraft.

My guess is this could be generalized for both ASSAP and CDTI. Need to check with them.

2.1.9 Performance Monitoring

2.2 Airborne Surveillance and Separation Assistance Processing (ASSAP) Subsystem Requirements

2.2.1 Introduction

ASSAP is a function that receives surveillance reports on other aircraft/vehicles from multiple sources and derives traffic surveillance and application-specific information for visual and / or aural display to the CDTI for the flight crew. ASSAP receives ADS-B / ADS-R / TIS-B reports that are assembled by the ADS-B/TIS-B Receive subsystem from corresponding ADS-B / ADS-R / TIS-B messages.

Note: Future ASAS MOPS that include other applications may also provide guidance information to the CDTI.

It is recognized that manufacturers may implement separate ASSAP and CDTI functions, or a single integrated function that satisfies the requirements of both the ASSAP and CTDI functions.

2.2.2 Performance Requirements

Add list of end-to-end performance **(within ASSAP only?)** metrics, e.g.:

- latency,
- availability,
- integrity
- probability of mismatching TCAS/ADS-B tracks or TCAS/TIS-B tracks, or not matching TCAS/ADS-B tracks or TCAS/TIS-B tracks
- probability of mismatching TIS-B/ADS-B tracks, or not matching TIS-B/ADS-B tracks
- probability of not suppressing own-ship shadows on CDTI (i.e., TIS-B with ownship track)

Traced to ASA Requirements: (R.208-210)

Latency for the combination of ASSAP and the CDTI **(CAN'T PUT REQUIREMENTS ON CDTI HERE)** (interface E to interface G) **shall** (R3.208) be less than 400 ms for targets that are used by coupled applications, targets against which there is an alert, and the 10 highest priority targets. For all other targets, data latency **shall** (R3.209) be less than 1 second.

Note: *The prioritization of targets is application-specific and is to be specified in the ASAS MOPS. The specific allocation of latency to ASSAP and CDTI is also to be specified in the MOPS, including bus latencies.*

ASSAP **shall** (R3.210) achieve the subsystem integrity risk and continuity risk requirements listed in Table 2-1.

Table 2-1: ASSAP Availability, Continuity, and Integrity Requirements (Failure rate per flight hour)

	ASA Capability Level			
Feature	**Basic**	**Intermediate**	**Advanced 1**	**Advanced 2**
Subsystem Continuity Risk	10^{-3}	10^{-3}	10^{-4}	10^{-4}
Subsystem Integrity Risk	10^{-3}	10^{-3}	10^{-5}	10^{-5}

2.2.3 Functional Requirements of ASSAP

ASSAP consist of four main functions:

- Interface maintenance to the following subsystems: ADS-B/TIS-B Receiver, Navigation, CDTI, and TCAS when available;
- Surveillance processing on all available surveillance reports;
- Application-specific processing;
- Performance Monitoring.

In the following subsections requirements for these functions are further defined.

Traced to ASA Requirement

The following are high level functional requirements from ASA MASPS categorized into the three main functions (may not be complete).

Interface Requirements	Surveillance Processing	Application-Specific Processing
Own-ship navigation: Each ASA participant should input to ASSAP the highest quality state data that is available on-board. This should be the same as that used for ADS-B transmission	ASSAP ***shall*** (R3.169) provide a tracking function.	ASSAP ***shall*** (R2.27) assess the ability of own-ship and traffic targets to support the active applications.
Own-ship quality is very similar to target ship quality; however, as the information comes directly from the navigation system it is not yet categorized into NIC, NAC and SIL values. An integrity containment radius for position and associated no-alarm probability are assumed to be available from the navigation system. A	The tracking function shall (R3.170) maintain, for each A/V under track, a file that contains, at a minimum, the elements listed in Table 3-4.	The ASSAP track report ***shall*** (R3.197) be updated to reflect any degraded conditions for EVAcq or ASSA/FAROA, as appropriate, as per Table 2-3.

95% accuracy bound on both position and velocity are also assumed to be available.		
ASSAP ***shall*** (R3.217) provision for the acceptance of these parameters.ASSAP ***shall*** (R3.215) accept a Resolution Advisory flag from the TCAS equipment.	The tracking function shall (R3.171) determine all fields in Table 3-4 that are not directly provided in measurements. The last measurement data fields indicated in Table 3-4 are intended to include variables that were obtained with the last valid measurement received for the track.	The ASSAP track report ***shall*** (R3.198) indicate if the track's quality is insufficient for a basic application.
ASSAP ***shall*** (R3.216) accept a Traffic Advisory flag from the TCAS equipment.	If the aircraft ADS-B installations includes multiple ADS-B links, ASSAP surveillance processing ***shall*** (R3.185) correlate traffic from the different links and associate the traffic with the appropriate ASSAP track.	The degraded data field ***shall*** (R3.193) indicate if the data is considered to be degraded for an active application.
Interface information content in Tables 3-18, 3-16	The tracking function shall (R3.177) initiate a tack for each observed a/v when sufficient measurement information is received to form a minimum track state.	The data quality requirements in Table 2-3 ***shall*** (R2.29) be met for each ACL (note: recommend changing "ACL" to application).
	The tracking function shall (R3.178) terminate a track when the maximum coast interval (Table 2-3, row 17) has been exceeded for all of the applications for which the track is potentially being used.	
	ASSAP shall (R3.176) estimate the quality of the track state information that is maintained in the track file, and maintain quality measures for the track state information, as indicated in Table 3-15.	
	ASSAP surveillance processing ***shall*** (R3.175) optimize the quality of the information best suited to the applications being run (e.g., accuracy, integrity containment bound, or integrity containment risk).	
	ASSAP ***shall*** (R3.186) provide current traffic state position information to the interface with the CDTI with at least a 1Hz rate.	
	ASSAP ***shall*** (R3.188) deliver *track reports* (Table 3-15) to the CDTI for all aircraft of sufficient quality for at least enhanced visual acquisition, extrapolated to a common time that is within 1 second of the time the data is delivered to the CDTI, with at least a 1Hz rate.	
	In the case where there is no valid velocity data, ASSAP ***should*** derive velocity from successive position measurements.	
	ASSAP ***shall*** (R3.189) estimate the velocity accuracy, and use the estimated value to determine traffic qualification as appropriate as indicated by Table 2-3.	

	The ASSAP track ID is a unique identifier from ASSAP to the CDTI that identifies the traffic for which data is being provided. The ASSAP subsystem shall (R3.272) provide to the CDTI, and the CDTI subsystem shall (R3.271b) accept from the ASSAP subsystem, a unique ASSAP track ID for traffic to be displayed.	

2.2.3.1 ASSAP Input / Output Requirements

This section summarizes ASSAP interfaces to other subsystems shown in Figure 1-1.

2.2.3.1.1 ASSAP Input Requirements from ADS-B/TIS-B Receiver

In addition to the interface requirements given I Table 3-18 of the ASA MASPS, let's investigate the following issues:

Issue 1 - May need to address the need to coast some parameters that are not received at every UAT message. For example, UAT does not transmit NAC and SIL with every message. (*Pending Issue Presentation from Roxaneh Chamlou)*

Issue 2 - Do we need to further process the reports assembled from 1090 messages? – *No, according to ACSS discussion paper.*

Issue 3 - Do we need provide guidance on how to process TIS-B Management Reports derived from TIS-B Management Messages? – *This is pending Program Office Decision*

Traced to ASA Requirements:

Table #: Information Elements to ASSAP from ADS-B/TIS-B Receiver

Info Category	Information Element	Reference Section for Definition	Basic	Basic with CD option	Basic with ASSA & FAROA option	Intermediate
Aircraft State Data	Time Of Applicability		•	•	•	•
	Latency		•	•	•	•
	Latitude (WGS-84)		•	•	•	•
	Longitude (WGS-84)		•	•	•	•
	Horizontal Position Valid		•	•	•	•
	Geometric Altitude		•	•	•	•
	Geometric Altitude Valid		•	•	•	•
	Air / Ground State				•	
	North Velocity While Airborne		•	•	•	•
	East Velocity While Airborne		•	•	•	•
	Airborne Horizontal Velocity Valid		•	•	•	•
	Ground Speed While on the Surface				•	
	Surface Ground Speed Valid				•	

Info Category	Information Element	Reference Section for Definition	Basic	Basic with CD option	Basic with ASSA & FAROA option	Intermediate
	Heading While on the Surface (true / mag)				•	
	Heading Valid				•	
	Pressure Altitude		•	•	•	•
	Pressure Altitude Valid		•	•	•	•
	Vertical Rate		•	•	•	•
	Vertical Rate Type (baro / geo)		•	•	•	•
	Vertical Rate Valid		•	•	•	•
	Navigation Integrity Category		•	•	•	•
ID / Status	ADS-B Version Number		•	•	•	•
	Participant Address		•	•	•	•
	Address Qualifier		•	•	•	•
	Call Sign / Flight ID		d	d	d	d
	ASA Capability Level (ACL)		•	•	•	•
	A/V Length and Width Codes				•	
	Emitter Category		•	•	•	•
	Transmit Quality Level		•	•	•	•
	TCAS Installed and Operational					
	TCAS Target Status					
	Navigation Accuracy Category for Position (NAC_P)		•	•	•	•
	Navigation Accuracy Category for Velocity (NAC_V)		•	•	•	•
	Surveillance Integrity Level (SIL)		•	•	•	•
	Barometric Altitude Quality (BAQ)		•	•	•	•
	SIL_{BARO}		•	•	•	•
	True/Magnetic Heading				•	

