2.4. ASSAP Equipment Performance – Environmental Conditions

2.4.1. General Requirements ~~(info was in 2.4)~~

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 Number 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.

2.4.2. ~~ASSAP~~Specific Requirements (?)

2.4.2.1. Verification of Monitoring (§2.2.4.3)

No specific test procedure is required to validate §2.2.4.3.

2.4.2.1.1. Verification of General Requirements (§2.2.4.3.1)

No specific test procedure is required to validate §2.2.4.3.1.

2.4.2.1.1.1. Verification of Self Test (§2.2.4.3.1.1)

The Monitor **shall** include a self-test function, capable of being initiated by the pilot. As a minimum, self-test **shall** test all audible and visual annunciators 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.

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

The manufacturer shall provide a test plan to verify that the self-test function operates as specified in subparagraph 2.2.4.3.1.1. The general considerations stated in subparagraph TBD for performance monitoring apply. Procedures for self-test verification may, whenever appropriate, use the results of tests performed under subparagraph TBD for performance monitoring.

2.4.2.1.1.2. Verification of Non Interference (§2.2.4.3.1.2)

The Monitor **shall** not interfere with the normal operation of ASA. Any RF test signals used by the Monitor **shall** be restricted by the compatibility requirements [TCAS and ADS-B MOPS?]

No verification requirements? (None in TCAS MOPS DO-185A)

2.4.2.1.2. Verification of Monitoring of ASAS Computer Resources (§2.2.4.3.2)

ASAS **shall** include provision for monitoring its computer resources. As a minimum this monitoring **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** annunciate a failure. A means of computer performance testing is required to enable ASAS 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.

The verification of ASAS computer resources shall include the following items:

1. RAM pattern tests – the manufacturer shall verify RAM by writing unique patterns of 1's and 0's into RAM and then read these values back out of RAM to check for bad bits. Each memory bit shall be verified using both 0's and 1's.

2. CPU instruction tests – the manufacturer shall verify that CPU instructions are correct and functional (ie; not corrupted).

3. Program memory tests – the manufacturer shall verify that the software program contained in program memory is as originally loaded. (ie; has not been corrupted)

4. Input/Output Tests – the manufacturer shall verify all ASAS I/O functions.

5. Timing Tests – the manufacturer shall verify that all CPU's, microcontrollers and other devices utilizing a clock input operate within their allowable timing constraints as established by each device's manufacturer.

2.4.2.1.3. Verification of ASAS Input Data Monitoring (§2.2.4.3.3)

No specific test procedure is required to validate §2.2.4.3.3.

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2.4.2.1.3.1. Verification of ADS-B Receive Subsystem (§2.2.4.3.3.1)

ASAS **shall** monitor the ADS-B report interface from each ADS-B receiver. ASAS **shall** annunciate a failure on loss of input data from any ADS-B receive subsystem.

Note: this could be accomplished though a periodic heartbeat message that would indicate function in the absence of traffic

The manufacturer shall verify the ADS-B receive monitor per the following procedure:

1. Provide ADS-B receive data into the ASAP function, either via a real unit or a simulated data stream. Interrupt the ADS-B receive data into ASAP and verify the annunciation of loss of ADS-B receive data.

2. Provide ADS-B receive data into the ASAP function, either via a real unit or a simulated data stream. Corrupt the ADS-B receive reports into ASAP and verify the annunciation of loss of ADS-B receive data.

2.4.2.1.3.2. Verification of TCAS (§2.2.4.3.3.2)

ASAS **shall** monitor TCAS output to verify TCAS function. ASAS **shall** annunciate a failure on loss of data from TCAS

Note: this could be accomplished though a periodic heartbeat message that would indicate function in the absence of traffic

The manufacturer shall verify the TCAS monitor per the following procedure:

3. Provide TCAS data into the ASAP function, either via a real unit or a simulated data stream. Interrupt the TCAS data into ASAP and verify the annunciation of loss of TCAS data.

4. Provide TCAS data into the ASAP function, either via a real unit or a simulated data stream. Corrupt the TCAS data words into ASAP and verify the annunciation of loss of TCAS data.

2.4.2.1.3.3. Verification of Ownship State Data (§2.2.4.3.3.3)

ASAS **shall** monitor the inputs that provide Ownship state data. ASAS **shall** annunciate a failure on loss of any positional or velocity data.