2.2.3.1.2 ASSAP Input Requirements from TCAS

Table #: Information Elements to ASSAP from TCAS

Info Category	Information Element	Reference Section for Definition	Basic	Basic with CD option	Basic with ASSA & FAROA option	Intermediate
TCAS related data **[notes 1,7]**	TCAS Target Status		•	•	•	•
	Range [note 1]		•	•	•	•
	Bearing [note 1]		•	•	•	•
	Pressure Altitude [note 2]		•	•	•	•
	TCAS Altitude Rate [note 3]		•	•	•	•
	Mode S Address [notes 2, 5]		•	•	•	•

Info Category	Information Element	Reference Section for Definition	Basic	Basic with CD option	Basic with ASSA & FAROA option	Intermediate
	TCAS Track ID [note 1]		•	•	•	•
	TCAS Report Time		•	•	•	•

• = Required; d = desired

Traced to ASA Requirements:

- For initial ASA applications, TCAS data is needed to support configurations with integrated ASA/TCAS traffic displays. The following data items ***shall*** (R3.214) be provided to ASSAP for each TCAS track that is to be displayed:
  - RA Active
  - TA Active
  - Range
  - Bearing
  - Altitude
  - Altitude Rate
  - TCAS Target Aircraft Address - the 24-bit aircraft address (i.e., Mode S address) for the TCAS track (if available to TCAS)
  - TCAS Track ID – internal track ID for the TCAS track (the scheme for identifying TCAS track ID is not standardized)
  - TCAS Report Time – this time may be derived , rather than a specific parameter.
- ASSAP ***shall*** (R3.215) accept a Resolution Advisory flag from the TCAS equipment.
- ASSAP ***shall*** (R3.216) accept a Traffic Advisory flag from the TCAS equipment.

2.2.3.1.3 ASSAP Input Requirements from Own-ship Navigation

Own-ship navigation: Each ASA participant should input to ASSAP the highest quality state data that is available on-board. This should be the same as that used for ADS-B transmission

Table # : Information Elements to ASSAP from Own-ship Navigation

Info Category	Information Element	Reference Section for Definition	Basic	Basic with CD option	Basic with ASSA & FAROA option	Intermediate
Own-ship state data	Time of Applicability		•	•	•	•
	Horizontal Position		•	•	•	•

Info Category	Information Element	Reference Section for Definition	Basic	Basic with CD option	Basic with ASSA & FAROA option	Intermediate
	Horizontal Velocity		•	•	•	•
	Geometric Altitude		•	•	•	•
	Geometric Altitude Rate		•	•	•	•
	Pressure Altitude		•	•	•	•
	Pressure Altitude Rate [note 4]		•	•	•	•
	Ground Speed (on surface)				•	
	Heading (on surface) [note 5]				•	
Own-ship quality	Integrity Containment Region		•	•	•	•
	Integrity Containment Risk		•	•	•	•
	Position Accuracy		•	•	•	•
	Velocity Accuracy		•	•	•	•

• = Required; d = desired

Traced to ASA Requirements:

Own-ship quality is very similar to target ship quality; however, as the information comes directly from the navigation system it is not yet categorized into NIC, NAC and SIL values. An integrity containment radius for position and associated no-alarm probability are assumed to be available from the navigation system. A 95% accuracy bound on both position and velocity are also assumed to be available.

- ASSAP ***shall*** (R3.217) provision for the acceptance of these parameters.

2.2.3.1.4 ASSAP Input Requirements from CDTI

Table: ASSAP from CDTI Report Elements

Info Category	Information Element	Reference Section for Definition	Basic	Basic with CD option	Basic with ASSA & FAROA option
Flight Crew Inputs	Application Selection		•	•	•
	Coupled Target				
	Selected Target				
	ANSD			•	
	Low Level Alert Selection			•	
	Future: Own-ship Planned Final Approach Speed				
Ownship ID	Own-ship Category				

• = Required; d = desired

2.2.3.1.5 ASSAP Output Requirements to CDTI

Table: ASSAP to CDTI Report Elements

Category	Contents	Reference Section	Notes
ID	Call Sign / Flight ID		
State Vector Estimate	Time of SV Estimate		
	Horizontal Position Relative to Own-ship		
	Geometric Altitude		
	Pressure Altitude		
	North Velocity		
	East Velocity		
	Vertical Rate (Baro/Geo)		
	Vertical Rate Type (Baro / Geo)		
	Barometric Altitude Integrity		
Other	Selected Target Closure Rate		
	Degraded Data		
Alerts	CAZ Alert [note 1]		
	CDZ Alert [note1]		
Status	Emitter Category		
	A/V Length and Width Codes		
	Emergency / Priority Status		
	Supported Applications		
TCAS [note 2]	Correlated ADS-B / TCAS Target		
	TCAS Target Status		

Traced to ASA Requirements:

- ASSAP **shall** (R3.186) provide current traffic state position information to the interface with the CDTI with at least a 1Hz rate.
- ASSAP **shall** (R3.187) make ASSAP track reports available to the CDTI for all active applications.
- ASSAP **shall** (R3.188) deliver *track reports* (Table 3-15) to the CDTI for all aircraft of sufficient quality for at least enhanced visual acquisition, extrapolated to a common time that is within 1 second of the time the data is delivered to the CDTI, with at least a 1Hz rate.
- In the case where there is no valid velocity data, ASSAP ***should*** derive velocity from successive position measurements.
- ASSAP **shall** (R3.189) estimate the velocity accuracy, and use the estimated value to determine traffic qualification as appropriate as indicated by Table 2-3.

NOTE: Develop précised conditions under which airborne and surface traffic is to be displayed and filtered in this MOPS.

2.2.3.2 Surveillance Processing

Describe functional architecture for surveillance processing:

- Source-Level Track Generation / Maintenance

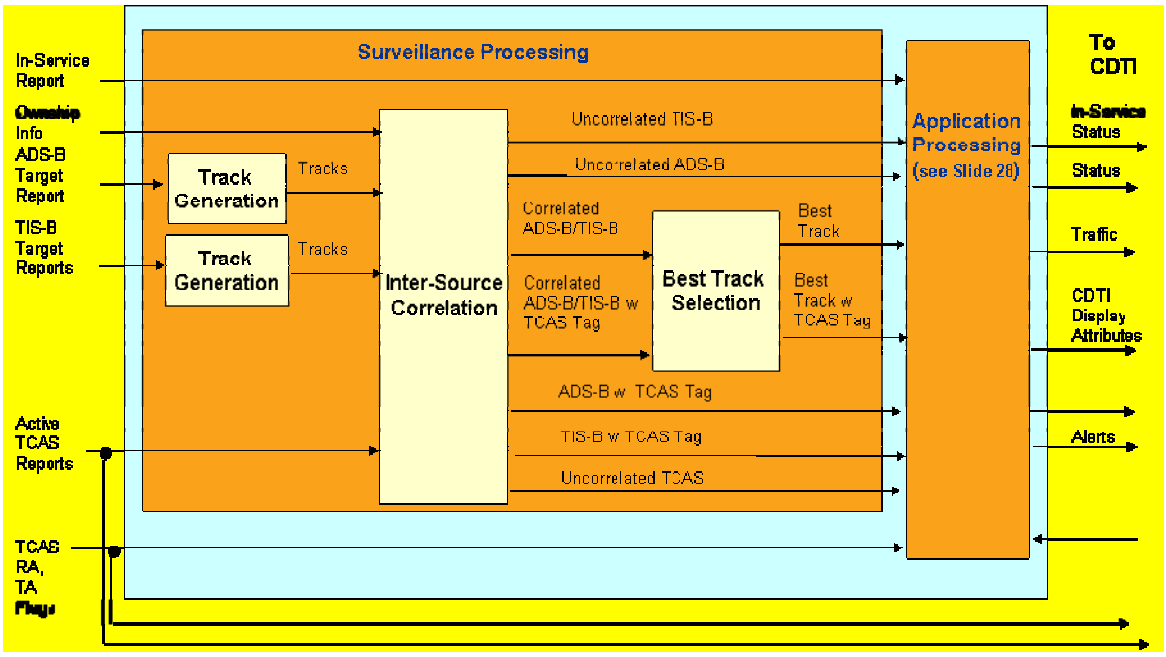
- Establish tracks from ADS-B/ADS-R and TIS-B sources separately.

- Inter-Source Correlation
  - Perform correlation between source-level tracks (ADS-B/ADS-R tracks and TIS-B tracks) to detect when an A/V is tracked by multiple sources.
  - Perform correlation between ownship track and TIS-B track to remove "shadow" on ownship.
  - Perform correlation between TCAS reports and current source-level tracks and tag the source-level tracks with the correlation status.
- Best Source Selection
  - Select the best track when source-level tracks from ADS-B/ADS-R and TIS-B sources correlate.

Explain rationale for this architecture:

- ASSAP surveillance sources (i.e., TIS-B and ADS-B) are employed as mutually exclusive services.
  - Under the Fundamental TIS-B Service, only non-equipped A/V are transmitted.
  - The rarity of simultaneous reporting of an A/V by both TIS-B and ADS-B services does not warrant the complexity of "fusion" tracking.
  - The rare case when both services report on the same A/V, has to be detected by ASSAP to mitigate sending dual tracks to the CDTI for the same A/V.
- Developed an adaptation of a Source-Level Tracker for ASSAP to process ADS-B and TIS-B surveillance sources.

(*Reference: ASSAS Strawman Functional Architecture_Aug906.ppt, Roxaneh Chamlou)*



2.2.3.2.1 Source Level Track Generation / Maintenance

Proposed functions:

- Report Filtering: Culling and Prioritization to Maintain Track Capacity — Preclude reports from further processing according to a list of criteria and priorities to prevent exceeding the track capacity.

- Report-to-Track Association — Match up (perhaps multiple) existing tracks with received report.

- Report-to-Track Resolution — Final track-to-report assignment or track initiation assignment.

- Track State Estimation / Update / Maintenance — Incorporate received report into estimation of track state and track uncertainty for existing tracks.

- Track Initiation — New tracks created using reports not associated with existing tracks.

- Termination

    - Delete track records when reports no longer received.

- Prediction: Estimate track position and uncertainty where it "should" be at some future time (CDTI refresh times). – *Joel proposed at the Nov meeting at RTCA not to predict (extrapolate) the uncertainty because it is included in the application analysis. If we proceed that way, I propose we explicitly state that in the assumptions section.*

- Track Splitting: Detect duplicate target IDs (i.e., multiple A/Vs erroneously assigned the same address) and assign unique track IDs.

- Track Merging for TIS-B only (optional): Detect dual tracks (i.e., one A/V assigned multiple addresses) and merge into one track.

(*Reference: ASSAS Strawman Functional Architecture_Aug906.ppt, Roxaneh Chamlou)*

Traced to ASA Requirements:

ASSAP **shall** (R3.169) provide a tracking function.

- The tracking function **shall** (R3.170) maintain, for each A/V under track, a file that contains, at a minimum, the elements listed in Table 3-4.

- The tracking function **shall** (R3.171) determine all fields in Table 3-4 that are not directly provided in measurements. The last measurement data fields indicated in Table 3-4 are intended to include variables that were obtained with the last valid measurement received for the track.

2.2.3.2.1.1 Report Filtering: Culling and Prioritization to Maintain Track Capacity

Include results from future issue paper assigned to Randy Sleight and Larry Bachman

Describe method of prioritizing tracks

- Range to ownship > 45 nmi???

2.2.3.2.1.2 Report-to-Track Association and Resolution

- Means by which reports are associated with existing tracks. An association criterion based on spatial correlation is proposed to reduce the number of candidate tracks that can be reasonably associated with the latest surveillance report.

- The new report **shall** have valid position and velocity information.

- The report-to-track association function **shall** determine whether the new report is spatially correlated with existing tracks. Rationale: Report-to-track association cannot be based solely on a match between Report ID and existing Track ID.

    - Due to installation errors (e.g., installer left default value or pilot entered wrong ID) duplicate IDs have been observed.

    - UAT Link: Nothing precludes A/Vs with duplicate IDs to be successfully decoded and presented to ASSAP, so a validation region is recommended. (1090ES Link: The avionics receiver cannot decode A/Vs with duplicate IDs and most likely will drop duplicate ID targets.)

- Spatial correlation *may* be accomplished with one or both types of windows

    - Candidate Window (CW) - a coarse window referenced to the position of the new Report that bounds the volume where the target could have been when it was last updated.

    - Association Window - a finer window that predicts candidate tracks to the TOA of the Report and takes into account the uncertainty of both the report and the candidate track may be employed to further define the validation region.

  (*Reference: ASSAS Strawman Functional Architecture_Aug906.ppt, Roxaneh Chamlou)*

  Appendix A, describes one acceptable set of algorithms for computing candidate and association windows.

- The Report-to-Track Resolution function consists of rules that determine when a report updates an existing track (that fall within the CW/AW validation windows) or initiates a new track.

    The report **shall** be resolved to update a track when an established track falls within the CW/AW validation windows and its track ID matches the report ID.

    The report **shall** be resolved to initiate a new track when no track with a track ID that matched the report ID can be found within the validation gate.

  (*Reference: ASSAS Strawman Functional Architecture_Aug906.ppt, Roxaneh Chamlou)*

  Appendix A, describes one acceptable set of algorithms for resolving incoming Report to existing tracks.

2.2.3.2.1.2.1 Association of ADS-B Targets from Multiple Links

Include results from issue paper: *Initial Thoughts on Dual Link Reception of ADS-B, Roxaneh Chamlou*

Traced to ASA Requirements:

- If the aircraft ADS-B installations includes multiple ADS-B links, ASSAP surveillance processing **shall** (R3.185) correlate traffic from the different links and associate the traffic with the appropriate ASSAP track.

2.2.3.2.1.3 Track State Estimation/Update/Maintenance

The ASSAP does not ingest measurements but tracked/filtered reports (i.e., consecutive reports are correlated). Standard tracking techniques that expect measurements as input are not appropriate.

The track state **shall** be updated with the report information when an incoming report has been associated and resolved for an existing track (see 2.2.3.2.1.1):

(*Reference: ASSAS Strawman Functional Architecture_Aug906.ppt, Roxaneh Chamlou)*

Appendix A, describes one acceptable set of algorithms for updating the track with new Report information.

2.2.3.2.1.4 Track Initiation / Track Disclosure

The ASA MASPS only talks about track initiation. We may want to distinguish between (i) track initiation when sufficient measurement information is received to form the minimum track state and (2) track disclosure which would declare an initiated track eligible for display (note, this is different from track selection for CDTI display). How long it takes to disclose the track is a tradeoff between early track display and false track display due to report anomalies.

- A new track ***shall*** be initiated when none of the existing tracks within the spatial correlation window can be associated with the current Report.
- The track ***shall*** be initiated after one Report.
  (Note: Typically a track is initiated after M detections out of N opportunities to mitigate false track initiation. However, this does not appear to be necessary for ASSAP: a TIS-B report has been pre-tracked (by a ground surveillance tracker) to mitigate false track generation (e.g., due multipath); an ADS-B Report is not false unless it is intentionally spoofed. (I think mitigating spoofing on the A/V is outside the scope of this MOPS.)
- The track **shall** be disclosed after … reports have updated the track (study anomalies).
- The new track ID **shall** be set to the report ID. Disagreement within WG: only internal issue. Response: See ASA MASPS requirement 3.3.3.3.1.2.1:

"ASSAP Track ID: The ASSAP track ID is a unique identifier from ASSAP to the CDTI that identifies the traffic for which data is being provided. The ASSAP subsystem shall (R3.272) provide to the CDTI, and the CDTI subsystem shall accept from the ASSAP subsystem, a unique ASSAP track ID for traffic to be displayed."

Traced to ASA Requirements:

The tracking function **shall** (R3.177) initiate a tack for each observed a/v when sufficient measurement information is received to form a minimum track state.

2.2.3.2.1.5 Track Termination

The Track Termination function **shall** delete the established track when the maximum coast interval has been exceeded for all of the applications for which the track is potentially being used.

Traced to ASA Requirements:

The tracking function **shall** (R3.178) terminate a track when the maximum coast interval (Table 2-3, row 17) has been exceeded for all of the applications for which the track is potentially being used.

2.2.3.2.1.6 Track State Prediction to a Common Time

The Track State Predictions functions **shall** perform the following operations on all active tracks that are going to be delivered to the CDTI at a 1Hz rate:

1. Retrieve the track state stored in WGS-84 coordinate system from the track file.
2. Convert the track state from WGS-84 to East-North-Up coordinates centered on ownship position.
3. Predict the track position to the time of delivery using a constant velocity, straight line target trajectory model.

Traced to ASA Requirements:

ASSAP **shall** (R3.175) estimate the quality of the track state information that is maintained in the track file, and maintain quality measures for the track state information, as indicated in Table 3-15.

ASSAP **shall** (R3.186) provide current traffic state position information to the interface with the CDTI with at least a 1 Hz rate.

ASSAP **shall** (R3.187) make ASSAP track reports available to the CDTI for all active applications. ASSAP **shall** (R3.188) deliver track reports to the CDTI for all aircraft of sufficient quality for at least enhanced visual acquisition, extrapolated to a common time that is within 1 second of the time the data is delivered to the CDTI, with at least a 1 Hz rate.

Comment: propose this be allocated here instead of Application Processing as indicated in ASA MASPS.

2.2.3.2.1.7 Track Merge (Optional for TIS-B)

2.2.3.2.1.8 Track Split

Rationale: Mode S SSR data with duplicate addresses recorded at Dallas Airport. Since an ADS-B report can be generated from a single UAT message, nothing precludes reception of duplicate addresses at ASSAP.

Background / Periodic Processing **shall** search the track files (at a source level, i.e., for ADS-B and TIS-B tracks) and ensure that each track has a unique track ID.

The criteria for splitting tracks with duplicate IDs into tracks with distinct track IDs **shall** be:

- Spatial Correlation: distance between the track positions > Thr_distance (adaptable)
- Speed Inconsistency: difference in speed > Thr_speed (adaptable)
- Ground Track Inconsistency (optional): difference in Ground Track > Thr_GT (adaptable)

A new unique local track ID **shall** be assigned to the track.

Traced to ASA Requirements:

The *ASSAP track ID* is a unique identifier from ASSAP to the CDTI that identifies the traffic for which data is being provided. The ASSAP subsystem **shall** (R3.272) provide to the CDTI, and the CDTI subsystem **shall** (R3.271b) accept from the ASSAP subsystem, a unique ASSAP track ID for traffic to be displayed.

2.2.3.2.2 Inter-Source Correlation (Cross Referencing between Sources)

- Correlate between ADS-B/ADS-R and TIS-B (traced to R3.183, R3.184).
- Correlate between ADS-B or ADS-R and TCAS, and between TIS-B and TCAS (traced to R3.179, R3. 181, R3.182).
- Correlate between ownship and TIS-B track and remove track (shadow). (Not traceable to ASA, but seems like a good idea.)

Traced to ASA Requirements:

Shall (R3.172) include a correlation function that associates traffic data from different surveillance sources that relate to the same aircraft/vehicle track, i.e., the correlation function is required to associate and cross-reference traffic data from ADS-B traffic, TIS-B traffic, and TCAS traffic. The correlation function **shall** (R3.173) update traffic cross references when new information is available from the ADS-B/TIS-B receive subsystem or TCAS.