The manufacturer shall verify the ownship data monitor per the following procedure:

5. Provide ownship data into the ASAP function, either via a real unit or a simulated data stream. Interrupt the ownship data into ASAP and verify the annunciation of loss of ownship data.

6. Provide ownship data into the ASAP function, either via a real unit or a simulated data stream. Corrupt the ownship data words into ASAP and verify the annunciation of loss of ownship data.

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~~2.4.3~~2.5. CDTI Equipment Performance – Environmental Conditions ~~(was section 2.5, but listed as 2.4.3 in writing responsibilities)~~

2.5.1. General Requirements

TBD

2.5.2. Specific Requirements (?)

~~2.5~~2.6. ASSAP Equipment Test Procedures ~~(listed as 2.6 in writing responsibilities, but no 2.5 existed).~~

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.

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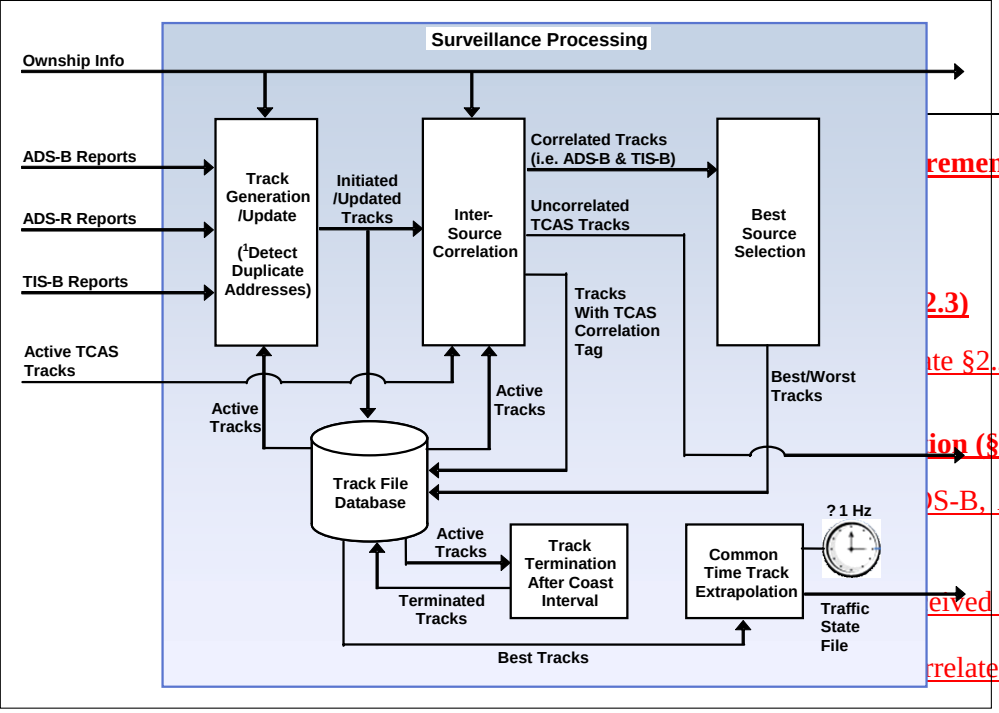

rements (§2.2.2)

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ion (§2.2.3.1)

S-B, ADS-R, and TIS-B) are tracked and

eived report to an existing track.

rrelates with the track.

c. A report **shall** initiate a new track when the report does not correlate with an existing track.

d. Report to track correlation logic **shall** take into consideration all of the following criteria: address, altitude, velocity, position, and quality.

e. The correlation algorithm **shall** perform at least as well as the example algorithm given in Appendix TBD with respect to distinguishing unique tracks and miscorrelating reports. This intent is met by passing the correlation test scenarios given in section 2.TBD.

f. ASSAP **shall** be capable of maintaining at least 130 source tracks. Priority will determine which tracks are maintained when more than 130 unique reports are presented to ASSAP.

*Note: Source tracks do not include TCAS tracks (**Test requirement needed**).*

2.6.3.1.1. Verification of Track Estimation (§2.2.3.1.1)

a. Track estimates **shall** be generated at a rate of 1 Hz or greater.

b. Track estimates **shall** include target horizontal position, altitude, and horizontal position accuracy indicators estimated to a common time of applicability for all tracks.

Test Tool Requirements:

This test will require the generation of scenarios using the data in table ##, in Appendix ##. It will also require a test tool for measuring track estimate output rates.

Test Procedure:

Devise a method of measuring the output rate for track estimates. Generate scenario(s) using the data in table ##. Be sure to allow ## second gaps in the ADS-B message flow to force track estimation and measure the track estimate output rate for each target in the Scenario. Verify that the rates equal or exceed one estimate per second for each of the test targets.

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Using these same generated scenario(s), verify that all of the track estimates made during the course of the scenario coincide with the values in table ## to include target horizontal position, altitude, and horizontal position accuracy indicators and also ensure that these parameters are estimated to a common time of applicability for all tracks.

Do we want a metric for measuring how accurate the estimates need to be?

2.6.3.2. Verification of Inter-source Correlation (§2.2.3.2)

No specific test procedure is required to validate §2.2.3.2.

2.6.3.2.1. Verification of Correlation of ADS-B, ADS-R, and TIS-B Tracks (§2.2.3.2.1)

The inter-source correlation algorithm **shall** perform at least as well as the example algorithm given in Appendix TBD with respect to distinguishing unique tracks and miscorrelating tracks between ADS-B, ADS-R, and TIS-B sources. This intent is met by passing the correlation test scenarios given in section 2.TBD.

2.6.3.2.2. Verification of Correlation of TIS-B with Ownship (§2.2.3.2.2)

The inter-source correlation algorithm **shall** perform at least as well as the example algorithm given in Appendix TBD with respect to correlating a TIS-B shadow with Ownship. This intent is met by passing the correlation test scenarios given in section 2.TBD.

2.6.3.2.3. Verification of Correlation of TCAS with ADS-B, ADS-R, and TIS-B Tracks (§2.2.3.2.3)

The inter-source correlation algorithm **shall** perform at least as well as the example algorithm given in Appendix TBD with respect to distinguishing unique tracks and miscorrelating tracks between TCAS and ADS-B, ADS-R, or TIS-B sources. This intent is met by passing the correlation test scenarios given in section 2.*TBD*.

2.6.3.3. Verification of Best Source Selection (§2.2.3.3)

When multiple source tracks correlate, the best quality source track **shall** be chosen using the following criteria in priority order:

1. Source with the greatest reported SIL
2. Source with the greatest reported NIC
3. Source with the greatest extrapolated NACp
4. Source with the greatest extrapolated NACv

TCAS reports do not contain any of these criteria. When a TCAS track correlates with an existing track it **shall** only be chosen as the best track when all other source position accuracies drop below the minimum threshold for performing the Enhanced Visual

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Acquisition application. This establishes a minimum requirement for source selection and is not intended to prohibit source fusion techniques.

Test Tool Requirements:

This test will require the generation of targets from at least 2 sources as well as from a TCAS source as a prerequisite.

Test Procedure:

Case 1: Generate a track from each source for a single target and give a high SIL value to one of the source tracks. Verify that the source track with the highest SIL value is selected.

Case 2: Generate a track from each source for a single target and have all the SIL values below the minimum threshold for performing the Enhanced Visual Acquisition application. Give one source track a higher NIC value and verify that this source track is selected.

Case 3: Generate a track from each source with SIL and NIC values below the minimum threshold for performing the Enhanced Visual Acquisition application. Give one source track a higher NACp and verify that this source track is selected.

Case 4: Generate a track from each source with SIL, NIC and NACp values below the minimum threshold for performing the Enhanced Visual Acquisition application. Give one source track a higher NACv and verify that this source track is selected.

Case 5: Generate a track from each source with SIL, NIC, NACp and NACv values below the minimum threshold for performing the Enhanced Visual Acquisition application. Generate a TCAS track for the same target and verify that the TCAS track is selected.

2.6.3.4. Verification of Track Termination (§2.2.3.4)

ASSAP **shall** terminate a track when the maximum coast interval has been exceeded for all of the applications for which the track is potentially being used. The coast interval is the elapsed time since a report from any source has been correlated with the track.

2.6.4. Verification of Application Processing (§2.2.4)

No specific test procedure is required to validate §2.2.4.

2.6.4.1. Verification of General Requirements (§2.2.4.1)

Tom Eich is on the hook

Ownship position data should (or **shall**?) 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.

The ASSA/FAROA requirements for airborne targets are consistent with the EVAcq requirements for airborne targets. The only difference is that ASSA/FAROA requires

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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.