2.2.3.2.2.1 Correlation between TIS-B Tracks and ADS-B/ADS-R Tracks

Background: Detects TIS-B shadows due to

- TIS-B Ground Subsystem's failure to associate ADS-B tracks with tracks generated from other sources (e.g., radar).
- ADS-B air-to-ground is limited due to line-of-sight blockage; air-to-air ADS-B is unhindered.

Correlation between ADS-B and TIS-B tracks **shall** be established in the following order

- Track ID is the same (unlikely to be the case).
- Call Sign is the same (optional input).

- Spatial correlation and velocity consistency is met over M-out-of-N most recent updates.

(*Reference: ASSAS Strawman Functional Architecture_Aug906.ppt, Roxaneh Chamlou)*

Appendix A, describes one acceptable set of algorithms for correlating TIS-B tracks to ADS-B/ADS-R tracks.

Traced to ASA Requirements:

TIS-B / ADS-B correlation: while it is normally expected that TIS-B and ADS-B information (on a given link) will be mutually exclusive, the possibility exists that an ASA participant will receive TIS-B and ADS-B information on the same aircraft. Therefore, ASSAP surveillance processing **shall** (R3.183) cross-correlate the traffic from TIS-B and ADS-B reports supplied by the ADS-B receiver. The correlation should make use of all available data that can assist in this process from state data and other information. The probability of mismatching TIS-B/ADS-B tracks, or not matching TIS-B/ADS-B tracks, **should** be minimized (the criterion for minimizing **shall** (R3.184) be defined in the ASAS MOPS).

2.2.3.2.2.2 Correlation of TCAS Targets with other Tracks

Spatial correlation **shall** be used to determine correlation between TCAS Report and existing TIS-B and ADS-B tracks.

(*Reference: ASSAS Strawman Functional Architecture_Aug906.ppt, Roxaneh Chamlou)*

Appendix A, describes one acceptable set of algorithms for correlating TCAS Report trto other tracks tracks.

Traced to ASA Requirements:

If TCAS data is to be integrated on the CDTI, ASSAP **shall** (R3.179) correlate the TCAS tracks with its internal tracks to the extent practicable. For correlated TCAS tracks, ASSAP **shall** (R3.180) recognize if a track has an active TCAS resolution advisory or traffic advisory, and shall (R3.181) provide that information in the track file (see **Error! Reference source not found.**). The probability of mismatching TCAS/ADS-B tracks, or not matching TCAS/ADS-B tracks, should be minimized (the criterion for minimizing **shall** (R3.182) be defined in the ASAS MOPS).

2.2.3.2.2.3 Correlation between TIS-B Tracks and Own-ship Track

The Inter-Source Correlation Functions **shall** maintain an ownship track with updates from the ownship navigation system.

The ownship track **shall** be correlated to active TIS-B tracks based on spatial correlation and velocity consistency over M-out-of-N most recent updates.

Not traced to ASA MASPS.

(*Reference: ASSAS Strawman Functional Architecture_Aug906.ppt, Roxaneh Chamlou)*

Appendix A, describes one acceptable set of algorithms for correlating TIS-B tracks to ownship track.

2.2.3.2.3 Best Source Selection

Best Source Selection is performed between TIS-B and ADS-B/ADS-R in cases where both are available. The TIS-B service will typically provide for targets that are not ADS-B equipped.

Selection Process (Until one "best" track is available)

– 1) Select Track with both Valid Position and Velocity State Data

  - Airborne: First select sources that have both valid position and velocity. If there are none, then just select sources that have valid "position".
  - Ground: Select sources with valid position.
  - Without "valid" position, there is no valid track.

– 2) Select Track with highest TQL

  - All current ADS-B and TIS-B Link MOPS are interpreted as TQL=0. Future revisions of the Link MOPS are expected to comply with the ASA MASPS TQL.

– 3) Select Track with best integrity for most stringent Active ASA Application

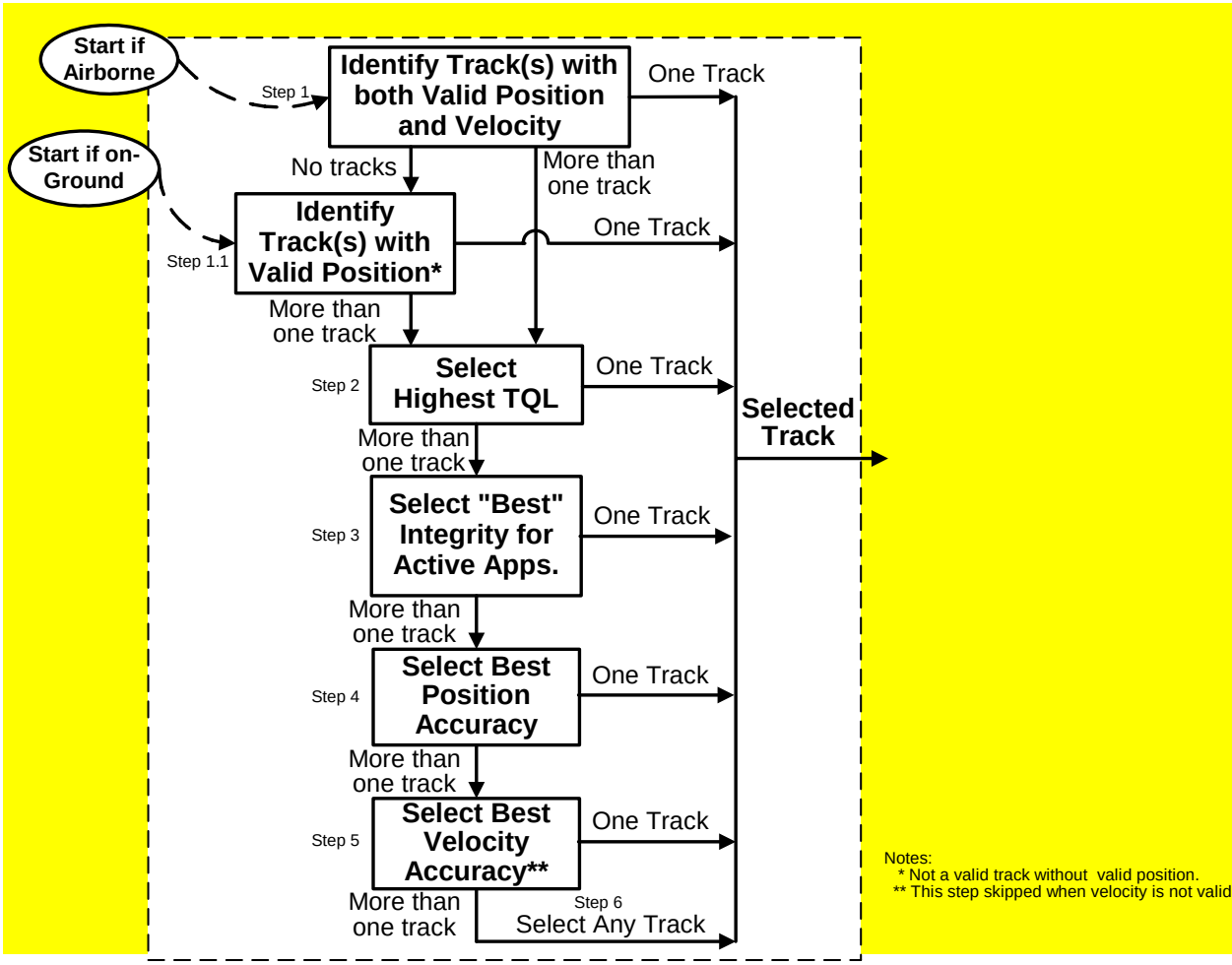
  - For tracks with SIL ≥ 1, select track with smallest containment region (highest NIC)
    - SIL ≥ 1 satisfies Basic and Intermediate ASA applications requirements
    - When the ASSAP MOPS is written to address higher ACLs, then we may need to expand the integrity screening of step 3 (e.g., first select tracks with SIL ≥ 2) to satisfy the "**shall**" requirement to optimize the track selection to the applications being run

– 4) Select Track with best position accuracy (highest NACP)

– 5) Select Track with best velocity accuracy (highest NACV)

– 6) If more than one track is still available, select any of the tracks that remain. They are equivalent.

  - Would like to select ADS-B Track over TIS-B Track [if known]
    - Rationale: TIS-B probably has more lag with all the other parameters equal



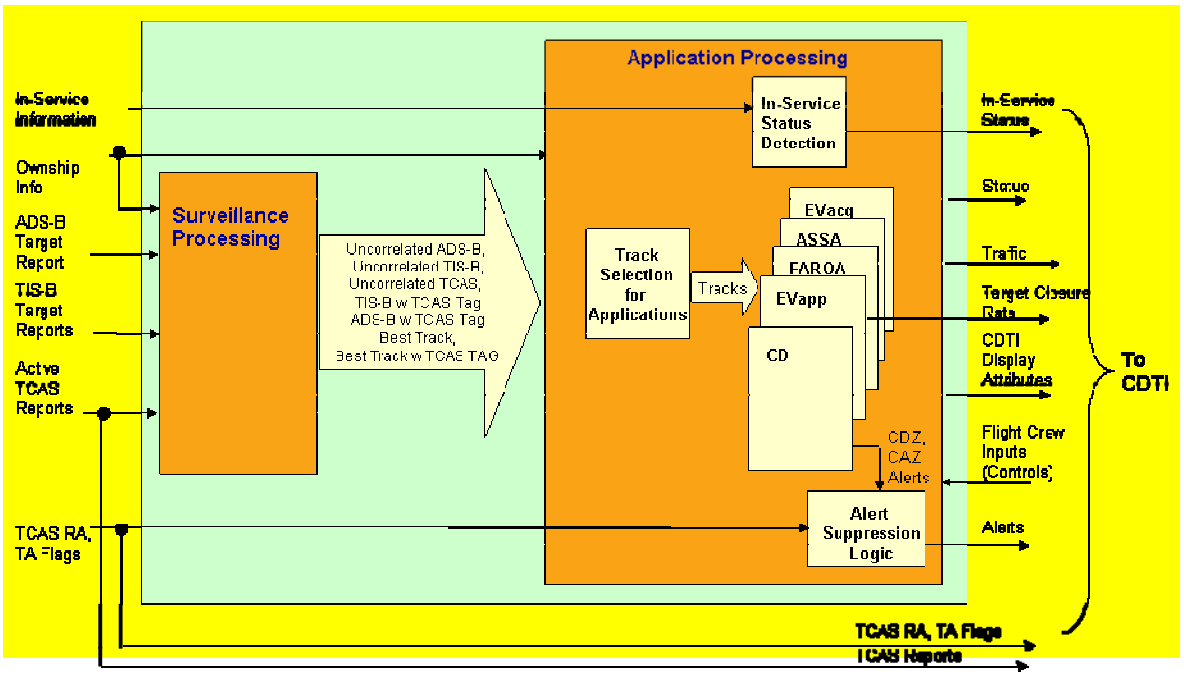
(*Reference: Wichgers_Strawman_Track_Selection_Logic_2006-05-16.ppt, Joel Wichgers)*