2.6.4.2. Verification of Application-Specific Requirements (§2.2.4.2)

No specific test procedure is required to validate §2.2.4.2.

2.6.4.2.1. Verification of Enhanced Visual Acquisition (EVAcq) (§2.2.4.2.1)

No specific test procedure is required to validate §2.2.4.2.1.

2.6.4.2.1.1. Verification of Ownship Requirements for EVAcq (§2.2.4.2.1.1)

ASSAP may perform the Enhanced Visual Acquisition application when Ownship horizontal position is valid. When Ownship horizontal position is invalid, ASSAP **shall** (R2.xxx) signal that EVAcq is inoperative via the CDTI interface. When Ownship 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 Ownship pressure altitude is invalid. However, without Ownship altitude, the relative altitude tags on the targets will have to be (**shall** be?) removed from the display. This is considered a degraded mode. No ASSAP system should be designed or installed (tested in Section 3?) without a pressure altitude source.

Test Tool Requirements:

This test will require a source for the generation of Own-ship data, a pressure altitude source and a CDTI Display

Test Procedure:

Case 1: Generate Own-Ship data with the Own-ship horizontal position invalid and verify that ASSAP signals that EVAcq is inoperative via the CDTI interface.

Case 2: Generate Own-Ship data with the Own-ship horizontal position accuracy parameter greater than 1.0 Nm and verify that ASSAP signals that EVAcq is inoperative via the CDTI interface.

Case 3: Generate Own-Ship data with the Own-ship pressure altitude invalid and verify that the relative altitude tags are not displayed.

2.6.4.2.1.2. Verification of Target Vehicle Requirements for EVAcq (§2.2.4.2.1.2)

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.

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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 coast interval based on a TIS-B update. A manufacturer is encouraged to use shorter coast intervals 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.

Test Tool Requirements:

This test will require the generation of multiple target scenarios as a prerequisite.

Test Procedure:

Case 1: Generate a scenario with a track that initially has NACp greater than or equal to 4. Have the NACp value drop below 4. Verify that the track is dropped from the CDTI at this time.

Case 2: Generate a scenario with a track that initially has NUC greater than or equal to 3. Have the NUC value drop below 3. Verify that the track is dropped from the CDTI at this time.

Case 3: Generate a scenario with a track that initially has NACp greater than or equal to 4. Update this track in 24 seconds and verify that the track remains on the CDTI. Update the track again in 25 seconds and verify that the track was dropped prior to the second update.

Case 4: Generate a scenario with a track that initially has NUC greater than or equal to 3. Update this track in 24 seconds and verify that the track remains on the CDTI. Update the track again in 25 seconds and verify that the track was dropped prior to the second update.

2.6.4.2.2. Verification of Airport Surface Situational Awareness/Final Approach and Runway Occupancy Awareness (ASSA/FAROA) (§2.2.4.2.2)

No specific test procedure is required to validate §2.2.4.2.2.

2.6.4.2.2.1. Verification of Ownship Requirements for ASSA/FAROA (§2.2.4.2.2.1)

Note: revisit altitude source issues after geo altitude action is resolved

ASSAP may perform the ASSA/FAROA application when Ownship 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 Ownship horizontal or vertical position is invalid, ASSAP **shall** (R2.xxx) signal that ASSA/FAROA is inoperative via the CDTI interface. When Ownship SIL is zero or Radius of Containment is greater than 0.1 Nm (185.2 m) or accuracy is greater than 0.04 Nm (74 m), ASSAP **shall** (R2.xxx) signal that ASSA/FAROA is inoperative via the CDTI interface.

Test Tool Requirements:

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This test will require a source for the generation of Own-ship data.

Test Procedure:

Case 1: Generate Own-Ship data with the Own-ship horizontal position invalid and verify that ASSAP signals that ASSA/FAROA is inoperative via the CDTI interface.

Case 2: Generate Own-Ship data, in the airborne state, with the Own-ship vertical position invalid and verify that ASSAP signals that ASSA/FAROA is inoperative via the CDTI interface.

Case 3: Generate Own-Ship data, in the on-ground state, with the Own-ship vertical position invalid and verify that ASSAP signals that ASSA/FAROA is operative via the CDTI interface.

Case 4: Generate Own-Ship data with the Own-ship SIL set to zero and verify that ASSAP signals that ASSA/FAROA is inoperative via the CDTI interface.

Case 5: Generate Own-Ship data with the Own-ship Radius of containment greater than 0.1 Nm and verify that ASSAP signals that ASSA/FAROA is inoperative via the CDTI interface.

Case 6: Generate Own-Ship data with the Own-ship position accuracy greater than 0.04 Nm and verify that ASSAP signals that ASSA/FAROA is inoperative via the CDTI interface.

2.6.4.2.2.2. Verification of Target Vehicle Requirements for ASSA/FAROA (§2.2.4.2.2.2)

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 DO-260A and DO-282A Version 1 surface 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 DO-260 and DO-282 Version 0 surface target track **shall** (R2.xxx) have a NUC of 7 or greater to be marked a valid ASSA/FAROA target.

An ASSA/FAROA target **shall** (R2.xxx) be derived from a target track with valid horizontal position. An airborne target track with NACp less than 4 or NUC less than 3 **shall** (R2.xxx) be dropped from the CDTI interface.

** work the language so both requirements are stated consistently i.e dropped or displayed

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

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ASSA/FAROA on the CDTI interface. This coasting interval is based on the TIS-B update rate. A manufacturer is encouraged to use shorter coasting intervals 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.

2.6.4.2.2.3. Verification of Conflict Detection (CD) (§2.2.4.2.2.3)

The objective of Conflict Detection (CD) is to enhance the flight crew's awareness of participating proximate traffic by providing alerts when aircraft separation is predicted to become compromised. The alerts may prompt the flight crew to exercise "see and avoid" procedures. Avoidance maneuvers are not provided by the application, and the flight crew must not maneuver based solely on the CDTI information. The CD application is a subset of the Airborne Conflict Management (ACM) application.

ASSAP's contribution to this application includes the tracking and target correlation requirements that are applicable to all applications. ASSAP determines whether the quality of Ownship information and target vehicle information is sufficient to perform CD.

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. CAZ alerts and 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.

The CD algorithm **shall** perform at least as well as [measured how? what metric?] the example algorithm given in Appendix TBD with respect to time to alert and false alarm rate. This intent is met by passing the conflict detection test scenarios given in section 2.TBD.

2.6.4.2.2.3.1. Verification of Ownship Requirements for CD (§2.2.4.2.2.3.1)

ASSAP may perform the Conflict Detection application when Ownship horizontal and vertical positions are valid and of sufficient quality. Vertical position is satisfied by Height Above the Ellipsoid (HAE) or pressure altitude. When Ownship horizontal or vertical position is invalid, ASSAP **shall** (R2.xxx) signal that CD is inoperative via the CDTI interface. When Ownship horizontal position uncertainty is greater than 0.5 NM, ASSAP **shall** (R2.xxx) signal that CD is inoperative via the CDTI interface. When HAE is used for vertical position and Ownship vertical position uncertainty is greater than 45 m, ASSAP **shall** (R2.xxx) signal that CD is inoperative via the CDTI interface.

ASSAP may perform the CD application when Ownship horizontal velocity is of sufficient quality. When Ownship horizontal velocity uncertainty is greater than 3 m/s, ASSAP **shall** (R2.xxx) signal that CD is inoperative via the CDTI interface.

When Ownship Integrity Containment Risk is greater than 10^{-2}/hr or Radius of Containment is greater than 1 NM, ASSAP **shall** (R2.xxx) signal that CD is inoperative via the CDTI interface.

Test Tool Requirements:

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This test will require a source for the generation of Own-ship data.

Test Procedure:

Case 1: Generate Own-Ship data with the Own-ship horizontal position invalid and verify that ASSAP signals that CD is inoperative via the CDTI interface.

Case 2: Generate Own-Ship data, in an airborne state, with the Own-ship vertical position invalid and verify that ASSAP signals that CD is inoperative via the CDTI interface.

Case 3: Generate Own-Ship data with the Own-ship horizontal position uncertainty set greater than 0.5NM and verify that ASSAP signals that CD is inoperative via the CDTI interface.

Case 4: Generate Own-Ship data, in the airborne state using HAE for vertical position where the vertical position uncertainty is set greater than 45m, and verify that ASSAP signals that CD is operative via the CDTI interface.

Case 5: Generate Own-Ship data with the Own-ship horizontal velocity uncertainty set greater than 3m/s and verify that ASSAP signals that CD is inoperative via the CDTI interface.

Case 6: Generate Own-Ship data with the Own-ship Radius of containment greater than 1 NM and verify that ASSAP signals that CD is inoperative via the CDTI interface.