Traced to ASA Requirements:

ASSAP surveillance processing **shall** (R3.175) optimize the quality of the information best suited to the applications being run (e.g., accuracy, integrity containment bound, or integrity containment risk).

2.2.3.3 Applications Processing

Provide a functional architecture description.



2.2.3.3.1 General Requirements

Motherhood reqmnts

2.2.3.3.1.1 Common Application Processing Requirements

Proposed topics:

Track selection from 120 tracks (min capacity requirement) to ~ 30; prioritization generic enough to allow flexibility [ACSS]

Sort out whether to show targets as normal/degraded. Not individual application but when multiple applications are active. [CDTI SG; ACSS]

2.2.3.3.1.2 Track Selection for Application (does this go under application specific section?)

Pending issue paper on how tracks are selected to meet different quality requirement of active applications (e.g., which tracks have to meet EVacq vs ASSA/FAROA requirements).

Related ASA Requirements:

- ASSAP **shall** (R2.27) assess the ability of own-ship and traffic targets to support the active applications.
- The data quality requirements in Table 2-3 **shall** (R2.29) be met for each ACL (note: recommend changing "ACL" to application).
- ASSAP track quality **shall** (R3.195) be compared with acceptable values for basic and intermediate applications (Table 2-3).
- The ASSAP track report **shall** (R3.197) be updated to reflect any degraded conditions for EVAcq or ASSA/FAROA, as appropriate, as per Table 2-3.
- The ASSAP track report **shall** (R3.198) indicate if the track's quality is insufficient for a basic application.

- If the installed system has the option for CD, ASSAP **shall** (R3.199) determine if each track is eligible for CD processing, as per Table 2-3.

Requirements from ASA that no longer apply:

- Supported application **shall** (R3.191) indicate the ASA Capability Level of the target track, and **shall** (R3.192) indicate any operational applications that are being processed for the track (i.e., CD, ASSA, FAROA).
- If the sole surveillance source of information is ADS-B or TIS-B, the track quality assessment **shall** (R3.196) be based on the transmit quality level (TQL) transmitted by the source and, for TQL > 1, the NIC, NACP, NACV, and SIL requirements.

Tentative Resolution:

2.2.3.3.1.3 Determination of Track Relative Horizontal Position

Traced to ASA Requirements:

The horizontal position of the target track relative to own-ship **shall** (R3.190) be computed by applying the appropriate coordinate transformation between the track's latitude and longitude and own-ship's latitude and longitude and the display coordinates. (Slant to horizontal range)

2.2.3.3.1.4 Determination of Degraded Target Conditions [ACSS]

Traced to ASA Requirements:

- The degraded data field **shall** (R3.193) indicate if the data is considered to be degraded for an active application.
- The ASSAP track report **shall** (R3.197) be updated to reflect any degraded conditions for EVAcq or ASSA/FAROA, as appropriate, as per Table 2-3.
- The ASSAP track report **shall** (R3.198) indicate if the track's quality is insufficient for a basic application.

2.2.3.3.1.5 Determination of Selected Target Closure Rate or Ground Speed

Traced ASA Requirement:

- The selected target closure rate **shall** (R3.194) indicate the radial line of sight closure rate between own-ship and the selected target. (slant range)

2.2.3.3.1.6 Processing of Selected Surveillance ID/Status Elements [ACSS]

Traced to ASA Requirements:

- The ASA MASPS version number **shall** (R3.203) be used to coordinate applications processing appropriately for the version combination on own-ship and the target ship.
- Call Sign / Flight ID **shall** (R3.204) be included in the ASSAP track file and **shall** (R3.205) be provided to the CDTI in the ASSAP/CDTI report (Table).

- ASA Category **shall** (R3.206) be forwarded to the CDTI.
- A/V length and width codes **shall** (R3.207) be forwarded to the CDTI.
- Emergency / priority status **shall** (R3.208) be forwarded to the CDTI.
- ASSAP **shall** (R3.209) convert heading from true or magnetic heading to the appropriate orientation for consistent display on the CDTI.

2.2.3.3.1.7 Track Prioritization for CDTI Display

Proposed Priority:

- TCAS RA
- TCAS TA
- ASA Application Alerts
- Coupled Traffic
- Selected Traffic
- Closest in Range or one with the shortest time of closest point of

(*Reference: ACSSASSAPMOPSIssueI5.ppt, Tom Eich)*

2.2.3.3.1.8 In-Service Status Detection (Pending Program Office Decision)

Not traced to ASA MASPS

2.2.3.3.2 Application-Specific Requirements

2.2.3.3.2.1 Enhanced Visual Acquisition

ASSAP's contribution to this application includes the tracking and target correlation requirements that are applicable to all applications. ASSAP also determines whether own aircraft information and target vehicle information is good enough to perform EVAcq. The delivery of target information to the CDTI interface is the final step of ASSAP's EVACq responsibility.

2.2.3.3.2.1.1 Own Aircraft Requirements

ASSAP may perform the Enhanced Visual Acquisition application when own aircraft horizontal position is valid. When own aircraft horizontal position is invalid, ASSAP SHALL (R2.xxx) signal that EVAcq is inoperative via the CDTI interface. When own aircraft horizontal position accuracy is greater than 1.0 Nm (1852m), ASSAP SHALL (R2.xxx) signal that EVAcq is inoperative via the CDTI interface.

ASSAP may perform the Enhanced Visual Acquisition application when own aircraft pressure altitude is invalid. This is considered a degraded mode. No ASSAP system should be designed or installed without a pressure altitude source.

**The following paragraph should be moved to the general requirements section.

Own ship position data should be delivered to ASSAP such that the uncompensated latency is less than 200 ms. GPS sensors compliant with ARINC 743A-4 and RNP FMS compliant with ARINC 702A Supplement 3 are examples of acceptable position sources.

2.2.3.3.2.1.2 Target Vehicle Requirements

All versions of existing ADS-B links are eligible to be EVAcq targets (e.g. DO-260 Version 0).

An EVAcq target SHALL (R2.xxx) be derived from a target track with valid horizontal position. A target track with NACp less than 4 or NUC less than 3 SHALL (R2.xxx) be dropped from the CDTI interface.

If an EVAcq track is not updated within 24.2 seconds, ASSAP SHALL (R2.xxx) drop the target from the CDTI interface. This is a maximum allowed timeout based on a TIS-B update. A manufacturer is encouraged to use shorter timeouts for ADS-B and ADS-R targets.

The integrity requirement of this application was determined to be 10^{-2}. This is the same order of magnitude as the accuracy parameter. As a result, the community decided that the accuracy parameter was sufficient to determine state data quality for this application.

2.2.3.3.2.2 ASSA/FAROA

ASSAP's contribution to this application includes the tracking and target correlation requirements that are applicable to all applications. ASSAP also determines whether own aircraft information and target vehicle information is good enough to perform ASSA/FAROA. The delivery of target information to the CDTI interface is the final step of ASSAP's ASSA/FAROA responsibility.

2.2.3.3.2.2.1 ASSA/FAROA Own Aircraft Requirements

ASSAP may perform the ASSA/FAROA application when own aircraft horizontal position and vertical position is valid and of sufficient quality. Vertical position is satisfied by Height Above the Ellipsoid (HAE) or pressure altitude when airborne. Vertical position is satisfied by definition when on the ground. When own aircraft horizontal or vertical position is invalid, ASSAP SHALL (R2.xxx) signal that ASSA/FAROA is inoperative via the CDTI interface. When own aircraft SIL is zero or Radius of Containment is greater than 0.1 Nm (185.2 m) or accuracy is greater than TBD Nm (TBD m) (pending Sheila's action item to check on Boeing/Jeppeson Database error), ASSAP SHALL (R2.xxx) signal that ASSA/FAROA is inoperative via the CDTI interface.

2.2.3.3.2.2.2 Target Vehicle Requirements

All versions of existing ADS-B links are eligible to be ASSA/FAROA targets (e.g. DO-260 Version 0).

An ASSA/FAROA target SHALL (R2.xxx) be derived from a target track with valid horizontal and vertical position. Vertical position is satisfied by Height Above the Ellipsoid (HAE) or pressure altitude when airborne. Vertical position is satisfied by definition when on the ground.

A Version 1 target track SHALL (R2.xxx) have a NACp of 8 or greater, a NIC of 8 or greater, and a SIL of 1 or greater to be marked a valid ASSA/FAROA target.