Case 7: Generate Own-Ship data with the Own-ship Integrity Containment Risk set greater than 10^{-2}/hr and verify that ASSAP signals that CD is inoperative via the CDTI interface.

2.6.4.2.2.3.2. Verification of Target Vehicle Requirements for CD (§2.2.4.2.2.3.2)

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

A CD 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 pressure altitude is used for vertical position, a target track **shall** (R2.xxx) have a NACp of 5 or greater to be marked as a valid CD target. When HAE is used for vertical position, a target track **shall** (R2.xxx) have a NACp of 9 or greater to be marked as a valid CD target.

A target track **shall** (R2.xxx) have a NACv of 2 or greater to be marked as a valid CD target.

A target track **shall** (R2.xxx) have a SIL of 0 (10^{-2}/hr) or greater and a NIC of 5 or greater to be marked as a valid CD target.

If a CD target is not updated within 30 seconds, ASSAP **shall** (R2.xxx) mark the target as invalid for the Conflict Detection application.

Test Tool Requirements:

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This test will require the generation of target tracks.

Test Procedure:

Case 1: Generate target data with a valid horizontal and vertical position and verify that ASSAP signals that a CD target is derived via the CDTI interface.

Case 2: Generate target data with a pressure source for altitude and a NACp value set to 4 and verify that ASSAP signals that CD is inoperative via the CDTI interface.

Case 3: Generate target data with a pressure source for altitude and a NACp value set to 5 and verify that ASSAP signals that a CD target is derived via the CDTI interface.

Case 2: Generate target data with an HAE source for altitude and a NACp value set to 8 and verify that ASSAP signals that CD is inoperative via the CDTI interface.

Case 3: Generate target data with an HAE source for altitude and a NACp value set to 9 and verify that ASSAP signals that a CD target is derived via the CDTI interface.

2.6.4.2.2.4. Verification of Enhanced Visual Approach (EVApp) (§2.2.4.2.2.4)

No specific test procedure is required to validate §2.2.4.2.2.4.

2.6.4.2.2.4.1. Verification of Ownship Requirements for EVApp (§2.2.4.2.2.4.1)

ASSAP may perform the Enhanced Visual Approach application when Ownship horizontal and vertical positions are valid and of sufficient quality. Vertical position is satisfied by Height Above the Ellipsoid (HAE) or pressure altitude. When Ownship horizontal or vertical position is invalid, ASSAP **shall** (R2.xxx) signal that EVApp is inoperative via the CDTI interface. When Ownship horizontal position uncertainty is greater than 0.1 NM (185.2 m), ASSAP **shall** (R2.xxx) signal that EVApp is inoperative via the CDTI interface. When HAE is used for vertical position and Ownship vertical position uncertainty is greater than 45 m, ASSAP **shall** (R2.xxx) signal that EVApp is inoperative via the CDTI interface.

ASSAP may perform the Enhanced Visual Approach application when Ownship horizontal velocity is of sufficient quality. When Ownship horizontal velocity uncertainty is greater than 10 m/s, ASSAP **shall** (R2.xxx) signal that EVApp is inoperative via the CDTI interface.

When Ownship Integrity Containment Risk is greater than 10^{-3}/hr or Radius of Containment is greater than 0.2 NM (370.4 m), ASSAP **shall** (R2.xxx) signal that EVApp is inoperative via the CDTI interface.

2.6.4.2.2.4.2. Verification of Target Vehicle Requirements for EVApp (§2.2.4.2.2.4.2)

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

An EVApp 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 pressure altitude is used for vertical position, a target track **shall** (R2.xxx) have a NACp of 7 or greater to be marked as a valid EVApp target. When HAE