A Version 0 target track SHALL (R2.xxx) have a NUC of 7 or greater to be marked a valid ASSA/FAROA target.

** This paragraph needs revised and move to the general requirements section.

It is the intent of these requirements to be compatible with the EVAcq requirements for airborne targets. The only difference is that ASSA/FAROA requires ADS-B reports have a valid altitude to be displayed. Without that, the presentation could depict an aircraft flying over the airfield at altitude. This is a nuisance at best, and potentially false and misleading information. Regarding the accuracy requirements, targets with NACp less than 8 have the potential to be depicted on a movement area they are not on. This is considered unacceptable.

If an ASSA/FAROA target in motion is not updated within 11 seconds (**11 seconds is twice the terminal radar sweep rate), ASSAP SHALL (R2.xxx) mark the target invalid for ASSA/FAROA on the CDTI interface. This timeout is based on the TIS-B update rate. A manufacturer is encouraged to use shorter timeouts for ADS-B and ADS-R targets. In motion is defined as moving more than 10 meters in 30 seconds. If an ASSA/FAROA target stopped is not updated within 15 seconds (**15 seconds is 3 times the low squitter rate), ASSAP SHALL (R2.xxx) mark the target invalid for ASSA/FAROA on the CDTI interface.

2.2.3.3.2.3 CD

Determination of Conflict Alert

Traced to ASA Requirements:

If the installed system has the option for conflict detection (CD), ASSAP **shall** (R3.199) determine if each track is eligible for CD processing. Each track that is eligible for CD **shall** (R3.200) be processed by the CD alerting function, and CAZ alerts or CDZ alerts **shall** (R3.201) be issued as appropriate. ASSAP **shall** (R3.202) include in the ASSAP track report the status of the CAZ alert and the CDZ alert.

Alert Suppression Logic

This is not traced to the MASPS.

2.2.3.3.2.4 Enhanced Visual Approach

2.2.3.4 Monitor Requirements

An automatic performance monitoring system, the Monitor, **shall** be implemented.

Note: The purpose of performance monitoring is to detect malfunctions that degrade or preclude ASSAP functionality.

2.2.3.4.1 General Requirements

2.2.3.4.1.1 Failure Response

When a failure is detected, i.e., when the Monitor declares a ASSAP failure, the Monitor **shall**:

a. Indicate to the flight crew that an abnormal condition exists.

b. Anything else??

The Monitor **shall** indicate an ASSAP operational status of "not operational" to the CDTI. The Monitor responses **shall** be accomplished by positive means such that the response functions show an abnormal condition within one second?? of failure detection.

2.2.3.4.1.2 Noninterference with Normal Operation

The Monitor **shall** not interfere with the normal operation of the ASSAP equipment.

2.2.3.4.1.3 Self-Test

The Monitor **shall** include a self-test function, capable of being initiated by the pilot. As a minimum, self-test **shall** test the (aural) alarm and activate each display element in a pre-determined temporal pattern to allow visual verification that display outputs issued by the digital processor can be correctly interpreted by the pilot. The self-test function **shall** not interfere with the normal operation of the equipment.

Note: Flight-crew-initiated operation of display indications for test purposes is not considered interference with normal equipment operation.

2.2.3.4.2 Monitoring of ASSAP Components

2.2.3.4.2.1 Computer Monitoring

The Monitor **shall** include provisions for computer performance monitoring. As a minimum these tests **shall** include random access memory (RAM) pattern tests, central processing unit (CPU) instruction tests, program memory tests, CPU input/output functions tests, and CPU timing tests. The Monitor **shall** be capable of detecting a failure in the computer performance monitoring and upon detection **shall** declare an ASSAP failure.

A means of computer performance testing is required to enable the ASSAP computer performance to be monitored both under normal bench test conditions and under environmental extremes. These computer performance tests may be included in the Monitor or may be a separate test program for use during environmental testing.

2.2.3.4.2.2 Ownship State Data Input Monitoring

The navigation system **shall** provide the Monitor with the quality (i.e., integrity and accuracy of position and velocity) of the ownship state data. The Monitor **shall** declare an ASSAP failure when

(a) Quality has fallen below a threshold (define what that is!!!) for xxx (5?) consecutive ASSAP updates.

(b) Ownship position information is not available for xxx seconds

2.3 Cockpit Display of Traffic Information (CDTI) Subsystem Requirements -- Rathinam

2.4 ASSAP Subsystem Equipment Performance – Environmental Conditions

The environmental tests and performance requirements described in this subsection are intended to provide a laboratory means of determining the overall performance characteristics of the equipment under conditions representative of those that may be encountered in actual aeronautical operation.

Unless otherwise specified, the test procedures applicable to a determination of equipment performance under environmental test conditions are contained in RTCA Document No. DO-160D, *Environmental Conditions and Test Procedures for Airborne Equipment*. General information on the use of RTCA/DO-160D is contained in Sections 1 through 3 of that document. Also, a method of identifying which environmental tests were conducted and other amplifying information on the conduct of the tests is contained in Appendix A of RTCA/DO-160D.

Some of the performance requirements in Subsection 2.2 are not required to be tested to all of the conditions contained in RTCA/DO-160D. Judgment and experience have indicated that these particular parameters are not susceptible to certain environmental conditions and that the level of performance specified in Subsection 2.2 will not be measurably degraded by exposure to these conditions.

In addition to the exceptions above, certain environmental tests contained in this subsection are not required for minimum performance equipment unless the manufacturer wishes to qualify the equipment for additional environmental conditions. If the manufacturer wishes to qualify the equipment to these additional conditions, then these tests **shall** be performed.

Use only those tests listed below that are necessary to assure proper operation in the aeronautical environments envisioned by the Committee. Paragraph 1.0 of RTCA/DO-160D provides additional information on this subject.

2.5 CDTI Subsystem Equipment Performance – Environmental Conditions

2.6 Verification of Surveillance and Separation Assistance Processing ASSAP Subsystem Requirements

The test procedures set forth in the following subparagraphs are considered satisfactory for use in determining required performance under standard and stressed conditions. Although specific test procedures are cited, it is recognized that other methods may be preferred by the testing facility. These alternate procedures may be used if the equipment manufacturer can show that they provide at least equivalent information. In such cases, the procedures cited herein should be used as one criterion in evaluating the acceptability of the alternate procedures. (From 1090 MOPS)

2.6.1 Definition of Standard Conditions of Test

The following definitions of terms and conditions of tests are applicable to the equipment tests specified herein commencing at §2.6.2:

a. Power Input Voltage - Unless otherwise specified, all tests shall be conducted with the power input voltage adjusted to design voltage +/- 2 percent. The input voltage shall be measured at the input terminals of the equipment under test.

b. Power Input Frequency

1. In the case of equipment designed for operation from an AC source of essentially constant frequency (e.g., 400 Hz), the input frequency shall be adjusted to design frequency +/- 2 percent.

2. If the equipment is designed for operation from an AC source of variable frequency (e.g., 300 to 1000 Hz), tests shall be conducted with the input frequency adjusted to within five percent of a selected frequency and, unless otherwise specified, within the range for which the equipment is designed.

c. Accuracy of Test Equipment - Throughout this section, the accuracy of the test equipment is not addressed in detail, but rather is left to the calibration process prescribed by the agency which certifies the testing facility.

d. Adjustment of Equipment - The circuits of the equipment under test shall be properly aligned and otherwise adjusted in accordance with the manufacturer's recommended practices prior to application of the specified tests. Unless otherwise specified, adjustments may not be made once the test procedures have started.

e. Test Instrument Precautions - During the tests, precautions shall be taken to prevent the introduction of errors resulting from the connection of voltmeters, oscilloscopes and other test instruments, across the input and output terminals of the equipment under test.

f. Ambient Conditions - Unless otherwise specified, all tests shall be conducted under conditions of ambient room temperature, pressure and humidity. However, the room temperature shall not be lower than 10 degrees C.

g. Connected Loads - Unless otherwise specified, all tests shall be performed with the equipment connected to loads having the impedance values for which it is designed.

h. Standard ADS-B Broadcast Message Test Signals

The ADS-B Broadcast Message general signal conventions shall be as specified in 2.2.2 and 2.2.3 through 2.2.3.2.1.1.6.

General Characteristics

(a). Radio Frequency: The carrier frequency of the signal generator for ADS-B Broadcast Messages shall be 1090 +/- 1.0 MHz.

(b). CW Output: The CW output between pulses shall be at least 50 dB below the peak level of the pulse.

(c). Pulse Rise and Fall Time: Rise and fall times shall be as specified in subparagraphs 2.2.3.1.3.

(d). Pulse Top Ripple: The instantaneous amplitude of the pulses shall not fall more than 1 dB below the maximum value between the 90 percent voltage amplitude point on the leading and trailing edge of the pulse.

(e). Signal Level: Unless otherwise noted in the measurement procedure, the signal level shall be -60 +/- 3 dBm.

(f). Broadcast Message Rate: Unless otherwise noted in the measurement procedure, ADS-B Broadcast Message Rates shall be 60 +/- 5 Hz.

(g). ICAO 24-Bit Discrete Address: Unless otherwise noted in the measurement procedure, the ADS-B Transmitting System address used for all broadcast messages shall be: Hexadecimal – AA AAAA, (i.e., binary – 1010 1010 1010 1010 1010 1010).

2.6.2 Verification of Performance Requirements (§2.2.2)

Purpose/Introduction:

Add list of end-to-end performance **(within ASSAP only?)** metrics, e.g.:

- latency,
- availability,
- integrity
- probability of mismatching TCAS/ADS-B tracks or TCAS/TIS-B tracks, or not matching TCAS/ADS-B tracks or TCAS/TIS-B tracks
- probability of mismatching TIS-B/ADS-B tracks, or not matching TIS-B/ADS-B tracks
- probability of not suppressing own-ship shadows on CDTI (i.e., TIS-B with ownship track)

Traced to ASA Requirements: (R.208-210)

Latency for the combination of ASSAP and the CDTI **(CAN'T TEST CDTI HERE)** (interface E to interface G) **shall** (R3.208) be less than 400 ms for targets that are used by coupled applications, targets against which there is an alert, and the 10 highest priority targets. For all other targets, data latency **shall** (R3.209) be less than 1 second.

Note: *The prioritization of targets is application-specific and is to be specified in the ASAS MOPS. The specific allocation of latency to ASSAP and CDTI is also to be specified in the MOPS, including bus latencies.*

ASSAP **shall** (R3.210) achieve the subsystem integrity risk and continuity risk requirements listed in Table 2-1.

Table 2-2: ASSAP Availability, Continuity, and Integrity Requirements (Failure rate per flight hour)

	ASA Capability Level			
Feature	**Basic**	**Intermediate**	**Advanced 1**	**Advanced 2**
Subsystem Continuity Risk	10^{-3}	10^{-3}	10^{-4}	10^{-4}
Subsystem Integrity Risk	10^{-3}	10^{-3}	10^{-5}	10^{-5}

Equipment Required:

The tests performed in this subparagraph require **TBD** equipment as described in §2.6.**tbd**.

Also required is a **TBD** source, which is capable of emulating the output of a 1090 Extended Squitter ADS-B receiver, with **TBD**, and **TBD**.

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.2.a)

For the tests in this subparagraph, configure the ASSAP according to **TBD**. As the very last configuration step, set **TBD** to "**TBD**"

Step 2: Latency Test (§2.2.2.a)

For the tests in this subparagraph, configure the ASSAP according to **TBD**. As the very last configuration step, set **TBD** to "**TBD**"

Step 3: Availability Test Setup (§2.2.2.b)

For the tests in this subparagraph, configure the ASSAP according to **TBD**. As the very last configuration step, set **TBD** to "**TBD**"

Step 4: Availability Test (§2.2.2.b)

For the tests in this subparagraph, configure the ASSAP according to **TBD**. As the very last configuration step, set **TBD** to "**TBD**"

Step 5: Integrity Test Setup (§2.2.2.c)

For the tests in this subparagraph, configure the ASSAP according to **TBD**. As the very last configuration step, set **TBD** to "**TBD**"

Step 6: Integrity Test (§2.2.2.c)

For the tests in this subparagraph, configure the ASSAP according to **TBD**. As the very last configuration step, set **TBD** to "**TBD**"

Step 7: **TBD** Test Setup (§2.2.2.d)

TBD …

2.6.3 Verification of Functional Requirements of ASSAP (§2.2.3)

Purpose/Introduction:

Summary of §2.2.3 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.1 Verification of ASSAP Input / Output Requirements (§2.2.3.1)

No specific test procedure is required to validate (§2.2.3.1)

2.6.3.1.1 Verification of ASSAP Input Requirements from ADS-B/TIS-B Receiver (§2.2.3.1.1)

Purpose/Introduction:

Summary of §2.2.3.1.1 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.1.2 Verification of ASSAP Input Requirements from TCAS (§2.2.3.1.2)

Purpose/Introduction:

Summary of §2.2.3.1.2 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.1.3 Verification of ASSAP Input Requirements from Own-ship Navigation (§2.2.3.1.3)

Purpose/Introduction:

Summary of §2.2.3.1.3 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.1.4 Verification of ASSAP Input Requirements from CDTI (§2.2.3.1.4)

Purpose/Introduction:

Summary of §2.2.3.1.4 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.1.5 Verification of ASSAP Output Requirements to CDTI (§2.2.3.1.5)

Purpose/Introduction:

Summary of §2.2.3.1.5 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2 Verification of Surveillance Processing (§2.2.3.2)

Purpose/Introduction:

Summary of §2.2.3.2 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2.1 Verification of Source Level Track Generation / Maintenance (§2.2.3.2.1)

Purpose/Introduction:

Summary of §2.2.3.2.1 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2.1.1 Verification of Report Filtering: Culling and Prioritization to Maintain Track Capacity (§2.2.3.2.1.1)

Purpose/Introduction:

Summary of §2.2.3.2.1.1 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2.1.2 Verification of Report-to-Track Association and Resolution (§2.2.3.2.1.2)

Purpose/Introduction:

Summary of §2.2.3.2.1.2 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2.1.2.1 Verification of Association of ADS-B Targets from Multiple Links (§2.2.3.2.1.2.1)

Purpose/Introduction:

Summary of §2.2.3.2.1.2.1 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2.1.3 Verification of Track State Estimation/Update/Maintenance (§2.2.3.2.1.3)

Purpose/Introduction:

Summary of §2.2.3.2.1.3 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2.1.4 Verification of Track Initiation / Track Disclosure (§2.2.3.2.1.4)

Purpose/Introduction:

Summary of §2.2.3.2.1.4 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2.1.5 Verification of Track Termination (§2.2.3.2.1.5)

Purpose/Introduction:

Summary of §2.2.3.2.1.5 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2.1.6 Verification of Track State Prediction to a Common Time (§2.2.3.2.1.6)

Purpose/Introduction:

Summary of §2.2.3.2.1.6 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2.1.7 Verification of Track Merge (Optional for TIS-B) (§2.2.3.2.1.7)

No specific test procedure is required to validate (§2.2.3.2.1.7)

2.6.3.2.1.8 Verification of Track Split (§2.2.3.2.1.8)

Purpose/Introduction:

Summary of §2.2.3.2.1.8 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2.2 Verification of Inter-Source Correlation (Cross Referencing between Sources) (§2.2.3.2.2)

Purpose/Introduction:

Summary of §2.2.3.2.2 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2.2.1 Verification of Correlation between TIS-B Tracks and ADS-B/ADS-R Tracks (§2.2.3.2.2.1)

Purpose/Introduction:

Summary of §2.2.3.2.2.1 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2.2.2 Verification of Correlation of TCAS Targets with other Tracks (§2.2.3.2.2.2)

Purpose/Introduction:

Summary of §2.2.3.2.2.2 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2.2.3 Verification of Correlation between TIS-B Tracks and Own-ship Track (§2.2.3.2.2.3)

Purpose/Introduction:

Summary of §2.2.3.2.2.3 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.2.3 Verification of Best Source Selection (§2.2.3.2.3)

Purpose/Introduction:

Summary of §2.2.3.2.3 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3 Verification of Applications Processing (§2.2.3.3)

No specific test procedure is required to validate (§2.2.3.3)

2.6.3.3.1 Verification of General Requirements (§2.2.3.3.1)

Purpose/Introduction:

Summary of §2.2.3.3.1 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.1.1 Verification of Common Application Processing Requirements (§2.2.3.3.1.1)

Purpose/Introduction:

Summary of §2.2.3.3.1.1 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.1.2 Verification of Track Selection for Application (does this go under application specific section?) (§2.2.3.3.1.2)

Purpose/Introduction:

Summary of §2.2.3.3.1.2 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.1.3 Verification of Determination of Track Relative Horizontal Position (§2.2.3.3.1.3)

Purpose/Introduction:

Summary of §2.2.3.3.1.3 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.1.4 Verification of Determination of Degraded Target Conditions [ACSS] (§2.2.3.3.1.4)

Purpose/Introduction:

Summary of §2.2.3.3.1.4 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.1.5 Verification of Determination of Selected Target Closure Rate or Ground Speed (§2.2.3.3.1.5)

Purpose/Introduction:

Summary of §2.2.3.3.1.5 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.1.6 Verification of Processing of Selected Surveillance ID/Status Elements [ACSS] (§2.2.3.3.1.6)

Purpose/Introduction:

Summary of §2.2.3.3.1.6 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.1.7 Verification of Track Prioritization for CDTI Display (§2.2.3.3.1.7)

Purpose/Introduction:

Summary of §2.2.3.3.1.7 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.1.8 Verification of In-Service Status Detection (Pending Program Office Decision) (§2.2.3.3.1.8)

Purpose/Introduction:

Summary of §2.2.3.3.1.8 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.2 Verification of Application-Specific Requirements (§2.2.3.3.2)

No specific test procedure is required to validate (§2.2.3.3.2)

2.6.3.3.2.1 Verification of Enhanced Visual Acquisition (§2.2.3.3.2.1)

Purpose/Introduction:

Summary of §2.2.3.3.2.1 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.2.1.1 Verification of Own Aircraft Requirements (§2.2.3.3.2.1.1)

Purpose/Introduction:

Summary of §2.2.3.3.2.1.1 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.2.1.2 Verification of Target Vehicle Requirements (§2.2.3.3.2.1.2)

Purpose/Introduction:

Summary of §2.2.3.3.2.1.2 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.2.2 Verification of ASSA/FAROA (§2.2.3.3.2.2)

Purpose/Introduction:

Summary of §2.2.3.3.2.2 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.2.2.1 Verification of ASSA/FAROA Own Aircraft Requirements (§2.2.3.3.2.2.1)

Purpose/Introduction:

Summary of §2.2.3.3.2.2.1 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.2.2.2 Verification of Target Vehicle Requirements (§2.2.3.3.2.2.2)

Purpose/Introduction:

Summary of §2.2.3.3.2.2.2 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.2.3 Verification of CD (§2.2.3.3.2.3)

Purpose/Introduction:

Summary of §2.2.3.3.2.3 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.3.2.4 Verification of Enhanced Visual Approach (§2.2.3.3.2.4)

Purpose/Introduction:

Summary of §2.2.3.3.2.4 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.4 Verification of Monitor Requirements (§2.2.3.4)