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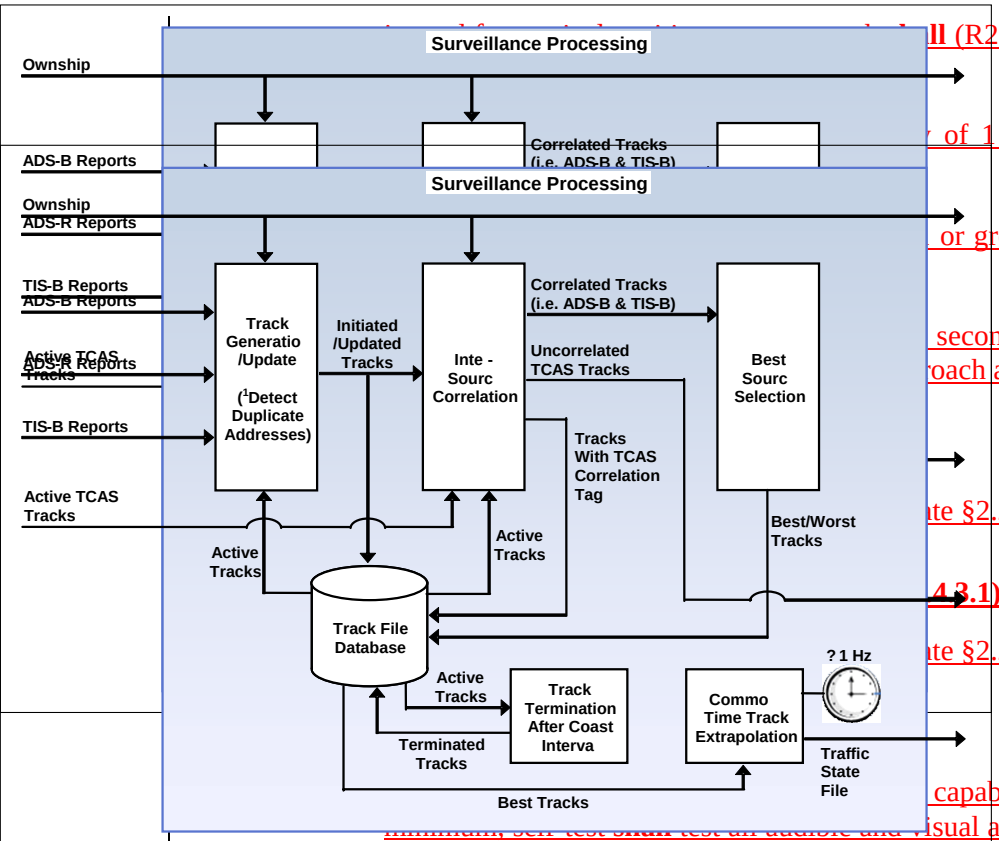

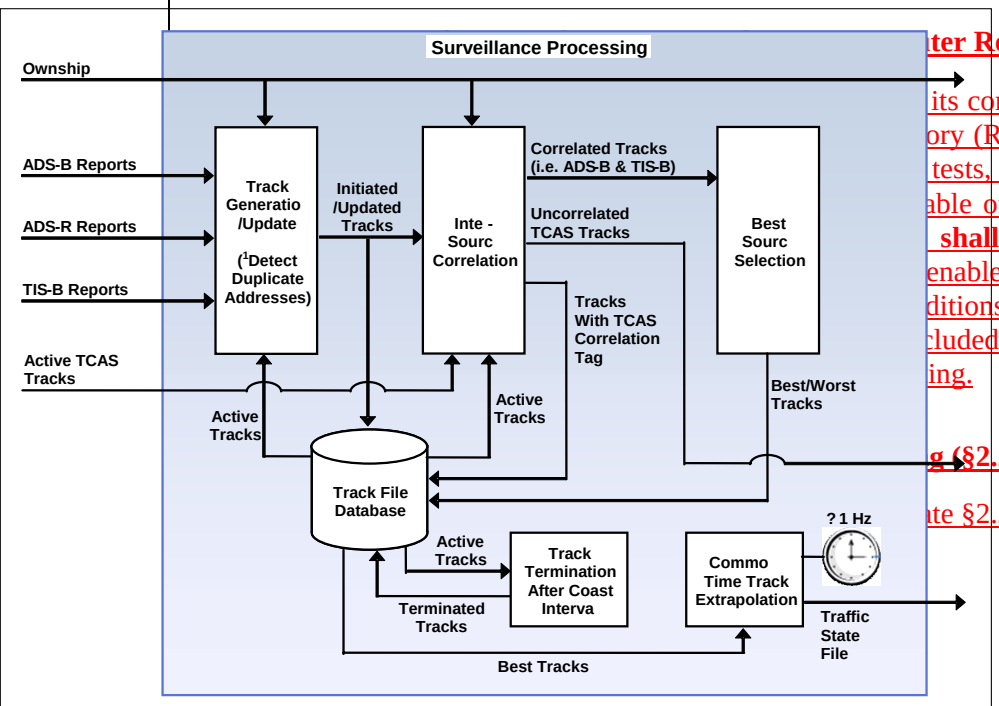

ll (R2.xxx) have a NACp of 9 or greater to

of 1 or greater to be marked as a valid

or greater and a NIC of 7 or greater to be

seconds, ASSAP **shall** (R2.xxx) mark the
oach application.

te §2.2.4.3.