Purpose/Introduction:

Summary of §2.2.3.4 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.4.1 Verification of General Requirements (§2.2.3.4.1)

No specific test procedure is required to validate (§2.2.3.4.1)

2.6.3.4.1.1 Verification of Failure Response (§2.2.3.4.1.1)

Purpose/Introduction:

Summary of §2.2.3.4.1.1 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.4.1.2 Verification of Noninterference with Normal Operation (§2.2.3.4.1.2)

Purpose/Introduction:

Summary of §2.2.3.4.1.2 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.4.1.3 Verification of Self-Test (§2.2.3.4.1.3)

Purpose/Introduction:

Summary of §2.2.3.4.1.3 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.4.2 Verification of Monitoring of ASSAP Components (§2.2.3.4.2)

No specific test procedure is required to validate (§2.2.3.4.2)

2.6.3.4.2.1 Verification of Computer Monitoring (§2.2.3.4.2.1)

Purpose/Introduction:

Summary of §2.2.3.4.2.1 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.6.3.4.2.2 Verification of Ownship State Data Input Monitoring (§2.2.3.4.2.2)

Purpose/Introduction:

Summary of §2.2.3.4.2.2 requirements - **TBD**

Equipment Required:

The tests performed in this subparagraph require **TBD …**

Measurement Procedures:

Step 1: Latency Test Setup (§2.2.**tbd**)

For the tests in this subparagraph, configure the ASSAP according to **TBD** …

2.7 CDTI Subsystem Equipment Test Requirements

3 INSTALLED EQUIPMENT PERFORMANCE

This section states the minimum acceptable level of performance for the equipment when installed in the aircraft. For the most part, installed performance requirements are the same as those contained in Section 2, which were verified through bench and environmental test. However, certain requirements may be affected by the physical installation (e.g., antenna patterns, receiver sensitivity, etc.) and can only be verified after installation. The installed performance limits stated below take in consideration these situations.

3.1 Equipment Installation

3.1.1 Accessibility

Controls and monitors provided for in-flight operations shall be readily accessible from the pilot's normal seated position. The appropriate operator/crew member(s) shall have an unobstructed view of displayed data when in the normal seated position.

3.1.2 Aircraft Environment

Equipment shall be compatible with the environmental condition present in the specific location in the aircraft where the equipment is installed.

3.1.3 Display Visibility

Display intensity shall be suitable for data interpretation under all cockpit ambient light conditions ranging from total darkness to reflected sunlight.

Note: *Visors, glare-shields or filters may be an acceptable means of obtaining daylight visibility.*

3.1.4 Dynamic Range

Operation of the equipment shall not be adversely affected by aircraft maneuvering or changes in attitude encountered in normal flight conditions.

3.1.5 Failure Protection

Any probable failure of the equipment shall not degrade the normal operation of equipment or systems connected to it. Likewise, the failure of interfaced equipment or systems shall not degrade normal operation of this equipment.

3.1.6 Interference Effects

The equipment shall not be the source of harmful conducted or radiated interference nor be adversely affected by conducted or radiated interference from other equipment or systems installed in the aircraft.

Note: *Electromagnetic compatibility problems noted after installation of this equipment may result from such factors as the design characteristics of previously installed*

systems or equipment and the physical installation itself. It is not intended that the equipment manufacturer design for all installation environments. The installing facility will be responsible for resolving any incompatibility between this equipment and previously installed equipment in the aircraft. The various factors contributing to the incompatibility shall be considered.

3.1.7 Inadvertent Turnoff

Appropriate protection shall be provided to avert the inadvertent turnoff of the equipment.

3.1.8 Aircraft Power Source

State any requirements for connecting the equipment to the aircraft power source(s) to assure the equipment will perform its intended function(s) in the operational environment.

3.1.9 Other Requirements

Continue with other requirements concerning equipment installation items such as antenna, etc.

3.2 Installed Equipment Performance Requirements

The installed equipment shall meet the requirements of Subsections 2.1 and 2.2 in addition to, or as modified by, the requirements stated below.

State the requirements that the equipment must meet when installed in the aircraft. The following guidelines, although not all inclusive, serve to illustrate some of the more important aspects that should be considered:

a. ***Requirements should be strictly limited to those that the Committee considers necessary for all applications and user classes.***

b. ***In general, use one paragraph to express a single requirement.***

c. ***Requirements should be expressed in a manner that does not constrain design innovation.***

d. ***Requirements should not place undue constraints on installation flexibility.***

e. ***Care should be taken to define requirements that may be at variance with those stated in Section 2 because of physical or other installation constraints.***

f. ***State those requirements that the equipment must meet to perform its intended function(s) but can only be verified after installation.***

g. ***Unless a requirement can be verified solely through visual inspection, it should be expressed in measurable terms.***

h. ***Particular care must be taken to assure that the requirement statement is compatible with test procedures to be developed for paragraph 3.4.***

3.3 Conditions of Test

The following subparagraphs define conditions under which tests, specified in paragraph 3.4, shall be conducted.

3.3.1 Safety Precautions

State any personnel and/or equipment safety precautions that should be observed because of any unique characteristics of the equipment or installation.

3.3.2 Power Input

Unless otherwise specified, all aircraft electrically operated equipment and systems shall be turned ON before conducting interference testing.

3.3.3 Environment

During testing, the equipment shall not be subjected to environmental conditions that exceed those specified by the equipment manufacturer.

3.3.4 Adjustment of Equipment

Circuits of the equipment under test shall be properly aligned and otherwise adjusted in accordance with the manufacturer's recommended practices prior to application of the specified tests.

3.3.5 Warm-up Period

Unless otherwise specified, tests shall be conducted after a warm-up (stabilization) period of not more than fifteen (15) minutes.

3.3.6 Continue with Other Conditions as Necessary

3.4 Test Procedures for Installed Equipment Performance

The following test procedures provide one means of determining installed equipment performance. Although specific test procedures are cited, it is recognized that other methods may be preferred by the installing activity. These alternate procedures may be used if they provide at least equivalent information. In such cases, the procedures cited herein should be used as one criterion in evaluating the acceptability of the alternate procedures. The equipment shall be tested to determine compliance with the minimum requirements stated in Subsection 2.2. In order to meet this requirement, test results supplied by the equipment manufacturer or other proof of conformity may be accepted in lieu of bench tests performed by the installing activity.

3.4.1 Ground Test Procedures

3.4.1.1 Conformity Inspection

Visually inspect the installed equipment to determine the use of acceptable workmanship and engineering practices. Verify that proper mechanical and electrical connections have

been made and that the equipment has been located and installed in accordance with the manufacturer's recommendations.

3.4.1.2 Equipment Function

Vary all controls of the equipment through their full range to determine that the equipment is operating according to the manufacturer's instruction and that each control performs its intended function.

3.4.1.3 Interference Effects

With the equipment energized, individually operate each of the other electrically operated aircraft equipment and systems to determine that significant conducted or radiated interference does not exist. Evaluate all reasonable combinations of control settings and operating modes. Operate communication and navigation equipment on the low, high and at least on, but preferably four, mid-band frequencies. Make note of system or modes of operation that should also be evaluated during flight. If appropriate, repeat tests using emergency power with the aircraft's batteries alone and the inverters operating.

3.4.1.4 Power Supply Fluctuations

Under normal aircraft conditions, cycle the aircraft engine(s) through all normal power settings and verify proper operation of the equipment as specified by the equipment manufacturer.

3.4.1.5 Equipment Accessibility

Determine that all equipment controls and displayed data are readily accessible and easily interpreted.

3.4.1.6 Continue with Other Test Procedures

Continue with other test procedures to verify those installed performance requirements of paragraphs 3.1 and 3.2 that can be demonstrated with the aircraft on the ground.

3.4.2 Flight Test Procedures

3.4.2.1 Displayed Data Readability

Determine that normal conditions of flight do not significantly affect the readability of displayed data.

3.4.2.2 Interference Effects

For aircraft equipment and systems that can be checked only in flight, determine that operationally significant conducted or radiated interference does not exist. Evaluate all reasonable combinations of control settings and operating modes. Operate communications and navigation equipment on the low, high and at least one, but preferable four, mid-band frequencies.

3.4.2.3 Continue with Other Test Procedures

Continue with other test procedures to verify those installed performance requirements of paragraphs 3.1 and 3.2 that can only, or more conveniently, be demonstrated in flight. Certain cases such as navigation performance, airborne coverage, etc., may require that the aircraft fly paths having specific characteristics. These essential characteristics, including typical flight test paths, should be included together with suggested data acquisition and analysis methods.

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4 EQUIPMENT OPERATIONAL PERFORMANCE CHARACTERISTICS

4.1 Required Operational Performance Requirements

To ensure the operator that operations can be conducted safely and reliably in the expected operational environment, there are specific minimum acceptable performance requirements that shall be met. The following paragraphs identify these requirements.

4.1.1 Power Inputs

Prior to flight, verify that the equipment is receiving primary input power necessary for proper conditions.

4.1.2 Equipment Operating Modes

The equipment shall operate in each of its operating modes.

4.1.3 Continue with Other Operational Requirements as Necessary

4.2 Test Procedures for Operational Performance Requirements

Operation equipment tests may be conducted as part of normal pre-flight tests. For those tests that can only be run in flight, procedures should be developed to perform these tests as early during the flight as possible to verify that the equipment is performing its intended function(s).

4.2.1 Power Input

With the aircraft's electrical power generating system operating, energize the equipment and verify that electrical power is available to the equipment.

4.2.2 Equipment Operating Modes

Verify that the equipment performs its intended function(s) for each of the operating modes available to the operator.

4.2.3 Continue with Other Test Procedures

Continue with other test procedures to verify the requirements of paragraph 4.1.

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