4.3.1)

te §2.2.4.3.1.

capable of being initiated by the pilot. As a
~~minimum, self-test shall~~ test all audible and visual annunciators 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.

2.6.4.3.1.2. Verification of Non Interference (§2.2.4.3.1.2)

The Monitor **shall** not interfere with the normal operation of ASA. Any RF test signals used by the Monitor **shall** be restricted by the compatibility requirements [TCAS and ADS-B MOPS?]

ter Resources (§2.2.4.3.2)

its computer resources. As a minimum this
ory (RAM) pattern tests, central processing
tests, CPU input/output functions tests, and
able of detecting a failure in the computer
shall annunciate a failure. A means of
enable ASAS computer performance to be
ditions and under environmental extremes.
cluded in the Monitor or may be a separate
ing.

g (§2.2.4.3.3)

te §2.2.4.3.3.

2.6.4.3.3.1. Verification of ADS-B Receive Subsystem (§2.2.4.3.3.1)

ASAS **shall** monitor the ADS-B report interface from each ADS-B receiver. ASAS **shall** annunciate a failure on loss of input data from any ADS-B receive subsystem.

Note: this could be accomplished though a periodic heartbeat message that would indicate function in the absence of traffic

2.6.4.3.3.2. Verification of TCAS (§2.2.4.3.3.2)

ASAS **shall** monitor TCAS output to verify TCAS function. ASAS **shall** annunciate a failure on loss of data from TCAS

Note: this could be accomplished though a periodic heartbeat message that would indicate function in the absence of traffic

2.6.4.3.3.3. Verification of Ownship State Data (§2.2.4.3.3.3)

ASAS **shall** monitor the inputs that provide Ownship state data. ASAS **shall** annunciate a failure on loss of any positional or velocity data.

2.7. CDTI Equipment Test Procedures

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~~3.4. Equipment Installation

~~3.1.1~~3.4.1. Accessibility

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

~~3.1.2~~3.4.2. Aircraft Environment

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

~~3.1.3~~3.4.3. Display Visibility

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

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

~~3.1.4~~3.4.4. Dynamic Range

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

~~3.1.5~~3.4.5. Failure Protection

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

~~3.1.6~~3.4.6. Interference Effects

The equipment ~~shall~~**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~~**shall** be considered.*

~~3.1.7~~3.4.7. Inadvertent Turnoff

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

~~3.1.8~~3.4.8. 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~~3.4.9. Other Requirements

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

~~3.2~~3.5. Installed Equipment Performance Requirements

The installed equipment ~~shall~~**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:

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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~~3.6. Conditions of Test

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

~~3.3.1~~3.6.1. 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~~3.6.2. Power Input

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

~~3.3.3~~3.6.3. Environment

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

~~3.3.4~~3.6.4. Adjustment of Equipment

Circuits of the equipment under test ~~shall~~**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~~3.6.5. Warm-up Period

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

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~~3.3.6~~3.6.6. Continue with Other Conditions as Necessary

~~3.4~~3.7. 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~~**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~~3.7.1. Ground Test Procedures

~~3.4.1.1~~3.7.1.1. 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~~3.7.1.2. 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~~3.7.1.3. 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~~3.7.1.4. 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~~3.7.1.5. Equipment Accessibility

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

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~~3.4.1.6~~3.7.1.6. 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~~3.7.2. Flight Test Procedures

~~3.4.2.1~~3.7.2.1. Displayed Data Readability

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

~~3.4.2.2~~3.7.2.2. 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~~3.7.2.3. 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~~4.4. 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~~**shall** be met. The following paragraphs identify these requirements.

~~4.1.1~~4.4.1. Power Inputs

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

~~4.1.2~~4.4.2. Equipment Operating Modes

The equipment ~~shall~~**shall** operate in each of its operating modes.

~~4.1.3~~4.4.3. Continue with Other Operational Requirements as Necessary

~~4.2~~4.5. 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~~4.5.1. 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~~4.5.2. 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~~4.5.3. Continue with Other Test Procedures

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

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